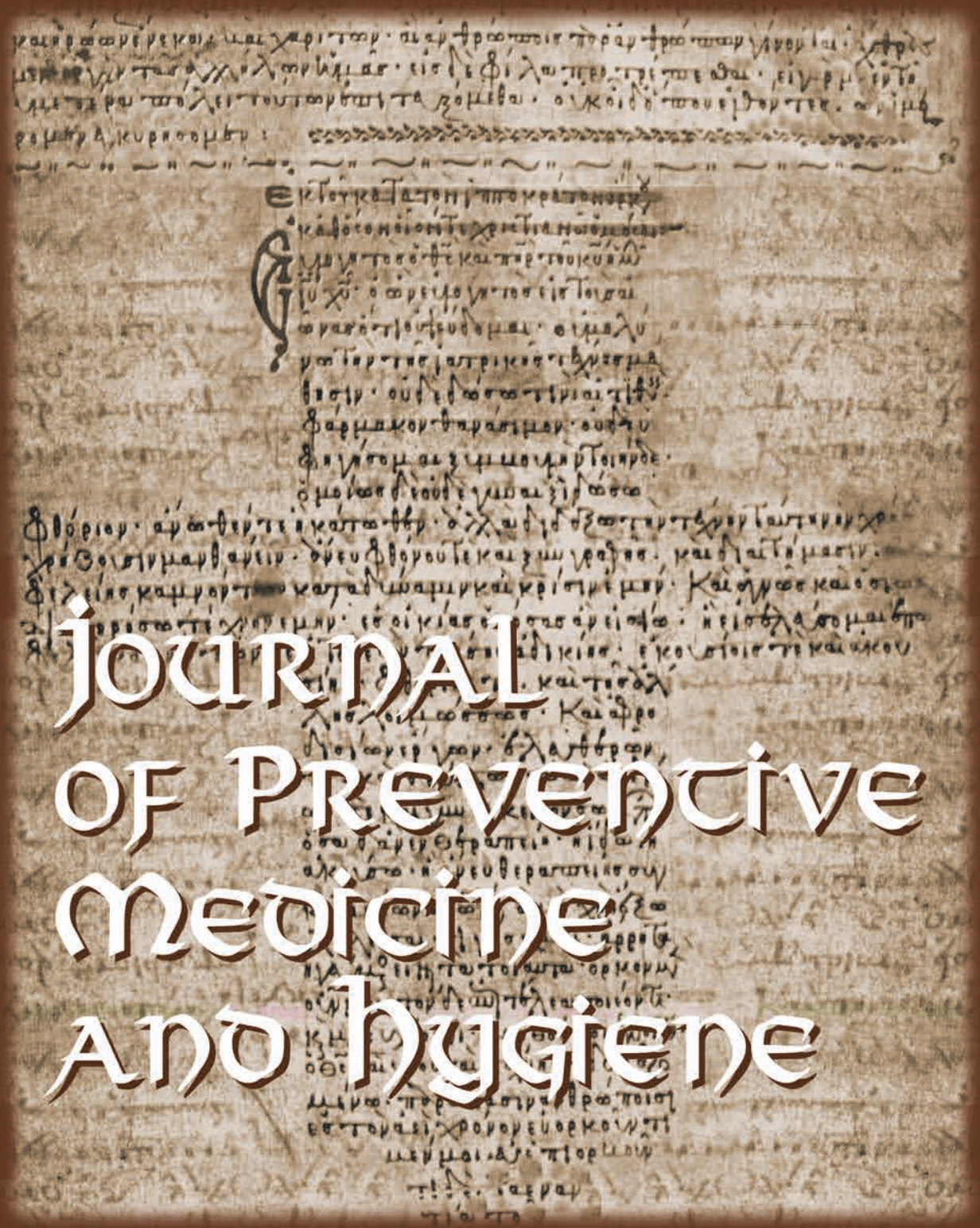
ISSN 2421-4248

vol. 62/3 n.

September 2021

Cited in Index Medicus / Medline
NLM ID 921440 (Pub-Med)



The original document of Hippocrates' oath

Journal of Preventive Medicine and Hygiene

The Journal has been accreditated, on occasion of the 17th December 2004 Meeting of the Executive and Scientific SItI Councils, by the Italian Society of Hygiene, Preventive Medicine and Public Health

PACINI EDITORE MEDICINA

JOURNAL OF PREVENTIVE MEDICINE AND HYGIENE

http://www.jpmh.org

Managing Editor: Patrizia Alma Pacini
Publisher: Pacini Editore Srl, Via Gherardesca 1, 56121 Pisa, Italy

Published online September 2021

Authorization Tribunal of Genoa, Italy n. 507 - 10/6/1960
Journal registered at "Registro pubblico degli Operatori della Comunicazione" (Pacini Editore srl registration n. 6269 - 29/8/2001).

Contents

RESEARCH ARTICLE

University community-based survey on the knowledge, attitude and perception about COVID-19 pandemic: the Federal University of Agriculture, Abeokuta, Nigeria as a case study

OLUBUKOLA TOLULOPE ADENUBI1, OLUWAWEMIMO OLUSEUN ADEBOWALE[2], ABIMBOLA ADETOKUNBO OLOYE[3], NOAH OLUMIDE BANKOLE[4], PATIENCE OLUWATOYIN AYO-AJAYI[5], ADEBAYO KOYUUM AKINLOYE[6]

[1] Department of Veterinary Pharmacology and Toxicology, College of Veterinary Medicine, Federal University of Agriculture, Alabata, Abeokuta, Ogun State, Nigeria; [2] Department of Veterinary Public Health and Preventive Medicine, College of Veterinary Medicine, Federal University of Agriculture, Alabata, Abeokuta, Ogun State, Nigeria; [3] Department of Veterinary Surgery and Theriogenology, College of Veterinary Medicine, Federal University of Agriculture, Alabata, Abeokuta, Ogun State, Nigeria; [4] Department of Veterinary Microbiology, College of Veterinary Medicine, Federal University of Agriculture, Alabata, Abeokuta, Ogun State, Nigeria; [5] Department of Veterinary and Pest Control Services, Federal Ministry of Agriculture and Rural Development, Nigeria; Nigerian Field Epidemiology and Laboratory Training Program; [6] Department of Veterinary Anatomy, College of Veterinary Medicine, Federal University of Agriculture, Alabata, Abeokuta, Ogun State, Nigeria

Keywords

Attitude • COVID-19 • Knowledge • Perception • University

Summary

Introduction. *Coronavirus disease (COVID-19) is impacting social, economic and political patterns globally. To contain its spread, Nigeria like many other countries, imposed drastic measures such as lockdown/curfew.*

Objectives. *This study assessed the knowledge, attitude and perception (KAP) about COVID-19 pandemic among members of staff of a university community in Nigeria. University staff members contribute to national development through dissemination of specialized knowledge and skills and guiding the young generation.*

Methods. *A cross-sectional survey using an anonymous, self-designed, online KAP questionnaire was conducted from April 18 to May 31, 2020. The questionnaire consisted of ten knowledge questions regarding the transmission and prevention of COVID-19. The questions on attitude (15) and perception (10) assessed respondents' behaviour towards adherence to government policies and views on government efforts to contain the infection respectively.*

Results. *A total of 125 (teaching) and 102 (non-teaching) staff responded. Approximately 59.1% of the respondents were males. The mean knowledge and positive attitude levels were 70.8% (SD ± 9.6%) and 83.1% (SD ± 13.07 %) respectively. Significant differences in the knowledge mean scores were observed for demographic categories such as educational qualification ($p = 0.001$), staff work category ($p \leq 0.000$), work background ($p \leq 0.000$), and type of lockdown ($p = 0.027$). Most of the respondents (85.3%) opined that COVID-19 was a biological weapon and viewed the lockdown as necessary (81.5%). However, they thought that the Nigerian government was not doing enough to mitigate COVID-19 spread.*

Conclusions. *The perception of COVID-19 in the university community bear implications across public health initiatives, compliance with precautionary behaviour and bilateral relations with foreign nations.*

Introduction

The first known case of the novel coronavirus disease (COVID-19), is traced back to December 2019 in Wuhan, Hubei, China [1]. As at July 4, 2020, the virus has been reported worldwide, with over 10,922 324 confirmed cases and 523,011 deaths [2]. Countries worst hit include USA (128 481 deaths), Brazil (61,884 deaths), UK (44,131 deaths), Italy (34,833 deaths), France (29,808 deaths), Mexico (29,189 deaths) and Spain (28,385 deaths) [2]. The World Health Organisation (WHO) declared the outbreak a public health emergency of international concern on January 30, 2020 and recognised it as a pandemic on March 11, 2020 [3].

All African countries have recorded COVID-19 infection. South Africa has the highest number of confirmed cases (177,124) with 2,952 deaths, followed by Nigeria (27,564 confirmed cases with 628 deaths) as at July 4 [2]. The index case of COVID-19 in Nigeria was confirmed by the Nigeria Centre for Disease Control (NCDC) in Lagos State on February 27. In Ogun State, the closest neighbouring state to Lagos, another patient who had been in contact with the index case was identified shortly after. The disease has since spread to 35 of the 36 states of Nigeria and the federal capital territory (FCT) [4].

COVID-19 is caused by the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), a novel virus closely related to SARS-CoV, pangolin and bat coronaviruses [5]. The virus is mainly spread during close contact and by respiratory droplets produced when an infected person coughs or sneezes. It is contagious from both symptomatic and asymptomatic

carriers. Common symptoms include fever, cough and shortness of breath and the incubation period ranges from two to 14 days [6]. To date, there is no known vaccine or specific antiviral therapy and management remains largely symptomatic and supportive. This is projected to likely cost the global economy US$1 trillion this year [7].

Consequent upon this, the WHO advised on several methods to help curb the virus and save health systems globally from complete collapse. Recommended non-pharmaceutical interventions include frequent hand washing, maintaining personal hygiene, social/physical distancing, monitoring and self-isolation of possible contacts [8]. As with several countries globally, the Nigerian President signed the COVID-19 Regulations 2020 declaring the disease as a "dangerous infectious disease" and imposed a nationwide lockdown from March 30, 2020. This involved restrictions on international, national and inter-state transport links, market, office or business transactions, educational institutions (primary, secondary and tertiary), sports, religious and all other related social gatherings [8]. Total lockdown (stay-at-home order) was imposed on Lagos, Ogun and FCT for an initial period of two weeks and on April 13, it was extended for another two weeks [9]. A phased and gradual easing of the lockdown was instituted from May 4.

Considering the grave impact of COVID-19 pandemic on the social, economic and political structure of the world, it has been likened to natural disasters and war outbreaks [10, 11]. Its emergence and spread, caused confusion, anxiety and fear among the general public [12]. Furthermore, the recommended ways of containing the spread of the virus such as self-isolation, quarantine, social distancing and the stigma associated with infected persons, put many people at risk of experiencing significant psychological distress [11]. By assessing people's knowledge about diseases, deeper insights into public perception and practices can be gained, thereby helping to identify attributes that influence adopting healthy practices and responsive behaviour [13, 14]. It is also important in identifying gaps and strengthening ongoing prevention efforts.

To the best of our knowledge, this study represents the first one examining the knowledge, attitude and perception (KAP) as well as concerns about COVID-19 among members of staff of a university community in Nigeria. Universities offer the society an opportunity to reflect on the critical, social, economic, cultural, moral and spiritual issues facing humanity. Its staff members contribute to national development through dissemination of specialized knowledge and skills and guiding the young generation. The findings of this study are expected to provide useful information about KAP to policymakers at this critical time. It may also inform public health officials on further public health interventions, awareness, and policy improvements pertaining to the COVID-19 pandemic.

Methods

Ethical approval

The study was conducted in accordance with internationally accepted principles. Ethical approval was obtained from the College of Veterinary Medicine, FUNAAB Research Ethics Committee (Ref. number: FUNAAB/COLVET/CREC/2020/04/01).

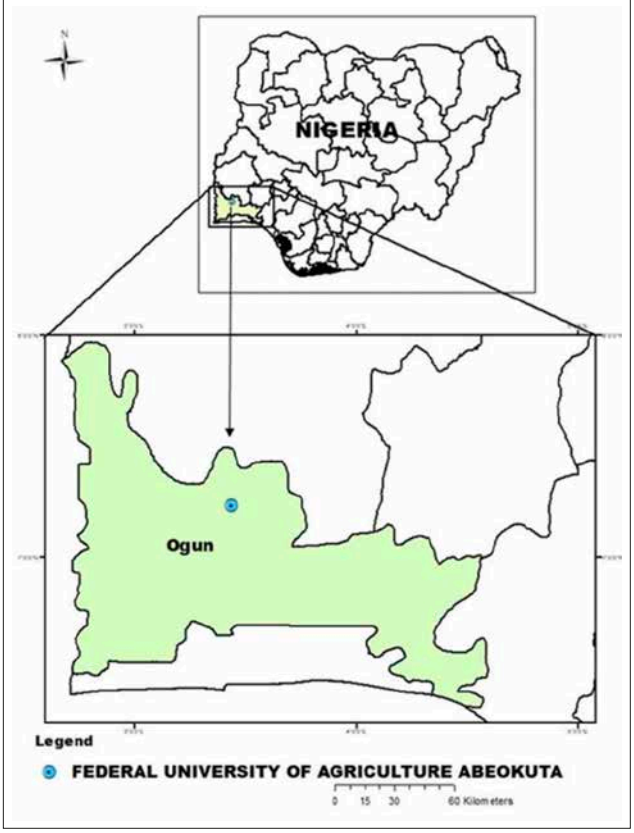
Study area

The Federal University of Agriculture, Abeokuta (FUNAAB) (Fig. 1), a unique and leading institution, is one of the three specialized Universities of Agriculture in Nigeria. It was established on January 1, 1988 with the triple mandate of teaching, research and extension (knowledge and technology transfer).

Study population

Members of staff of FUNAAB belonging to any one of the four associations in the University were eligible to participate and included: 1) Academic Staff Union of Universities (ASUU) comprising the teaching staff (lecturers); 2) National Association of Academic Technologists (NAAT); 3) Senior Staff Association of Nigerian Universities (SSANU); and 4) Non-Academic Staff Union of Education and Associated Institutions (NASU).

Fig. 1. Map of the Federal University of Agriculture, Abeokuta, Ogun State, Nigeria.



Study design, sample size and sampling

A cross-sectional survey using a validated, semi-structured online questionnaire was used to collect data from potential respondents [15]. Purposive and chain referral sampling techniques were employed to recruit participants.

As the survey was done during the lockdown, it was very difficult to physically access people at the time of data collection due to the restriction of movement. As such, the questionnaire using the Google Forms Platform (Mountain View, CA, USA) was designed by the investigators. A detailed informed consent was sought at the beginning of the online questionnaire and consent was a prerequisite to continue in the survey. The link of the questionnaire was sent via social media (WhatsApp and Telegram posts) to the different chairmen of the associations, deans and directors of colleges, directorates and units in FUNAAB. The prospective respondents were then encouraged to roll out the survey to as many colleagues as possible. Thus, the link was forwarded to people apart from the first point of contact.

All staff of the Federal University of Agriculture were eligible to participate. A total of 327 participants were needed considering a simple random sampling at an expected response rate of 50%, an absolute precision at a 95% confidence interval, with an acceptable error of 5% using Working in Epidemiology (WinEpi v.2.0). Considering the non-response rate, 10% of the sample size was added to give a total of 360 participants. Figure II describes the recruitment flowchart.

The online survey ran from April 18 (second phase of lockdown) to May 31 (last week of the lockdown in Ogun State). Participation was voluntary and anonymous, with respondents being assured that their responses would remain confidential and used only for research purposes. Two hundred and twenty - seven (227) correctly filled questionnaire was submitted through the Google form, exported unto excel spreadsheet and processed for statistical analysis (Fig. 2).

Questionnaire and data collection

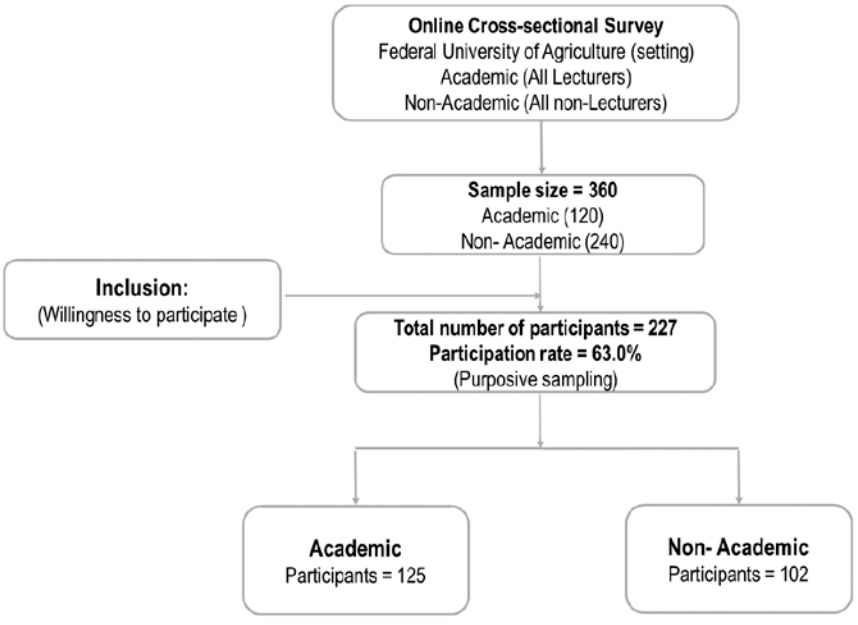
The questionnaire contained four sections. The first section consisted of information assessing socio-demographic attributes of the respondents on variables such as age, sex, staff work category, marital status, educational qualification, religion, number of persons and pets in household and state of residence during the lockdown.

The second section assessed the general knowledge about COVID-19. It consisted of ten questions regarding the source of COVID-19, modes of transmission, symptoms, susceptible individuals and methods of prevention, control and treatment.

In section three, the evaluation of respondents' attitude was performed by 15 questions. Parameters evaluated if the non-pharmaceutical interventions and social distancing rules were adhered to, if updates on COVID-19 were sought and how activities were undertaken during the lockdown and prophylactic use of drugs (orthodox or herbal). Using a Likert scale of 1-5 (1-lowest negative effect, 5-highest negative effect), the effect of the lockdown on the mental, physical, social, financial well-being and sexual performances of the respondents were also assessed.

The final section evaluated which of the impacts of COVID-19 individuals were most concerned about-the source, the spread, the actions or inactions of the Nigerian government and/or international bodies. The rate of satisfaction to the COVID-19 relief package of the government and other current measures taken by the Nigerian government during the lockdown was also assessed.

Fig. 2. Summary of the recruitment of participants.



Data analysis

Descriptive statistics were calculated for all variables in the forms of frequencies and proportions/percentages using Microsoft Excel® (2013). Respondents' knowledge and attitude towards COVID-19 was arrived at by summing correct responses, generating a maximum possible score of 27 and 11 respectively. A correct response to an item was assigned 1 point, while an incorrect/not sure response was assigned 0 point. Scores were then converted to percentages and a cut off < 70% and ≥ 70% was used to categorise respondents as having poor and good levels respectively. Normality tests were conducted on continuous variables using Kolmogorov-Smirnov (> 0.05) and Shapiro-Wilk (> 0.05) and data expressed as mean and standard deviation (Mean ± SD). Independent samples t-tests and one-way analysis of variance (ANOVA) were utilised to determine the differences in knowledge and attitude scores between groups of demographic variables.

All variables were recoded into binary outcomes for further analysis. Associations between the socio-demographics of respondents and knowledge level, social, financial, physical, and mental impact of the pandemic were determined using chi-square tests and binary logistic regression analysis (BLRA) (SPSS® 21 analysis software package IBM, Inc.). A $p < 0.05$ was considered statistically significant and crude odds ratios were computed to determine the strength of associations between variables at 95% confidence intervals (CIs). All illustrations were performed with Graphpad prism 8.0.

Results

Respondents' socio-demographics

Responses were received from 227 respondents comprising 125 (55.1%) teaching staff and 59.9% males. Approximately 40.1% of the respondents were within 40-49 years and 88.1% of them were married. All respondents (100%) had completed the primary school leaving certificate programme. A little over half of the respondents had household members between 5 and 10 (52.0%). Owning household pets was observed to be less common (23.3%). Most of the respondents resided within Ogun State (81.5%), and a total or partial lockdown was instituted in many of the respondents' (83.3%) states of residence (Tab. I).

Knowledge assessment of COVID-19

Table II showed that the common sources of information on COVID-19 were TV/radio (85.5%) and social media (79.3%). Many of the respondents could correctly identify COVID-19 as viral (97.4%), emerging (86.8%) and infectious (93.7%). Most common symptoms accurately identified by respondents was dry cough (93.7%), shortness of breath (92.1%), fever (87.7%), and sore throat (78.9%).

The mean knowledge score for participants was 19.1 ± 2.6 (70.8 ± 9.6%, range: 33.3-92.6%). About

Tab. I. Sociodemographic data of members of staff of the Federal University of Agriculture, Abeokuta, Ogun State, Nigeria.

S/N	Variables (n = 227)	Proportions (%)	95% CI
1	**Age**		
	20-29	9 (4.0)	2.0-7.7
	30-39	58 (25.6)	20.3-31.6
	40-49	91 (40.1)	33.9-46.6
	50-59	61 (26.9)	21.5-33.0
	60-69	7 (3.1)	1.4-6.3
	> 70	1 (0.4)	< 0.01-2.7
2	**Sex**		
	Female	91 (40.1)	33.9-46.6
	Male	136 (59.9)	53.4-66.1
3	**Educational qualification**		
	Primary	0 (0.0)	0
	Secondary	5 (2.2)	0.8-5.2
	Bachelor's	47 (20.7)	15.9-26.5
	Master's	62 (27.3)	21.9-33.4
	PhD	89 (39.2)	33.0-45.7
	Others	24 (10.6)	7.16-15.3
4	**Staff work categories**		
	Academic (teaching)	125 (55.1)	48.6-61.4
	Non-teaching	102 (44.9)	38.6-51.4
5	**Work background**		
	Scientific	163 (71.8)	65.6-77.3
	Non-scientific	64 (28.2)	22.7-34.4
6	**Marital status**		
	Married	200 (88.1)	83.2-91.7
	Single	24 (10.6)	7.2-15.3
	Divorced	0 (0.0)	0.3 to 4.0
	Widowed	3 (1.3)	
7	**Religion**		
	Christianity	194 (85.5)	80.3-89.5
	Islam	32 (14.1)	10.1-19.3
	Traditional	1 (0.4)	< 0.01-2.7
	Others	0 (0.0)	0
8	**Number of household members**		
	Less than 5	107 (47.1)	40.7-53.6
	5-10	118 (52.0)	45.5-58.4
	10 and above	2 (0.9)	0.03-3.4
9	**Do you have any household pets?**		
	Yes	53 (23.3)	18.3-29.3
	No	174 (76.7)	70.7-81.7
10	**State of residence during the lockdown**		
	Ogun	185 (81.5)	76.7-86.7
	Oyo	20 (8.8)	5.8-13.4
	Ekiti	1 (0.4)	< 0.01-2.7
	Osun	3 (1.3)	0.3-4.0
	Lagos	7 (3.1)	1.4-6.4
	Kogi	1 (0.4)	< 0.01-2.7
	Kwara	1 (0.4)	< 0.01-2.7
	Abia	2 (0.9)	0.03-3.4
	Enugu	3 (1.3)	0.3-4.0
	Kaduna	2 (0.9)	0.03-3.4
	Others	2 (0.9)	0.03-3.4
11	**Type of lockdown where resident**		
	Partial	189 (83.3)	77.8-87.6
	Total	38 (16.7)	12.41-22.2

N: total number of respondents.

59.5% of respondents scored above the ≥ 70% cut off for general good knowledge, which was averagely acceptable. The t-tests and ANOVA, as well as Chi-square analysis showed that knowledge score was not statistically significant with gender (p = 0.183), whereas, age groups (p = 0.040), educational qualification

Tab. II. Different sources of information and respondents' knowledge responses to COVID-19.

S/N	Variables (n = 227)	Proportion (%)
1	**Source of information**	
	Social media	180 (79.3)
	TV/Radio	194 (85.5)
	Friends	83 (36.6)
	Workplace	87 (38.3)
	Newspaper	102 (44.9)
	Others	8 (3.5) NCDC, WHO, Religious platforms
2	**COVID-19 is caused by**	
	Virus	221 (97.4)
	Bacteria	4 (1.7)
	Others	2 (0.9)
3	**COVID-19 is an**	
	Infectious disease	224 (98.7)
	Non-infectious disease	2 (0.9)
	Not sure	1(0.4)
4	**Is COVID-19 a new/emerging disease**	
	Yes	197 (86.8)
	No	21 (9.2)
	Not sure	9 (4.0)
5	**What parts of the body system does this disease affect?**	
	Digestive	32 (14.1)
	Respiratory	215 (94.7)
	Urinary	2 (0.9)
	Reproductive	5 (2.2)
	Nervous	18 (7.9)
	Not sure	6 (2.6)
6	**Identify a symptom for COVID-19**	
	Sore throat	179 (78.9)
	Dry cough	213 (93.8)
	Fever	199 (87.7)
	Running nose	112 (49.3)
	Vomiting	25 (11.0)
	Stooling	32 (13.7)
	Fatigue	97 (42.7)
	Bleeding	11 (4.8)
	Difficulty in breathing	209 (92.1)
7	**COVID-19 is spread by**	
	Contact with an infected person when they cough or sneeze	224 (98.7)
	Touching eyes, nose and mouth after contact with contaminated surfaces	219 (96.5)
	Consumption of wildlife	15 (6.6)
	Contact with pets	22 (9.7)
	From pregnant mother to baby	18 (7.9)
8	**Who is more likely to develop COVID-19?**	
	The elderly	144 (63.4)
	Children	44 (19.4)
	People with underlying infections	133 (58.6)
	Frontline health workers	103 (45.4)
	Pregnant women	20 (8.8)
	Anyone	121 (53.3)
9	**How long does it take to develop COVID-19 symptoms?**	
	1-2 days	4 (1.8)
	3-7 days	2 (0.9)
	2-14 days	187 (82.3)
	14 -28 days	34 (15.0)
	1-2 months	0 (0.0)
10	**Is there a cure/vaccine for COVID-19?**	
	Yes	12 (5.3)
	No	177 (78.0)
	Not sure	38 (16.7)

N: total number of respondents (members of staff of the Federal University of Agriculture, Abeokuta, Ogun State, Nigeria); NCDC: Nigeria Centre for Disease Control; WHO: World Health Organisation.

Tab. III. Demographic characteristics of respondents and their knowledge and attitude score.

S/N	Variables (n = 227)	Proportions (%)	Knowledge level (%) (Mean ± SD)	P value (ANOVA Independent T-test)	Attitude level (%) (Mean ± SD)	P value (ANOVA Independent T-test)
1	**Age**					
	20-29	9 (4.0)	65.4 ± 8.3		74.7 ± 23.1	
	30-39	58 (25.6)	71.0 ± 10.4		84.0 ± 12.4	
	40-49	91 (40.1)	71.1 ± 9.6	0.536	81.9 ± 12.5	0.212
	50-59	61 (26.9)	70.3 ± 8.6		84.1 ± 12.9	
	-69	7 (3.1)	70.9 ± 7.8		89.6 ± 6.3	
	≥ 70	1 (0.4)	74.1 ± 0.0		90.9 ± 0.0	
2	**Sex**					
	Female	91 (40.1)	71.7 ± 9.1	< 0.183	83.9 ± 13.2	0.421
	Male	136 (59.9)	70.0 ± 9.6		82.5 ± 13.0	
3	**Educational qualification**					
	Secondary	5 (2.2)	60.7 ± 5.0		83.6 ± 13.5	
	Bachelor's	47 (20.7)	67.5 ± 9.6		82.0 ± 14.3	
	Master's	62 (27.3)	72.1 ± 9.0	0.001*	82.2 ± 13.1	0.907
	PhD	89 (39.2)	72.7 ± 9.2		83.9 ± 12.3	
	Others	24 (10.6)	67.6 ± 8.7		84.1 ± 14.0	
4	**Staff work categories**					
	Academic (teaching)	125 (55.1)	73.0 ± 9.4	< 0.0001*	82.4 ± 13.6	0.401
	Non-teaching	102 (44.9)	67.8 ± 8.7		83.9 ± 12.5	
5	**Work background**					
	Scientific	163 (71.8)	71.8 ± 9.1		82.8 ± 12.6	
	Non-scientific	64 (28.2)	67.8 ± 9.7	< 0.000*	83.6 ± 14.2	0.662
6	**Marital status**					
	Married	200 (88.1)	70.6 ± 9.3	0.692	82.9 ± 12.6	0.350
	Single	24 (10.6)	70.8 ± 10.7		83.0 ± 17.2	
	Widowed	3 (1.3)	75.3 ± 5.7		93.9 ± 5.3	
7	**Religion (n = 226)**					
	Christianity	194 (85.5)	70.4 ± 9.5	0.408	-	0.255
	Islam	32 (14.1)	71.9 ± 9.4			
8	**Number of household members**					
	Less than 5	107 (47.1)	71.8 ± 10.2		82.1 ± 14.2	
	5-10	118 (52.0)	72.2 ± 7.9	0.214	83.7 ± 11.9	0.121
	10 and above	2 (0.9)	69.6 ± 8.7		100.0 ± 0.0	
9	**Do you have any household pets?**					
	Yes	53 (23.3)	69.5 ±11.1	0.313	81.1 ± 14.1	0.221
	No	174 (76.7)	71.0 ± 8.9		83.6 ±12.7	
10	**Type of lockdown where resident**					
	Partial	189 (83.3)	71.3 ± 9.2	0.027*	83.0 ± 13.2	0.823
	Total	38 (16.7)	67.6 ± 10.1		83.5 ± 12.7	

N: total number of respondents (members of staff of the Federal University of Agriculture, Abeokuta, Ogun State, Nigeria).

(p = 0.001; p = 0.01), staff work category (p ≤ 0.001; p = 0.010), work background (p ≤ 0.001), staff residence (p = 0.005) and type of lockdown (p = 0.027; p = 0.048) were significant. Dunnett's multiple comparisons test showed a significantly higher knowledge score for respondents holding Master's (p = 0.016) and PhD degrees (p = 0.010) than those with just the secondary school leaving certificate (Tabs. III, IV).

For BLRA, respondents within the age group < 40-49 years were about 2.2 times (OR = 2.18, 95% CI: 1.09-4.38; p = 0.030) more likely to have good knowledge on COVID-19 than older ones. Also, respondents resident within Ogun State were about 2.5 times (OR = 2.43, 95% CI: 1.04-5.67, p = 0.040) more likely to have good knowledge of COVID-19 than those residing outside the state. Although marginally significant, respondents having household pets have about 1.91 higher odds of good knowledge of COVID-19 (OR = 1.91, 95% CI: 0.98-3.76, p = 0.060) than respondents without pets (Tab. IV).

Attitude during the lockdown

Respondents were asked 15 questions to assess their compliance with the non-pharmaceutical interventions and the impact on their social, financial, physical and mental health. Most of the respondents complied with the use of nose/face masks, stay at home policy, social distancing and regular hand wash (Fig. 3). A total of 192 (84.6%) and 203 respondents (89.4%) used hand sanitizers, and soap and water respectively. Majority of the respondents rarely left their houses during the

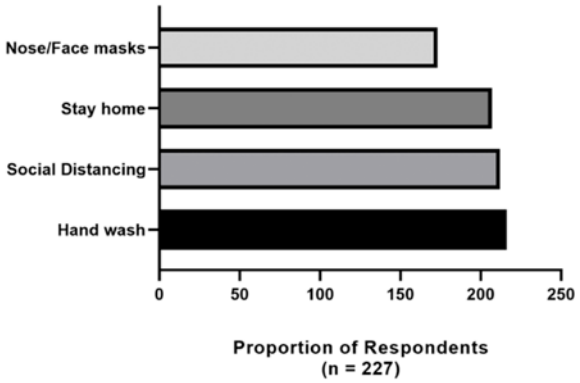
Tab. IV. Association between respondents' demographic characteristics and knowledge about COVID-19.

Variable	Category	OR	95% CI	P-value
Age groups in years	< 40-49 > 49	2.18 1	1.09-4.38	0.030*
Staff work categories	Academic (teaching) Non-teaching	0.59 1	0.29-1.17	0.130
Work background	Scientific Non-scientific	0.93 1	0.43-2.01	0.860
Number of household members	< 5 ≥ 5	0.73	0.40-1.34	0.310
Household pets	Yes No	1.91 1	0.98-3.76	0.060
State of residence during the lockdown	Within Ogun Outside Ogun	2.43 1	1.04-5.67	0.040*
Lockdown type	Partial Total	0.51 1	0.237-1.097	0.090

OR: Odd Ratio; CI: Confidence Interval; *: P ≤ 0.05; Reference = 1.00; Respondents: members of staff of the Federal University of Agriculture, Abeokuta, Ogun State, Nigeria.

lockdown (84.6%). When they did, they mostly went to the market (71.8%) and the less visited places were hospitals/clinics (10.6%) and religious houses (5.3%). Other preventive measures taken to prevent infection were eating healthy foods, use of hand gloves, prayers and use of dihydroxy chloroquine. To boost their immunity, about 7.5% of the respondents consumed multivitamins and 2.2% took herbal mixtures.

Fig. 3. Preventive measures complied with by respondents (n: total number of respondents – Members of staff of the Federal University of Agriculture, Abeokuta, Ogun State, Nigeria).

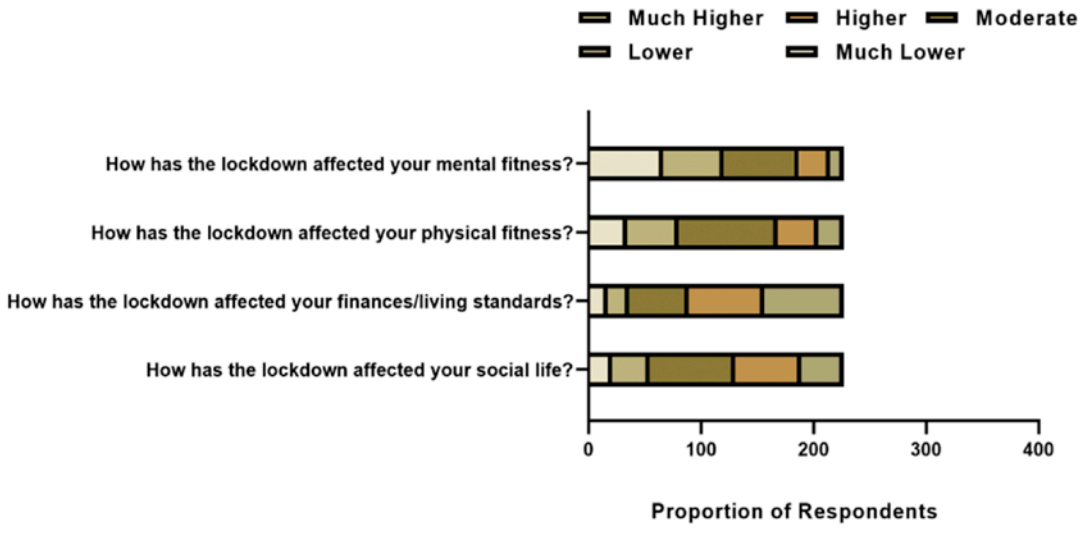


Respondents kept themselves busy during the lockdown by spending time with family (71.4%), watching movies (70.9%), reading (70.5%), engaging in social media activities (69.2%), working out (58.6%), working from home (47.3%), playing with their pets (2.2%) and visiting friends.

The mean attitude score was 9.1 ± 1.4 (83.1% ± 13.07, range 36.4-100.0%). Most of the respondents had good attitude levels (88.0%). Attitude scores among different demographic characteristics were statistically non-significant, showing respondents had a similar level of attitude across board (Tab. III).

The social (33.5%), physical (38.8%) and mental impact (29.5%) were self - reported as being moderately

Fig. 4. The effect of lockdown on respondents' social, financial, physical and mental well- being (respondents: members of staff of the Federal University of Agriculture, Abeokuta, Ogun State, Nigeria).



Tab. V . Association between selected respondents' demographic profiles and social, financial and mental impact due to COVID-19 pandemic.

Variable	Category	Social impact			Financial impact			Mental impact		
		OR	95% CI	P-value	OR	95% CI	P-value	OR	95% CI	P-value
Age groups in years	< 40-49 > 49	1.35 1	0.60-3.02	0.470	0.84 1	0.34-2.12	0.720	1.68 1	0.87-3.26	0.120
Sex	Female Male	0. 78 1	0.41-1.49	0.450	0.99 1	0.45-2.19	0.980	0.75 1	0.43-1.33	0.330
Educational qualification	Secondary Post-secondary	0.77 1	0.08-7.73	0.830	-	-	-	1.24 1	0.18-8.69	0.830
Staff work categories	Teaching Non-teaching	0.43 1	0.19-0.98	0.045*	0.39 1	0.14-1.08	0.070	1.03 1	0.52-2.04	0.930
Work background	Scientific Non-scientific	1.00 1	0.40-2.51	0.990	0.62 1	0.17-2.27	0.470	0.50 1	0.24-1.05	0.070
Marital status	Married Not married	1.40 1	0.48-4.10	0.540	1.81 1	0.58-5.62	0.310	0.59 1	0.23-1.49	0.260
Number of household members	< 5 ≥ 5	1.46 1	0.40-1.34	0.270	3.14 1	1.33-7.38	0.009*	1.74 1	0.98-3.08	0 .060
Household pets	Yes No	0.49 1	0.24-1.00	0.049*	1.39 1	0.53-3.60	0.500	0.65 1	0.34-1.27	0.210
State of residence during the lockdown	Within Ogun Outside Ogun	0.60 1	0.24-1.49	0.270	2.03 1	0.83-5.00	0.120	1.27 1	0.61-2.63	0 .530
Lockdown type	Partial Total	2.13 1	0.95-4.79	0.070	1.25 1	0.46-3.39	0.660	1.13 1	0.54-2.36	0.740

OR: Odd Ratio; CI: Confidence Interval; *: P ≤ 0.05; Reference = 1.00; Respondents: members of staff of the Federal University of Agriculture, Abeokuta, Ogun State, Nigeria.

affected by the lockdown. Contrastingly, respondents' (31.3%) financial/cost of living suffered a much higher impact (Fig. 4). The teaching staff are 0.43 less likely (OR = 0.43, 95% CI: 0.19-0.98, p = 0.045) to have a low social impact due to COVID-19 than the non-teaching members. Also, respondents with household pets were 0.49 less likely (OR = 0.49, 95% CI: 0.24-1.00, p = 0.049) to have a low social impact than those without household pets. Although only marginally significant, respondents under partial lockdown had 2.13 increased odds (OR = 2.13, 95% CI: 0.95-4.79, p = 0.070) for low social impact than those under total lockdown (Tab. V).

Respondents with family household members less than five were about three times more likely (OR = 3.14, 95% CI: 1.33-7.38, p = 0.009) to have a low financial impact due to COVID-19 lockdown than those with more than five members. Also, the non-teaching staff of the university were about 2.56 more likely (OR = 0.39, 95% CI: 0.14-1.08, p = 0.070) to experience a low financial impact than the teaching staff, but marginally significant (Tab. V).

Staff members with scientific background were half less likely (OR = 0.50, 95% CI: 0.24-1.05, p = 0.070) to have low mental health impact due to the pandemic than those with no scientific background. Household with members less than five were about 1.74 more likely (OR = 1.74, 95% CI: 0.98-3.08, p = 0.060) to have a low mental impact than those with more than or equal to five members (Tab. V).

Frequency of sexual performance was observed to be the same as before the pandemic in 46.7% of the respondents, 9.7% reported it was at its lowest ever and 12.8% at its highest frequency. The respondents reported they majorly suffered anxiety/worry/fear/ restlessness (59.9%) and boredom (48.0%). More of the respondents were optimistic while only 4.8% were angry or pessimistic (1.8%) about the pandemic.

Perception and concerns about COVID-19

Approximately 162/227 (85.3%) of the respondents perceived COVID-19 was likely a laboratory-made or biological weapon. About 19.8 and 8.8% slightly believed or were not sure respectively. The global and national situation of the pandemic were of worry to the respondents (84.1 and 53.7% respectively). The other concerns were increased crime rates (90.7%), the impact on the economy (88.5%) and children education (72.2%), idle children (62.6%), fear of themselves and family contracting the disease (52.4%), and domestic violence (40.1%).

The majority viewed the lockdown instituted by the government as necessary (81.5%), while 71.3% were not satisfied with the current COVID-19 relief package provided by the government and believed the government was not doing enough in containing the spread of the infection. About 90.5% of the respondents indicated their readiness to get involved in sharing or contributing their quota if the need arises.

Discussion

Nigeria, the most populous country in Africa, has adequately contained many outbreaks of emerging and re-emerging diseases such as poliomyelitis, avian influenza, African swine fever, Yellow fever, Lassa fever and Ebola virus disease [16]. Nigerians are distinct people with a rich culture of socializing and

daily income earning. Movement restriction, physical and social distancing, closure of schools and religious centres and the mandatory use of nose masks associated with COVID-19 greatly impacts the population [8].

This study assessed the KAP of an ivory tower-based population in Nigeria about COVID-19 pandemic and associated effects. A large proportion of the respondents were aware and knowledgeable about the presence, symptoms and mode of transmission of COVID-19 in Nigeria. This may be due to the educational status of the respondents as over 87% of them had a bachelor's degree or above. Many of them (71.8%) were in scientific work category. In addition, most of the respondents were married and fell within the active middle age group (40-49 years). All these stimulate interest and search for knowledge about COVID-19 and its transmission from various sources, to protect themselves and their families. These findings agree with previous studies which reported positive association between knowledge, educational background and age during epidemics/ pandemics [8, 14, 17-20].

It was also noticed that respondents having household pets had better knowledge of COVID-19. This may be due to information obtained from their veterinarians and they are likely to be more cautious. Though COVID-19 infection has been reported in dogs, there are no evidences yet that dogs and cats, can be sources of human infection [21].

Our study also identified the mass media (television, radio) and social media as the major sources of information about COVID-19. This indicates that a significant proportion of respondents are largely influenced by media information. Many of the respondents (81.5%) live in Ogun State where a total lockdown was instituted, hence, they accessed mass media more frequently. It is important to note that the Nigerian Ministry of Health presently conducts intensive awareness campaign on COVID-19 via the television and various social media in English, French and the three main Nigerian languages (Hausa, Igbo and Yoruba) [4]. The importance of the media in providing vital information during outbreaks has been confirmed by several researchers [22-24].

According to the Economic Commission for Africa, approximately 300 000 to 3.3 million COVID-19 related deaths are predicted to occur in Africa [25]. Fortunately, the mortality rate as at July 4, 2020 is quite low when compared with USA and European countriesv[26]. Many factors such as environmental (sunlight, humidity, prevalence of malaria parasite) and genetic have been attributed to it though none has yet been confirmed [26]. This may have contributed to the general positive and optimistic attitude toward COVID-19.

Respondents with less than five household members were more likely to have a low social, financial and mental impact due to COVID-19. This is not surprising as lesser amount will be expended on utilities, food, online education and childcare leading to less anxiety. This agrees with Nicola et al. [27] and Coibion et al. [28] who reported the socio-economic implications of the pandemic.

Respondents complied with the use of nose/face masks, stay at home policy, social distancing and regular hand hygiene as 84.6 and 89.4% used hand sanitizers, and soap and water respectively. Majority of the respondents rarely left their houses during the lockdown (84.6%), avoiding crowded places and physical contact. This suggests that Nigerians are generally very cautious. Health authorities should continue providing education and outreach materials, to increase public understanding of the disease.

Interestingly, of the 200 married respondents, 12.8% reported that their sexual performance was at its highest frequency apparently due to greater time spent with their spouses. However, 46.7% reported that frequency of sexual performance was same as before the pandemic, a situation that might be linked to shrewd time management while indoor. Indoor activities including doing office work at home take the mind off sexual intercourse. Sexual desire and frequency of intercourse were also reported to have significantly increased during the COVID-19 pandemic in Turkey and Italy, whereas quality of sexual life significantly decreased [29, 30]. About 9.7% of the respondents reported it was at its lowest ever. This may be due to phobia for unplanned pregnancy, anxiety over the pandemic which affects libido and deficient female contraception leading to preference for sexual abstinence.

Also worthy of note is the fact that hospital/clinic visits for non-COVID related cases was low (10.6%). This could lead to premature deaths from cases such as trauma, hypertension, childbirth etc. This may be due to the stigma associated with COVID-19 and the risk of infection or wrong diagnosis in hospitals. Stigma towards COVID-19 is caused by fear of its mortality and high communicability [31]. This can be resolved through proper education and transparency of healthcare policies.

A large percentage of respondents (85.3%) hold the view that the COVID-19 is a man-made biological weapon. This was also reported by Olapegba et al. [8]. It is important that the Nigerian government and other stake holders embark on campaigns to raise awareness of the true sources of COVID-19 to curb prejudice against foreign nationals.

Majority viewed the lockdown instituted by the government as necessary (81.5%) and agree that the virus can be successfully controlled by the Nigerian government if more efforts are put in contact tracing. This can be explained by the government's unprecedented actions and prompt response in taking stringent control and precautionary measures against previous epidemics, to safeguard the well-being of its citizens. This finding is consistent with recent studies conducted in China and Saudi Arabia, where majority of the participants were convinced that the disease is curable and that their country will combat the disease [14, 32]. However, these results contrast with findings in the USA that suggest people tend to express negative emotions, during a pandemic that could affect their attitude [33].

This study had its limitations as the survey was done during the lockdown. The adoption of the chain referral

sampling technique employed might limit generalizability of the finding to the general population. Also, response rate was low which may be associated with lack of access to internet facilities especially by members of staff in the lower category who may not have smartphones, cost of internet data or incompetence in filling online surveys. Also, data used in the analysis of this study were self-reported, which might suffer from reporting bias. Nevertheless, this study provides a baseline information on the KAP of members of staff of the university community about the ravaging COVID-19 pandemic in Nigeria.

We recommend that: 1) the media should be intensively used by governmental and non-governmental agencies to provide appropriate health education to avert the mounting myths and misinformation about the pandemic and teach the appropriate hygiene measures to adopt; 2) government should liaise more with national researchers and international organizations to strengthen capacity in the areas of research funding and health care systems to improve testing capacity and contact tracing; 3) a coherent, coordinated and credible policy response would provide the best chance at limiting the economic fallout due to COVID-19.

Conclusions

This study was significant as it is the first survey to assess the KAP about COVID-19 among this selected population of Nigerians. Majority of the respondents have adequate knowledge of COVID-19 with general positive and optimistic attitude towards controlling the pandemic. Knowledge of the disease is considered the stepping-stone to any health education activity that is implemented. All stake holders should intensify their effort in expediting and implementing preventive/control measures against COVID-19 at local, regional, national and international levels.

Acknowledgements

Funding sources: this research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

The authors are grateful to the management, executives of Associations, deans of Colleges and directors of Directorates of FUNAAB. All the respondents are also acknowledged.

Conflict of interest statement

The authors declare no conflict of interest.

Authors' contributions

OTA conceptualised the project and drafted the manuscript, OTA, OOA, AAO and NOAB designed the questionnaire and collected data, OOA, NOAB and POA did the statistical analysis, AKA revised the manuscript critically for important intellectual content. All authors read and approved the final version of the manuscript to be published and agreed to be accountable for all aspects of the work.

References

[1] Tang X, Wu C, Li X, Song Y, Yao X, Wu X, Duan Y, Zhang H, Wang Y, Qian Z, Cui J, Lu, J. On the origin and continuing evolution of SARS-CoV-2. Natl Sci Rev 2020. https://doi.org/10.1093/nsr/nwaa036

[2] World Health Organisation. Coronavirus disease (COVID-19) Situation Report 166. Available at: www.who.int/covid-19/information (accessed on 05/07/2020).

[3] Sohrabi C, Alsafi Z, O'Neill N, Khan M, Kerwan A, Al-Jabir A, Iosifidis C, Agha R. World Health Organization declares global emergency: a review of the 2019 novel coronavirus (COVID-19). Int J Surg 2020;76:71-6. https://doi.org/10.1016/j.ijsu.2020.02.034

[4] Nigeria Centre for Disease Control. An update of COVID-19 outbreak in Nigeria for Week 27. Available at: www.covid19.ncdc.go.ng (accessed on 05/07/2020).

[5] Li C, Yang Y, Ren L. Genetic evolution analysis of 2019 novel coronavirus and coronavirus from other species. Infect Genet Evol 2020;82:104285. https://doi.org/10.1016/j.meegid.2020.104285

[6] Huang C, Wang Y, Li X, Ren L, Zhao J, Hu Y, Zhang L, Fan G, Xu J, Gu X, Cheng Z, Yu T, Xia J, Wei Y, Wu W, Xei X, Yin W, Li H, Cao B. Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China. Lancet 2020;395:497-506. https://doi.org/10.1016/S0140-6736(20)30183-5

[7] Zetzsche DA, Consiglio R. One million or one hundred million casualties? The impact of the COVID-19 crisis on the least developed and developing countries. Law Work Pap Ser 2020;8:1-66. https://ssrn.com/abstract=35976577657

[8] Olapegba PO, Ayandele S, Kolawole SO, Oguntayo R, Gandi JC, Dangiwa AL, Ottu IFA, Iorfa SK. A preliminary assessment of novel Coronavirus (COVID-19) knowledge and perceptions in Nigeria. Social Sci Humanities Open 2020. https://doi.org/10.2139/ssrn.3584408

[9] Izah SC, Iniamagha I, Sylva L. Two months of COVID-19 pandemic in Nigeria: Distribution and responses of the Nigerian media. Epidemiol Int 2020;5:32-44. https://doi.org/10.24321/2455.7048.202015

[10] Morganstein JC, Ursano RJ. Ecological disasters and mental health: causes, consequences, and interventions. Front Psychiat 2020;11:1. https://doi.org/10.3389/fpsyt.2020.00001

[11] Fiorillo A, Gorwood P. The consequences of the COVID-19 pandemic on mental health and implications for clinical practice. Eur Psychiat 2020;63:1-2. https://doi.org/10.1192/j.eurpsy.2020.35

[12] Roy D, Tripathy S, Kar SK, Sharma N, Verma SK, Kaushal V. Study of knowledge, attitude, anxiety and perceived mental healthcare need in Indian population during COVID-19 pandemic. Asian J Psychiat 2020;102083. https://doi.org/10.1016/j.ajp.2020.102083

[13] Richards P. Ebola: How a people's science helped end an epidemic. London: Zed Books 2017.

[14] Al-Hanawi MK, Angawi K, Alshareef N, Qattan AMN, Helmy HZ, Abudawood Y, Alqurashi M, Kattan WM, Kadasah NA, Chirwa GC, Alsharqi O. Knowledge, attitude and practice toward COVID-19 among the public in the Kingdom of Saudi Arabia: a cross-sectional study. Front Public Health 2020;8:217. https://doi.org/10:3389/fpubh.2020.00217

[15] Geldsetzer P. Use of rapid online surveys to assess people's per-

ceptions during infectious disease outbreaks: a cross-sectional survey on COVID-19. J Med Internet Res 2020;22:e18790. https://doi.org/10.2196/18790

[16] Isere EE, Fatiregun AA, Ajayi IO. An overview of disease surveillance and notification system in Nigeria and the roles of clinicians in disease outbreak prevention and control. Niger Med J 2015;56:161-8. https://doi.org/10.4103/0300-1652.160347

[17] Brug J, Aro AR, Oenema A, de Zwart O, Richardus JH, Bishop GD. SARS risk perception, knowledge, precautions and information sources, the Netherlands. Emerg Infect Dis 2004;10:1486-9. https://doi.org/10.3201/eid1008.040283

[18] Choi JS, Yang NY. Perceived knowledge, attitude, and compliance with preventive behavior on influenza A (H1N1) by university students. J Korean Acad Adult Nurs 2010;22:250-9.

[19] Hussain ZA, Hussain SA, Hussain FA. Medical students' knowledge, perceptions, and behavioral intentions towards the H1N1 influenza, swine flu in Pakistan: a brief report. Am J Infect Control 2012;40:e11-e13. https://doi.org/10.1016/j.ajic.2011.12.004

[20] Olaseni AO, Akinsola OS, Agberotimi SF, Oguntayo R. Psychological distress experiences of Nigerians amid COVID-19 pandemic. Social Sci Humanities Open 2020:SSHO-D-20-00416. https://doi.org/10.2139/ssrn.3596106

[21] Goumenou M, Spandidos DA, Tsatsakis A. Possibility of transmission through dogs being a contributing factor to the extreme Covid19 outbreak in North Italy. Mol Med Rep 2020;21:2293-5. https://doi.org/10.3892/mmr.2020.11037

[22] Lau JTF, Yang X, Tsui H, Kim JH. Monitoring community responses to the SARS epidemic in Hong Kong: from day 10 to day 62. J Epidemiol Commun H 2003;57:864-70. https://doi.org/10.1136/jech.57.11.864

[23] Vartti AM, Oenema A, Schreck M, Uutela A, de Zwart O, Brug, J, Aro AR. SARS knowledge, perceptions, and behaviors: a comparison between Finns and the Dutch during the SARS outbreak in 2003. Int J Behav Med 2009;16:41-8. https://doi.org/10.1007/s12529-008-9004-6

[24] Voeten H, de Zwart O, Veldhuijzen IK, Yuen C, Jiang X, Elam G, Abraham T, Brug J. Sources of information and health beliefs related to SARS and Avian influenza among Chinese communities in the United Kingdom and The Netherlands, compared to the general population in these countries. Int J Behav Med 2009;16:49-57. https://doi.org/10.1007/s12529-008-9006-4

[25] Berhan Y. Will Africa be devastated by Covid-19 as many predicted? Perspective and Prospective. Ethiop J Health Sci 2020;30:459-67. https://doi.org/10.4314/ejhs.v30i3.17

[26] Otitoloju AA, Okafor IP, Fasona M, Bawa-Allah KA, Isanbor C, Onyeka CS, Folarin OS, Adubi TO, Sogbanmu TO, Ogbeibu AE. COVID-19 pandemic: examining the faces of spatial differences in the morbidity and mortality in sub-Saharan Africa, Europe and USA. MedRxiv 2020. https://doi.org/10.1101/2020.04.20.20072322

[27] Nicola M, Alsafi Z, Sohrabi C, Kerwan A, Al-Jabir A, Iosifidis C, Agha M, Agha R. The socio-economic implications of the coronavirus and COVID-19 pandemic: a review. Int J Surg 2020;78:185-93. https://doi.org/10.1016/j.ijsu.2020.04.018

[28] Coibion O, Gorodnichenko Y, Weber M. The cost of the COVID-19 crisis: Lockdowns, macroeconomic expectations, and consumer spending (No. w27141). National Bureau of Economic Research 2020. http://www.nber.org/papers/w27141

[29] Yuksel B, Ozgor F. Effect of the COVID-19 pandemic on female sexual behavior. Int J Gynecol Obstet 2020. https://doi.org/10.1002/ijgo.13193

[30] Cocci A, Giunti D, Tonioni C, Cacciamani G, Tellini R, Polloni G, Cito G, Presicce F, Di Mauro M, Mineruini A, Cimino S. Love at the time of the Covid-19 pandemic: preliminary results of an online survey conducted during the quarantine in Italy. Int J Impot Res 2020;1-2. https://doi.org/10.1038/s41443-020-0305-x

[31] Abdelhafiz AS, Mohammed Z, Ibrahim ME, Ziady HH, Alorabi M, Ayyad M, Sultan EA. Knowledge, perceptions, and attitude of egyptians towards the novel coronavirus disease (COVID-19). J Community Health 2020;1-10. https://doi.org/10.1007/s10900-020-00827-7

[32] Zhong BL, Luo W, Li HM, Zhang QQ, Liu XG, Li WT, Li Y. Knowledge, attitudes, and practices towards COVID-19 among Chinese residents during the rapid rise period of the COVID-19 outbreak: a quick online cross-sectional survey. Int J Biol Sci 2020;16:1745-52. https://doi.org/10.7150/ijbs.45221

[33] Blendon RJ, Benson JM, DesRoches CM, Raleigh E, Taylor-Clark K. The public's response to severe acute respiratory syndrome in Toronto and the United States. Clin Infect Dis 2004;38:925-31. https://doi.org/10.1086/382355

Received on July 5, 2020. Accepted on June 7, 2021.

Correspondence: O.T. Adenubi, Department of Veterinary Pharmacology and Toxicology, College of Veterinary Medicine, Federal University of Agriculture, PMB 2240, Alabata, Abeokuta, Ogun State, Nigeria - Tel.: +2348025409691 - E-mail: bukiadenubi@gmail.com

How to cite this article: Adenubi OT, Adebowale OO, Oloye AA, Bankole NO, Ayo-Ajayi PO, Akinloye AK. University community-based survey on the knowledge, attitude and perception about COVID-19 pandemic: the Federal University of Agriculture, Abeokuta, Nigeria as a case study. J Prev Med Hyg 2021;62:E575-E585. https://doi.org/10.15167/2421-4248/jpmh2021.62.3.1663

RESEARCH ARTICLE

Infodemiology of flu: Google trends-based analysis of Italians' digital behavior and a focus on SARS-CoV-2, Italy

OMAR ENZO SANTANGELO[1], SANDRO PROVENZANO[2], VINCENZA GIANFREDI[3]
[1]Azienda Socio-Sanitaria Territoriale di Lodi, Lodi, Italy; [2] Azienda Ospedaliera Universitaria Policlinico "P. Giaccone", Palermo, Italy; [3] School of Medicine, Vita-Salute San Raffaele University, Milan, Italy

Keywords

Flu • SARS-CoV-2 • Google trends • Big data • Medical informatics computing • Italy

Summary

Introduction. *The aim of the current study was to assess if the frequency of internet searches for influenza are aligned with Italian National Institute of Health (ISS) cases and deaths. Also, we evaluate the distribution over time and the correlation between search volume of flu and flu symptoms with reported new cases of SARS-CoV-2.*
Materials and methods. *The reported cases and deaths of flu and the reported cases of SARS-CoV-2 were selected from the reports of ISS, the data have been aggregated by week. The search volume provided by Google Trends (GT) has a relative nature and is calculated as a percentage of query related to a specific term in connection with a determined place and time-frame.*
Results. *The strongest correlation between GT search and influenza cases was found at a lag of +1 week particularly for the period 2015-2019. A strong correlation was also found at a lag of +1 week between influenza death and GT search. About the correlation between GT search and SARS-CoV-2 new cases the strongest correlation was found at a lag of +3 weeks for the term flu.*
Conclusion. *In the last years research in health care has used GT data to explore public interest in various fields of medicine. Caution should be used when interpreting the findings of digital surveillance.*

Introduction

Influenza (or even flu) is a viral infectious disease causing a respiratory tract infection that cause a high burden in terms of direct and indirect costs, therefore it is still a public health concern [1]. Indeed, influenza viruses are characterized by the antigenic drift, that is responsible for the annual variability of the virus genome, which in turn is the reason why people can get the flu more than one time in their life [2]. Another characteristic of the flu viruses is the seasonality. Indeed, flu viruses are most common during the fall and winter, with a peak activity between December and February [2]. During the last season 2019-2020, an elevated influenza-like-illness have been detected. This excess of cases is due to a novel Coronavirus, the SARS-CoV-2 (severe acute respiratory syndrome coronavirus 2), that was firstly identified in China, Wuhan, in the province of Hubei in December 2019 [3]. SARS-CoV-2 is responsible for a disease defined COVID-19 (where "CO" means corona, "VI" means virus, "D" means disease and "19" indicates the year in which it occurred) previously known as "2019 novel coronavirus". Flu and the new influenza-like-illness are both respiratory illnesses caused by different viruses: influenza and the new SARS-CoV-2 [4].
The two infectious diseases spread from person-to-person via respiratory droplets emitted when people cough, sneeze or talk (close contact increases risk of transmission), landing in the upper respiratory tract of people nearby [5]. Moreover, the two types of illnesses have similar symptoms, making the differential diagnosis quite complex. In most of the cases there are symptoms variously intense including runny or stuffy nose, fever, cough, and more serious symptoms as pneumonia, bacterial infections, or hospitalizations; even if the new SARS-CoV-2 might range from a complete asymptomatic presentation to a highly complicated pulmonary and multi-organs failure, showing a more severe manifestation and causing thousands of deaths [6]. The first Italian patient tested positive to SARS-CoV-2 was detected in February in Lombardy region [7, 8]. Since the 23rd of February 2020, 225,435 total cases and 31,908 deaths have been recorder in Italy [9]. In the weeks ahead, we have seen the exponential increase of new cases and deaths for COVID-19 and the number of affected countries climb even higher. However, these numbers might be underestimated since collected through the classical surveillance systems, that are largely affected by under-diagnosis and under-reporting [10]. Nowadays, flourishing evidence is focusing on the adoption of potential novel surveillance systems based on disease-related internet activity traces [11-16] in order to monitor in a fast and cheap fashion the spread of (emerging and old) infectious diseases. Therefore, the aim of the current study was to assess if the frequency of the Italian general population searches for influenza, using the Google Trends, are aligned with Italian National Institute of Health (ISS - Istituto Superiore di Sanità) influenza cases and deaths. Moreover, we also assessed

https://doi.org/10.15167/2421-4248/jpmh2021.62.3.1704

if there was a correlation between flu symptoms search volume and influenza cases and deaths. Lastly, due to the overlap with the spread of the new SARS-CoV-2, we evaluate the distribution over time and the correlation between Google search volume of flu and flu symptoms with reported cases of SARS-CoV-2 in Italy.

Materials and methods

A cross-sectional study design was used. The reported cases of flu were selected from October 2015 to April 2020. The reported deaths of flu were selected from October 2016 to April 2019. Every week from the 42nd week of the current year to the 17th week of the following year the ISS issues a bulletin with the flu cases reported in the previous week [17].

The reported cases of SARS-CoV-2 were selected from 24 February 2020 (9th week of 2020) to the end of 17th week of the following year [9], the data have been aggregated by week.

Data on Internet searches have been obtained from Google Trends (GT) based on Google Search, the most widely used internet search engine, analyzes the popularity research topics in Google using graphs to compare the search volume of different queries over time and across different geographical locations [18]. We used the following Italian search terms in the "Health" category: "Influenza" ("Flu" in English) and "sintomi influenza" ("Symptoms of Flu" in English).

Three time-frame elapsing have been extracted partly overlapping. The first from October 12, 2015 to April 28, 2019, named "2015-2019 period", the second from October 12, 2015 to April 26, 2020, named "2015-2020 period" and finally the third from October 17, 2016 to April 28, 2019, named "2016-2019 period". The data have been aggregated by week. According to the selected period, the relative search volume (RSV) changes, because it is a relative index.

The file in ".CSV" format has been downloaded. GT produces relative search volume (RSV) scaled to the highest search proportion week, which is computed as the percentage of queries concerning a particular term for a specific location and time period, where 100 is the maximum value and 0 is the minimum value. Thus, RSV allows for directly comparing search volume across search terms.

The data coincide temporally with the weekly incidence reported in the epidemiological bulletins of the ISS; then, the data extracted from GT have been moved over time (Lag), one week in the future and one week in the past. Cross-correlation results are obtained as product-moment correlations between the two-time series. The advantage of using cross-correlations is that it accounts for time dependence between two time-series variables. Statistical analyses have been performed using the Spearman's rank correlation coefficient (rho). The statistical significance level for the analyses has been fixed in 0.05. The data have been analyzed using the STATA statistical software, version 14 [19].

In the Tables, the wording "+1" means that we have moved the extracted data from Google one week in the future. In other words, Google anticipated the data by one week in relation to the comparison (for example the number of new cases of flu). Reverse speech for lag-1.

Results

Influenza-related digital behavior showed an increasing trend throughout the study period (from 2015 to 2019), with a peak during the epidemic year 2017, for influenza search term, and year 2019 for influenza symptoms search term. The temporal correlation between influenza cases reported by ISS and GT-based RSV was very large (rho > 0.70, highly statistically significant with p-values < 0.001) for the two study periods 2015-2019 and 2015-2020. The strongest correlation between Google trends search (for both flu and symptoms of flu) and the reported influenza cases from ISS was found at a lag of +1 week particularly for the period 2015-2019 (rho = 0.92 for flu and rho = 0.87 for symptoms), as showed in Table I. The correlation between influenza cases and Google trends search was still strong for the period 2015-2020 even if slightly attenuated compare to 2015-2019 (rho = 0.77 for flu and rho = 0.82 for symptoms, p-values < 0.001), as reported in Table I. In addition, a strong correlation was also found at a lag of +1 week between influenza death and Google trends search (rho = 0.84 for flu and rho = 0.81 for symptoms, p-values < 0.001), as described in Table II. These statistically significant patterns were depicted in Figure 1 (2015-2019 period) and Figure 2 (2015-2020 period) for influenza cases and in Figure 3 for deaths (2016-2019 period). When examining the

Tab. I. Focus on flu (2015-2019 and 2015-2020 periods). Time series bi-directional cross-correlation coefficients for 1 week displaying relationships between Google Trends Terms ("Flu" and "Symptoms of Flu") and cases reported by the ISS. Used Spearman's rank correlation coefficient.

	Lag in week compared to deaths reported by ISS		
2015-2019 period	**-1**	**0**	**+1**
Flu	0.8257*	0.8966*	0.9211*
Symptoms of Flu	0.7657*	0.8380*	0.8722*
2015-2020 period			
Flu	0.7521*	0.7755*	0.7704*
Symptoms of Flu	0.7991*	0.8377*	0.8212*

* p-value < 0.001.

Tab. II. Focus on flu (2016-2020 period). Time series bi-directional cross-correlation coefficients for 1 week displaying relationships between Google Trends Terms ("Flu" and "Symptoms of Flu") and deaths reported by the ISS. Used Spearman's rank correlation coefficient.

	Lag in week compared to deaths reported by ISS		
2016-2020 period	**-1**	**0**	**+1**
Flu	0.6015*	0.7545*	0.8366*
Symptoms of Flu	0.6177*	0.7439*	0.8056*

* p-value < 0.001.

Fig. 1. Google Trends curve as RSVs (Relative Search Volumes) for symptoms of Flu and Flu *vs* epidemiological cases of Flu in Italy at Lag 0. 2015-2019 period.

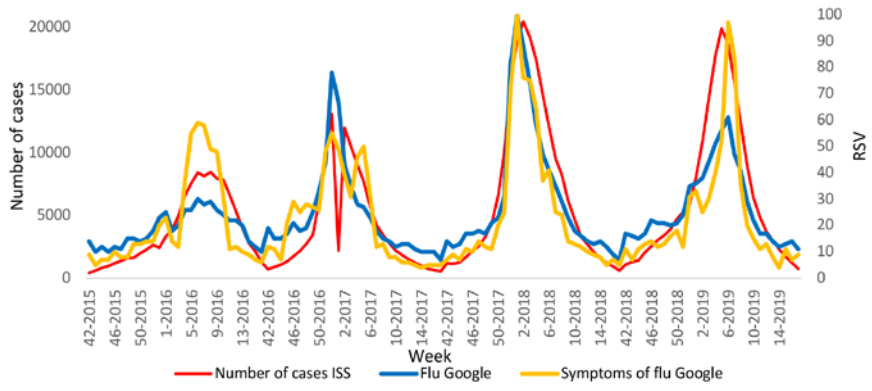


Fig. 2. Google Trends curve as RSVs (Relative Search Volumes) for symptoms of Flu and Flu *vs* epidemiological cases of Flu in Italy at Lag 0. RSV is relative search volumes. 2015-2020 period.

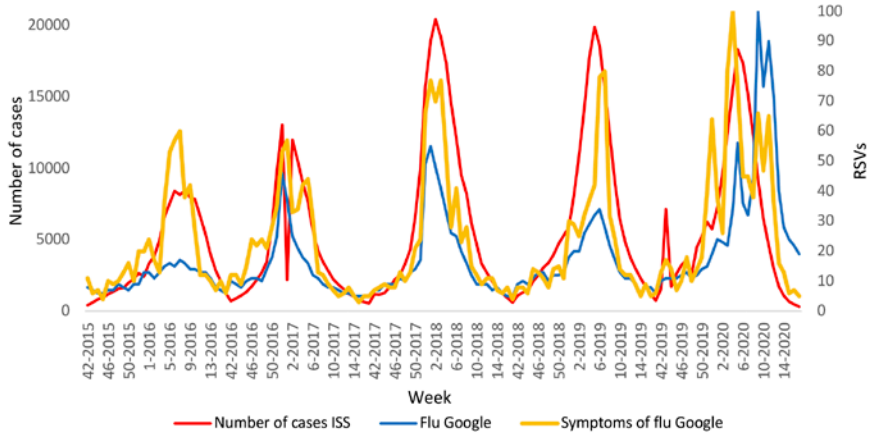
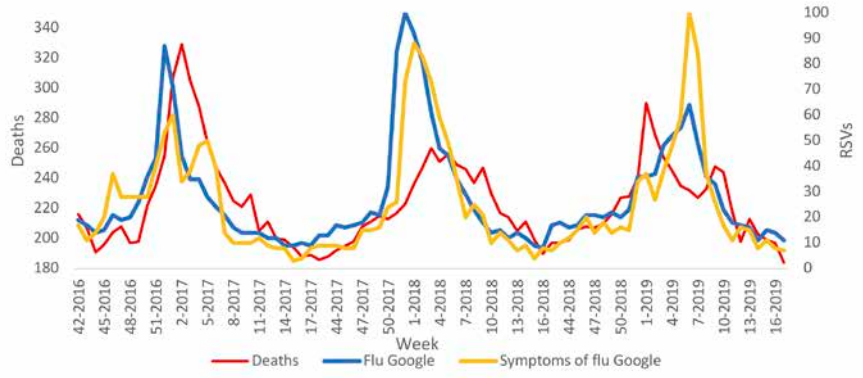


Fig. 3. Google Trends curve as RSVs (Relative Search Volumes) for symptoms of Flu and Flu *vs* epidemiological deaths of Flu in Italy at Lag 0. 2016-2019 period.



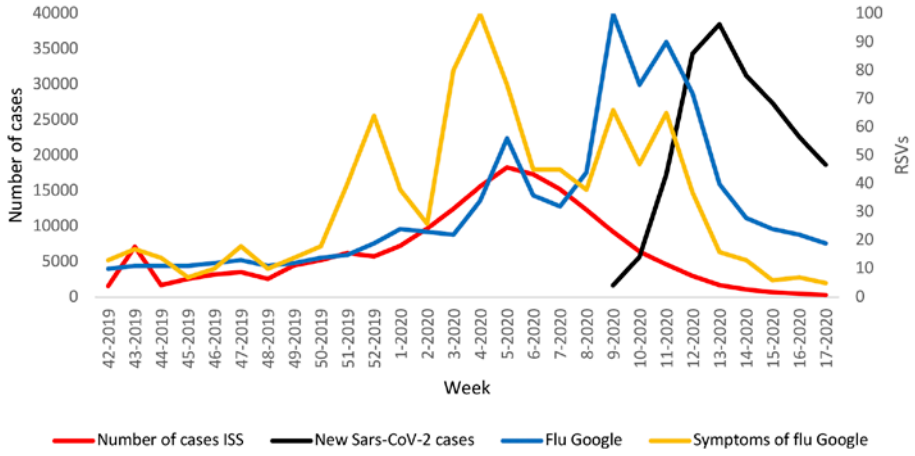
correlation between Google trends search and SARS-CoV-2 new cases reported by the Ministry of Health, the strongest correlation was found at a lag of +3 weeks for the search term flu (rho = 0.80, p-value < 0. 01) as showed in Table III. This statistical pattern is confirmed in Figure 4, where the Google research volume for flu and flu symptoms were plotted considering both influenza cases and new SARS-CoV-2 cases. In this figure, the search volume for flu and flu symptoms shows a double peak. The first is concurrent to the influenza cases peak, the second is precedent to the reported new SARS-CoV-2 cases.

Tab. III. Focus on SARS-CoV-2. Time series bi-directional cross-correlation coefficients for 1, 2, 3 and 4 weeks displaying relationships between Google Trends Terms ("Flu" and "Symptoms of Flu") and SARS-CoV-2 new cases. Used Spearman's rank correlation coefficient.

	Lag in week compared to SARS-CoV-2 new cases				
	0	+1	+2	+3	+4
Flu	-0.4167	-0.0500	0.3833	0.8000*	0.6500
Symptoms of Flu	-0.4333	-0.2000	0.1000	0.4435	0.0084

*: p-value < 0.01.

Fig. 4. Focus on SARS-CoV-2 new cases. Google Trends curve as RSVs (Relative Search Volumes) for symptoms of Flu and Flu *vs* epidemiological SARS-CoV-2 new cases in Italy at Lag 0. 2019-2020 period.



Discussion

In this study we found a large correlation between flu – cases and deaths – occurred in Italy and reported by ISS and GT research for both flu and flu symptoms. This result remains consistent even using different time lag, becoming more stronger when a time lag of +1 week was adopted. Due to the overlap between clinical symptomatology and season during which flu and SARS-CoV-2 spread among population (in Italy), we further assessed the correlation between Google trends search and SARS-CoV-2 new cases reported by the Ministry of Health. A strong correlation was found in this analysis as well, with the strongest correlation at a lag of +3 weeks. This means that at the beginning of the SARS-CoV-2 pandemic, people affected by COVID-19 searched on Internet information related to flu, probably confusing the two diseases. Moreover, it confirms the hypothesis that people frequently use internet for searching health related information.

On Feb 22, 2020 an Editorial on the scientific journal The Lancet entitled "COVID-19: fighting panic with information" focused on the real risk of sanitary emergency saying there could be no way to prevent a COVID-19 pandemic in this globalized time, but verified information is the most effective prevention against the disease of panic [20]. Thus, from the first moment it became clear that we were struggling not only with an epidemic, but also with an infodemic [21]. A global epidemic of misinformation – spreading mainly through social media platforms and fake news – poses a serious problem for public health although the WHO is leading the effort to stem of public emergency. As a public health emergency of international concern, the COVID-19 has drawn global attention and response. In the scenario of COVID-19 pandemic [22], it is extremely important to promote the flu vaccination during the next campaign increasing the opinion, knowledge and attitude of health workers and the population with dedicated health policies [23-25].

This is true for several reasons, firstly, it could directly reduce the burden of the flu pandemic (diminishing and limiting the number of patients hospitalized because of flu), secondly, reducing the number of patients hospitalized because of flu, it will ameliorate the hospital organization of patients eventually positive to SARS-CoV-2. Thirdly, in flu immunized patients the differential diagnosis between flu and SARS-CoV-2 could be facilitate improving the clinical management of these patients [26]. In planning these measures, considerations should be given to minimizing the excess risk of morbidity and mortality from vaccine-preventable diseases (VPDs). Such outbreaks may result in VPD-related deaths and an increased burden on health systems already strained by the response to the COVID-19 outbreak [27].

In this context, the big data generated by web searches become increasingly important in the search for new surveillance systems based on digital epidemiology. According to Marcel Salathe the term digital epidemiology is a field of study that uses data that was generated outside the public health system, i.e. with data that was not generated with the primary purpose of doing epidemiology [28].

In a similar way to the results of the scientific literature our study shown that digital epidemiology, integrated to modern infectious disease surveillance systems, aim to employ the speed and scope of big data in an attempt to provide global health security [29].
Our study has strengths and limitations. Google Trends data helps identify developing interests in different public health topics including known and emerging infectious diseases (i.e. flu and SARS-CoV-2) or related clinical and diagnostic aspects and screening tests. Internet searches can be an important source for generating hypotheses about knowledge, attitudes, and practices in public health topics; evaluating changes in information seeking after targeted interventions to prevent the spread of emerging infectious diseases or stem vaccine-preventable diseases. In this field, public health interventions could be evaluated almost immediately and with a minimal expenditure.
The mass media (TV, radio, and social network) may influence the online population's researches [30]. Indeed, the spike of Internet searches, for example, for "Flu" or "symptoms of Flu" may be attributed to various factors as an increased number of cases in the community and increased attention given by the mass media. Indeed, the data is only available for States and selected metropolitan areas limiting comparability with rural areas or areas with a low search volume, represented by the areas where Internet is less widespread among the population. Finally, Google Trends data are anonymous limiting the utility in examining subgroups or disparities among populations.
Thus, even considering the potential intrinsic limits of this analysis, our results show how this data might be extremely useful, encouraging the spread of future researches at each country level.
The results of this study suggest that Google Trends based surveillance systems might be relevant for public health and for public health workers [31], because these novel systems have the potentiality to inform how the public is interested in searching health related information [32]. The info surveillance systems, based on the intrinsic characteristic of dynamicity, have the power to inform and provide near real-time data, useful to plan public health interventions [33]. Public health workforce should enforce communication and internet-based skills in order to fruitfully use a new and cheap technology able to support interventions design and implementation [34].

Conclusions

How key information must be communicated to the public during the next phase of the pandemic is critical. In the last years research in health care has used GT data to explore public interest and trends in various fields of medicine. It is evident that caution should be used when interpreting the findings of Google Trends digital surveillance.

Acknowledgements

Funding sources: this research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Conflict of interest statement

The authors declare no conflict of interest.

Authors' contributions

OES conceived, designed, coordinated and supervised the research project. OES, SP and VG performed the data quality control, optimized the informatics database, performed the statistical analyses and evaluated the results. OES, SP and VG wrote the manuscript. All Authors revised the manuscript and gave their contribution to improve the paper. All authors read and approved the final manuscript.

References

[1] Rizzo C, Bella A, Viboud C, Simonsen L, Miller MA, Rota MC, Salmaso S, Ciofi degli Atti ML. Trends for influenza-related deaths during pandemic and epidemic seasons, Italy, 1969-2001. Emerg Infect Dis 2007;13:694-9. https://doi.org/10.3201/eid1305.061309

[2] Centers for Disease Control and Prevention. Influenza (Flu). 2019. https://www.cdc.gov/flu/about/season/flu-season.htm (accessed 18 May 2020).

[3] Brussow H. The novel coronavirus - a snapshot of current knowledge. Microb Biotechnol 2020;13:607-12. https://doi.org/10.1111/1751-7915.13557

[4] Pascarella G, Strumia A, Piliego C, Bruno F, Del Buono R, Costa F, Scarlata S, Agrò FE. COVID-19 diagnosis and management: a comprehensive review. J Intern Med 2020. https://doi.org/10.1111/joim.13091

[5] Ningthoujam R. COVID 19 can spread through breathing, talking, study estimates. Curr Med Res Pract 2020. https://doi.org/10.1016/j.cmrp.2020.05.003

[6] Huang Q, Deng X, Li Y, Sun X, Chen Q, Xie M, Liu S, Qu H, Liu S, Wang L, He G, Gong Z. Clinical characteristics and drug therapies in patients with the common type coronavirus disease 2019 in Hunan, China. Int J Clin Pharm 2020:1-9. https://doi.org/10.1007/s11096-020-01031-2

[7] Signorelli C, Odone A, Gianfredi V, Bossi E, Bucci D, Oradini-Alacreu A, Frascella B, Capraro M, Chiappa F, Blandi L, Ciceri F. COVID-19 mortality rate in nine high-income metropolitan regions. Acta Biomed 2020;91:7-18. https://doi. org/10.23750/abm.v91i9-S.10134

[8] Signorelli C, Odone A, Gianfredi V, Bossi E, Bucci D, Oradini-Alacreu A, Frascella B, Capraro M, Chiappa F, Blandi L, Ciceri F. The spread of COVID-19 in six western metropolitan regions: a false myth on the excess of mortality in Lombardy and the defense of the city of Milan. Acta Biomed 2020;91:23-30. https://doi.org/10.23750/abm.v91i2.9600.

[9] Ministry of Health. Covid-19 - Situazione in Italia. 2020. http://www.salute.gov.it/portale/nuovocoronavirus/dettaglioContenutiNuovoCoronavirus.jsp?area=nuovoCoronavirus&id=5351&lingua=italiano&menu=vuoto (accessed 17 May 2020).

[10] Gianfredi V, Moretti M, Fusco Moffa I. Burden of measles using disability-adjusted life years, Umbria 2013-2018. Acta Biomed 2020;91:48-54. https://doi.org/10.23750/abm.v91i3-S.9412

[11] Bragazzi NL, Barberis I, Rosselli R, Gianfredi V, Nucci D, Moretti M, Salvatori T, Martucci G, Martini M. How often people google for vaccination: qualitative and quantitative insights from a systematic search of the web-based activities using Google Trends. Hum Vaccin Immunother 2017;13:464-9. https://doi.org/10.1080/21645515. 2017.1264742

[12] Gianfredi V, Bragazzi NL, Mahamid M, Bisharat B, Mahroum N, Amital H, Adawi M. Monitoring public interest toward pertussis outbreaks: an extensive Google Trends-based analysis. Public Health 2018;165:9-15. https://doi.org/10.1016/j.puhe.2018.09.001

[13] Gianfredi V, Bragazzi NL, Nucci D, Martini M, Rosselli R, Minelli L, Moretti M. Harnessing big data for communicable tropical and sub-tropical disorders: implications from a systematic review of the literature. Front Public Health 2018;6:90. https:// doi.org/10.3389/fpubh.2018.00090

[14] Mahroum N, Bragazzi NL, Sharif K, Gianfredi V, Nucci D, Rosselli R, Brigo F, Adawi M, Amital H, Watad A. Leveraging google trends, twitter, and Wikipedia to investigate the impact of a celebrity's death from rheumatoid arthritis. J Clin Rheumatol 2018;24:188-92. https://doi. org/10.1097/RHU.0000000000000692

[15] Provenzano S, Santangelo OE, Giordano D, Alagna E, Piazza D, Genovese D, Calamusa G, Firenze A. Predicting disease outbreaks: evaluating measles infection with wikipedia trends. Recenti Prog Med 2019;110:292-6. https://doi.org/10.1701/3182.31610

[16] Santangelo OE, Provenzano S, Piazza D, Giordano D, Calamusa G, Firenze A. Digital epidemiology: assessment of measles infection through Google Trends mechanism in Italy. Ann Ig 2019;31:385-91. https://doi.org/10.7416/ai.2019.2300

[17] Istituto Superiore di Sanità. Rapporto Influnet. Aggiornamento 8 maggio 2020. 2020. https://old.iss.it/site/RMI/influnet/pagine/rapportoInflunet.aspx (accessed 17 May 2020).

[18] Google Trends. Scopri quali ricerche si fanno nel mondo. 2020. https://trends.google.it/trends/?geo=IT (accessed 17 May 2020).

[19] StataCorp. Stata Statistical Software. In: Station C, editor. StataCorp LP 2015.

[20] COVID-19: fighting panic with information. Lancet 2020;395:537. https://doi.org/10.1016/S0140-6736(20)30379-2

[21] Gianfredi V, Provenzano S, Santangelo OE. What can internet users' behaviours reveal about the mental health impacts of the COVID-19 pandemic? A systematic review. Public Health 2021;198:44-52. https://doi.org/https://doi.org/10.1016/j.puhe.2021.06.024

[22] Gianfredi V, Pennisi F, Lume A, Ricciardi GE, Minerva M, Riccò M, Odone A, Signorelli C. Challenges and opportunities of mass vaccination centers in COVID-19 times: a rapid review of literature. Vaccines (Basel) 2021;9(6). https://doi.org/10.3390/vaccines9060574

[23] Gentile L, Cuda A, Dallagiacoma G, Provenzano S, Santangelo OE, Navaro M, D'Aloisio F, Gianfredi V.Opinion, knowledge and attitude of public health residents towards the new mandatory vaccination law in Italy. J Public Health (Berl) 2020. https://doi.org/10.1007/ s10389-019-01171-4

[24] Gianfredi V, Dallagiacoma G, Provenzano S, Santangelo OE. Factors predicting health science students' willingness to be vaccinated against seasonal flu during the next campaign. Ann Ist Super Sanita 2019;55:209-16. https://doi.org/10.4415/ANN_19_03_03

[25] Santangelo OE, Cedrone F, Gentile L, Provenzano S, Dallagiacoma G, Armetta F, Gianfredi V.. Reasons behind flu vaccine acceptance and suggested interventions to promote flu vaccination acceptance among healthcare workers. J Infect Prev 2021;22:132-5.https://doi.org/10.1177/1757177420976804

[26] Gianfredi V, Santangelo OE, Provenzano S. The effects of COVID-19 pandemic on the trend of measles and influenza in Europe. Acta Biomed 2021;92:e2021318. https://doi.org/10.23750/abm.v92i4.11558

[27] World Health Organization. Guidance on routine immunization services during COVID-19 pandemic in the WHO European Region. 2020. http://www.euro.who.int/__data/assets/pdf_file/0004/433813/Guidance-routine-immunization-services-COVID-19-pandemic.pdf?ua=1 (accessed 20 May 2020).

[28] Salathe M. Digital epidemiology: what is it, and where is it going? Life Sci Soc Policy 2018;14:1. https://doi.org/10.1186/s40504-017-0065-7

[29] Eckmanns T, Fuller H, Roberts SL. Digital epidemiology and global health security; an interdisciplinary conversation. Life Sci Soc Policy 2019;15:2. https://doi.org/10.1186/s40504-019-0091-8

[30] Gianfredi V, Santangelo OE, Provenzano S. Correlation between flu and Wikipedia's pages visualization. Acta Biomed 2021;92:e2021056. https://doi.org/10.23750/abm.v92i1.9790

[31] Gianfredi V, Odone A, Fiacchini D, Rosselli R, Battista T, Signorelli C. Trust and reputation management, branding, social media management nelle organizzazioni sanitarie: sfide e opportunità per la comunità igienistica italiana. J Prev Med Hyg 2019;60:E108-E9.

[32] Bragazzi NL, Gianfredi V, Villarini M, Rosselli R, Nasr A, Hussein A, Martini M, Behzadifar M. Vaccines meet big data: state-of-the-art and future prospects. From the classical 3Is ("Isolate-Inactivate-Inject") Vaccinology 1.0 to Vaccinology 3.0, Vaccinomics, and beyond: a historical overview. Front Public Health 2018;6:62. https:// doi.org/10.3389/fpubh.2018.00062

[33] Gianfredi V, Grisci C, Nucci D, Parisi V, Moretti M. [Communication in health]. La comunicazione in sanità. Recenti Prog Med 2018;109:374-83. https://doi.org/10.1701/2955.29706

[34] Gianfredi V, Balzarini F, Gola M, Mangano S, Carpagnano LF, Colucci ME, Gentile L, Piscitelli A, Quattrone F, Scuri S, Mantovani LG, Auxilia F, Castaldi S, Capolongo S, Pelissero G, Odone A, Signorelli C. Leadership in public health: opportunities foryoung generations within scientific associations and the experience of the "Academy of Young Leaders". Front Public Health 2019;7:378. https://doi.org/10.3389/fpubh.2019.00378

Received on July 27, 2020. Accepted on July 29, 2020.

Correspondence: Sandro Provenzano, Azienda Ospedaliera Universitaria Policlinico "P. Giaccone", via del Vespro 129, 90127 Palermo (PA), Italia - Tel.: +390916553641 - Fax: +390916553697 - E-mail: provenzanosandro@hotmail.it

How to cite this article: Santangelo OE, Provenzano S, Gianfredi V. Infodemiology of flu: Google trends-based analysis of Italians' digital behavior and a focus on SARS-CoV-2 Italy. J Prev Med Hyg 2021;62:E586-E591. https://doi.org/10.15167/2421-4248/jpmh2021.62.3.1704

Research article

Contact tracing, use of surgical masks, hand hygiene and social distancing represent a bundle of effective measures to control SARS-CoV-2 spreading among healthcare workers in a paediatric hospital

DANIELA LA MASA[1], ORIETTA VIANELLO[1], MAURO PICCININI[1], MARCELLO MARIANI[2], GIACOMO BRISCA[1], CAROLINA SAFFIOTI[1], ALESSIO MESINI[1], EDDI DI MARCO[1], ELIO CASTAGNOLA[1];
WITH THE COLLABORATION OF THE COVID-19 GASLINI TASK FORCE[1]: MARCO GATTORNO, ANNA MARIA URBANO, MOHAMED MAGHNIE, LUCA A. RAMENGHI, MARCO ADRIANO, ANDREA MOSCATELLI, EMANUELA PICCOTTI, RAFFAELE SPIAZZI, SILVIA SCELSI, UBALDO ROSATI, PAOLO PETRALIA
[1] IRCCS Istituto Giannina Gaslini, Children's Hospital, Genova, Italy; [2] Department of Neuroscience, Rehabilitation, Ophthalmology, Genetics, Maternal and Child Health (DINOGMI), University of Genova, Italy

Keywords

Contact tracing • Surgical masks • Hand hygiene • Social distancing • SARS-CoV-2 • Paediatric hospital

Summary

Severe Acute Respiratory Syndrome Coronavirus-2 (SARS-CoV-2) is the causative agent of pandemic coronavirus disease 2019 (COVID 19). Protection from virus exposure in children's hospital is a pivotal aspect of SARS-COV-2 pandemic control. Healthcare workers (HCW) could play an important role in viral infection in-hospital spread. Infection control measures were thus implemented to protect fragile patients and healthcare workers.We retrospectively described a HCW infection-scase-series due to SARS-CoV-2 from February 24th to July 31stat the IRCCS Istituto Giannina Gaslini. Seven separate cases of SARS-CoV-2 infection were observed among healthcare workers, with a total of 395 contacts, and 23 (6%) secondary case. A program of contact tracing and quarantine of SARS-CoV-2 positive HCW, screening of asymptomatic HCW, use of surgical masks, hand hygiene, social distancing and use of PPE in COVID-19 cases assistance prevented the spread of the virus to patients and blocked the diffusion within the hospital.

Introduction

Severe Acute Respiratory Syndrome Coronavirus-2 (SARS-CoV-2) is the causative agent of pandemic coronavirus disease 2019 (COVID 19). In countries experiencing high rates of infection as Italy (Supplementary Fig. 1), pediatric population represents a minority of COVID-19 patients, even if severe clinical cases can be observed in children with risk factor [1-3]. Protection from SARS-CoV-2 exposure in children's hospital, where many fragile patients (e.g small birth weight and/or preterm neonates, cancer or transplants patients etc) are treated, is a pivotal aspect of SARS-CoV-2 pandemic control. Healthcare workers (HCW) could play an important role in viral infection spread to patients, colleagues or people outside healthcare system by acquiring infection inside or outside the hospital [4, 5]. In light of this, infection control measures were implementedto protect patients and HCW themselves. On February 21st, 2020, the first autochthonous case of COVID-19 was diagnosed, and on March 9th the Italian government implemented nation-wide measures to limit viral transmission. At the same time, Health Care Facilities adopted measures to reduce in-hospital spread of SARS-CoV-2. The aim of this study is to share our experience in the management of pandemic in a pediatric hospital and to describe a case series of HCW infections, their management and theactive surveillance proposed to individuate possible pre-symptomatic subjects with a screening campaign in HCW.

Materials and methods

We retrospectively described a case-series of HCW infections due to SARS-CoV-2 from February 24th to July 31st in the IRCCS Istituto Giannina Gaslini (IGG), a tertiary care children hospital, in Genoa, Italy. Since the beginning of the pandemic,IGG has set up a Crisis Unit to manage the emergency situation within the hospital. The management of HCW infections has been entrusted to Department of Preventive Medicine, in collaboration with the Infection Control Groupabout in-hospital contact tracing. Infectious Disease specialist has been consulted to define cases and contacts-of -cases, especially in hospitalized patients. Sars-Cov-2 detection on nasopharyngeal swabs was performed by Allplex 2019-nCoV RT-PCR Assay (Seegene Inc. Seoul Corea) that identifies 3 target genes (E, N and RdRP) of SARS-CoV-2 in a multiplex PCR single tube reaction.

https://doi.org/10.15167/2421-4248/jpmh2021.62.3.1719

Results

From February 24th to July 31st, 7 HCWindex-casesdetermined as many as clusters involving a total of 395 contacts and 23 (6%) secondary cases, as shown in Figure 1.

Two clusters were observed before implementation of more stringent control measures. The first was linked to a patient and her mother, admitted toRehabilitation department. Infection probablyderivedfrom a grandparent who visited the patient despitehospital warning and without declaringpresence of COVID-19 symptoms to hospital staff. Patient presented mild fever and upper respiratory tract infection signs, while themother declared only anosmia and ageusia. Since SARS-CoV-2 infection was not initially suspected, no HCW wore the recommended personal protective equipment (PPE) during contact with the index patient. Consequently, in the following 14 days, 9 (5%) of 179 traced contacts wasinfected. 5 of them were positive atin-hospital screening, while 4 developed symptoms at home and they were considered clinically documented and quarantined.The second cluster involved 48 HCW and 7 (14%) become infected. This cluster was linked to an intensive care unit (ICU) nurse who got the infection outside the hospital (probably on vacation)and infected shift colleagues which probably caused some further secondary case. Since hospital procedures in ICU called for wearing surgical masks, gowns and gloves, other than appropriate hand hygiene, no infection was documented in patients assisted by infected nurses. Both clusters were concomitant with infection peak in Liguria region (and Italy) (Supplementary Figs. 1, 2). After these clusters, IGG immediately activated an active search program of possible pre-symptomatic cases with contact tracing, test and quarantine of positive subjects, mandatory use of surgical masks and further implementation of hand hygiene and social distancing [5-7]. Screening was then extended to all HCW. This policy, together withhospital split and national lockdown, resulted effective in reducing in-hospital virus diffusion. In the following days we observed 5 further clusters with 4 of them, in short time from the second one, during the most aggressive phase of SARS-CoV-2 infections in Italy and Liguria (Supplementary Figs. 1, 2). Patients probably already incubating the disease at time of tightening of control measures.The number of secondary cases was limited despite a not negligible number of contacts at least in one of them (Fig. 1). In the same period, a total of 30 patients with SARS-CoV-2 infection were managed by HCW with the use of PPE recommended for COVID-19 patient care and no one acquired the virus. After the last identified cluster, from March 31 a total of 2,331 HCW were periodically tested during the hospital screening program: 11 (0.4%) had at least 1 positive test (the last one on May 18th), but no secondary case occurred.

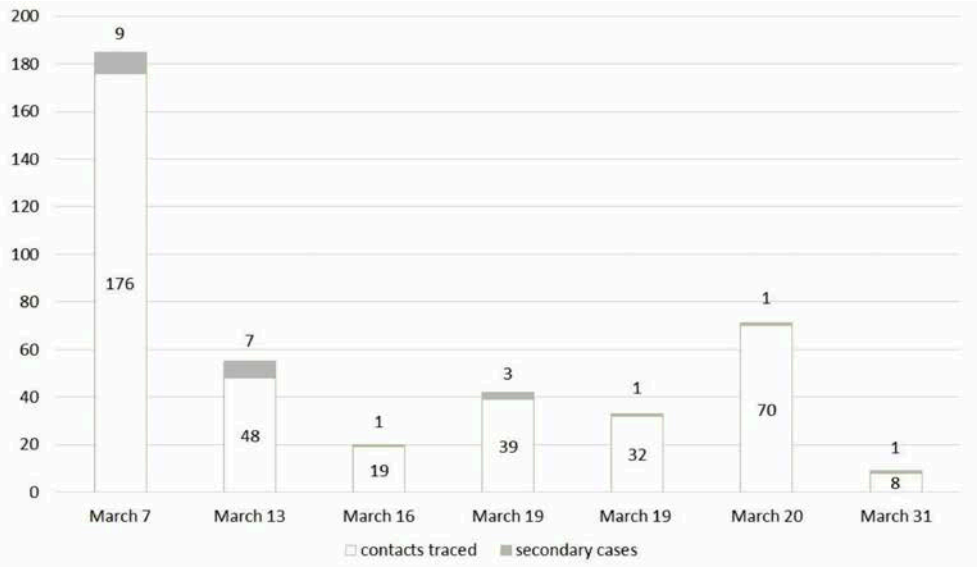
Discussion

On February 21st, 2020, the first autochthonous Italian case of COVID-19 was diagnosed, and on March 9ththe Italian Government implemented nation-wide measures to limit viral transmission.

The IRCCS Istituto Giannina Gaslini, Genova-Italy is a tertiary pediatric care hospital located in the North-West of Italy (Liguria), a region strongly involved in SARS-CoV-2 infection spread (Supplementary Figs. 1, 2).

From February 25th the Hospital Crisis Team adopted measures to reduce the risk of in-hospital spread of SARS-COV-2. Firstly, all HCW dealing with suspect or confirmed COVID-19 patients had to wear appropriate PPE recommended for COVID-19 patient care: liquid-repelling gowns, double gloves, a class 2 filtering face-

Fig. 1. Contact tracing in Italy, 2020.



piece respirator (FFP2) and eye protection (goggles or face shield). Meanwhile, hospital access was restricted to HCW and only one caregiver for each patient was allowed. All people accessing hospital had to undergo temperature check and were asked for presence of symptoms possibly related with COVID-19. Moreover,courtesy visits to patients were forbidden as well as access for all categories of non-HCW (e.g. administrative staff, teachers, medical students, volunteers, etc.) and all non-clinical activities were closed. At this time, nasopharyngeal swab with RT-PCR-SARS-CoV-2 detection was performed only in children who entered the emergency room with evocative symptoms for COVID-19 (or developed these symptoms after admission) or in HCW who became symptomaticduring hospital shift. HCW who presented symptoms at home were discouraged to attend work and were quarantined. These cases were considered as "clinically documented". In the meantime, patients, their caregivers and other HCW who were in contact with asuspected HCW index-case in the last 3 days before symptoms development were traced and tested. Furthermore, from March 14th the IGG crisis team blocked all medical activities that did not have an urgent/emergency character or that cannot be postponed.Hospital activity was organized in 2 separated channels: one for management of patients considered at risk or with suspect or confirmed SARS-CoV-2 infection (COVID-19-Hospital) and the other for all other patients. From the same day all HCW had to wear surgical masks [8] even if not involved in COVID-19-Hospital activities, in addition to hand hygiene with soap or isopropyl alcohol and other standard isolation procedures according with the type of possible pathogens transmission [9]. A screening program of all HCW was also implemented to detect possible pre-symptomatic carriers [5, 6]. Screening firstly involved HCW from Emergency Department, Infectious Diseases unit, Intensive Care Unit, Obstetric Department and Home-Care Service, then it was gradually extended to HCW from all other departments. Pregnant women at 37th week of gestation were screened even in absence of symptoms or contacts at risk before delivery, as well as oncologicchildren who had to be transferred to an adult's center to undergo fractionated radiotherapy for malignancy [10].

Conclusions

The initial IGG approach was to test all symptomatic HCW and trace and test all their contacts. always associated with social distancing, use of surgical masks and hand hygiene procedures. IGG policy for healthcare associated infections has been documented to be effective in the diffusion containment of other pathogens [9] and this approach surely played a positive role also in reducing SARS-CoV-2 diffusion at least to patients managed by pre-symptomatic HCW. Despiteincreased cost and depletion of supply of masks in health systems, the IGG approachtogether with national lockdown (HCW contact tracing/quarantine, screening, widespread use of surgical masks and hand hygiene, and use of PPE in COVID-19 cases assistance) was effective in containing the spread of SARS-CoV-2 within the hospital since, in our experience, the major sourceof SARS-CoV-2 infection in a pediatric hospital was represented by people coming from outside, including HCW [4, 5].

Acknowledgements

Funding sources: this research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.
The COVID-19 Gaslini Task Force: Marco Gattorno, Anna Maria Urbano, Mohamed Maghnie, Luca A. Ramenghi, Marco Adriano, Andrea Moscatelli, Emanuela Piccotti, Raffaele Spiazzi, Silvia Scelsi, Ubaldo Rosati, Paolo Petralia.

Conflict of interest statement

The authors declare no conflict of interest.

Authors' contributions

All authors should have made substantial contributions to all of the following. DLM, OV, MP, CS, AM: conception and design of the study, acquisition of data, analysis and interpretation of data; drafting the article or revising it critically for important intellectual content.
MM, GB, EDM: drafting the article and revising it critically for important intellectual content.
EC: conception and design of the study, acquisition of data, analysis and interpretation of data; final approval of the version to be submitted.

References

[1] Tagarro A, Epalza C, Santos M, Sanz-Santaeufemia FJ, Otheo E, Moraleda C, Calvo C. Screening and severity of coronavirus disease 2019 (COVID-19) in children in Madrid, Spain. JAMA Pediatr 2020:e201346. https://doi.org/10.1001/jamapediatrics.2020.1346

[2] Parri N, Lenge M, Buonsenso D; Coronavirus Infection in Pediatric Emergency Departments (CONFIDENCE) Research Group. Children with Covid-19 in pediatric emergency departments in Italy. N Engl J Med 2020;383:187-90. https://doi.org/10.1056/NEJMc2007617

[3] Riphagen S, Gomez X, Gonzalez-Martinez C, Wilkinson N, Theocharis P. Hyperinflammatory shock in children during COVID-19 pandemic. Lancet 2020;395:1607-8. https://doi.org/10.1016/S0140-6736(20)31094-1

[4] CDC COVID-19 Response Team. Characteristics of health care personnel with COVID-19 - United States, February 12 - April 9, 2020. MMWR Morb Mortal Wkly Rep 2020;69:477-81. https://doi.org/10.15585/mmwr.mm6915e6

[5] Canova V, Lederer Schläpfer H, Piso RJ, Droll A, Fenner L, Hoffmann T, Hoffmann M. Transmission risk of SARS-CoV-2 to healthcare workers -observational results of a primary care hospital contact tracing. Swiss Med Wkly 2020;150:w20257. https://doi.org/10.4414/smw.2020.20257

[6] Valent F, Gallo T, Mazzolini E, Pipan C, Sartor A, Merelli M, Bontempo G, Marzinotto S, Curcio F, Tascini C. A cluster of COVID-19 cases in a small Italian town: a successful example of contact tracing and swab collection. Clin Microbiol Infect 2020;26:1112-4. https://doi.org/10.1016/j.cmi.2020.04.028

[7] Advani SD, Smith BA, Lewis SS, Anderson DJ, Sexton DJ. Universal masking in hospitals in the COVID-19 era: is it time to consider shielding? Infect Control Hosp Epidemiol 2020:1-2. https://doi.org/10.1017/ice.2020.179

[8] Prather KA, Wang CC, Schooley TT. Reducing transmission of SARS-CoV-2. Masks and testing are necessary to combat asymptomatic spread in aerosols and droplets. Science 2020;368:1422-4. https://doi.org/10.1126/science.abc6197

[9] Castagnola E, Tatarelli P, Mesini A, Baldelli I, La Masa D, Biassoni R, Bandettini R. Epidemiology of carbapenemase-producingEnterobacteriaceae in a pediatric hospital in a country with high endemicity. J Infect Public Health 2019;12:270-4. https://doi.org/10.1016/j.jiph.2018.11.003

[10] Vagelli G, Garrè ML, Garaventa A, Dufour C, Dallorso S, Mesini A, Saffioti C, Scelsi S, Vianello O, Nulchis G, Castagnola E. Specific pathways to prevent SARS-CoV-2 infection in case of repeated hospital admissions for radiotherapy. Pediatr Blood Cancer 2020;67:e28463. https://doi.org/10.1002/pbc.28463

Received on August 13, 2020. Accepted on May 3, 2021.

Correspondence: Elio Castagnola, Infectious Diseases Unit, Istituto Giannina Gaslini, largo G. Gaslini 5, 16147 Genova, Italy - Tel.: +3901056362428 - E-mail: eliocastagnola@gaslini.org

How to cite this article: La Masa D, Vianello O, Piccinini M, Mariani M, Brisca G, Saffioti C, Mesini A, Di Marco E, Castagnola E; with the collaboration of The Covid-19 Gaslini Task Force: Gattorno M, Urbano AM, Maghnie M, Ramenghi AL, Adriano M, Moscatelli A, Piccotti E, Spiazzi R, Scelsi S, Rosati U, Petralia P. Contact tracing, use of surgical masks, hand hygiene and social distancing represent a bundle of effective measures to control SARS-CoV-2 spreading among healthcare workers in a paediatric hospital. J Prev Med Hyg 2021;62:E592-E597. https://doi.org/10.15167/2421-4248/jpmh2021.62.3.1719

Supplementary data

Fig. S1. Cases of COVID-19 in Italy in 2020.

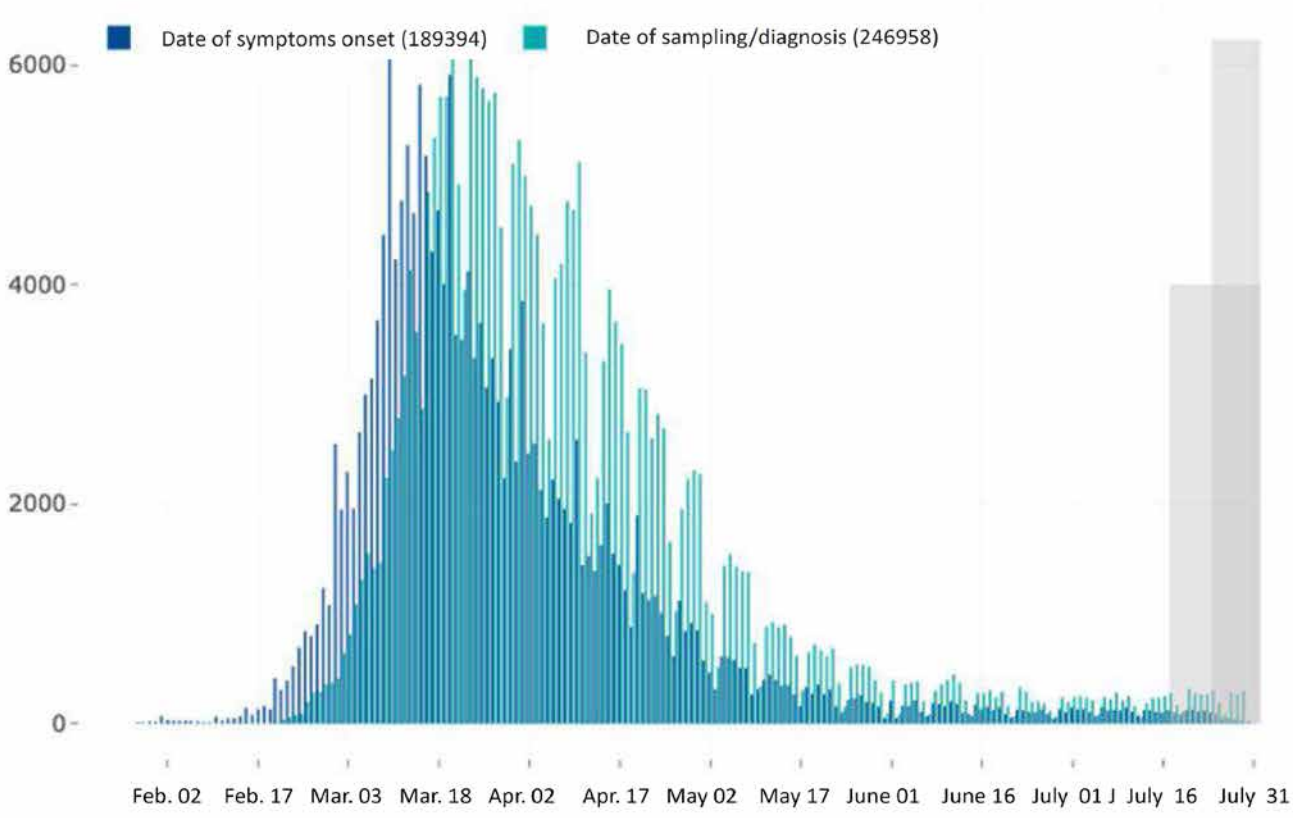
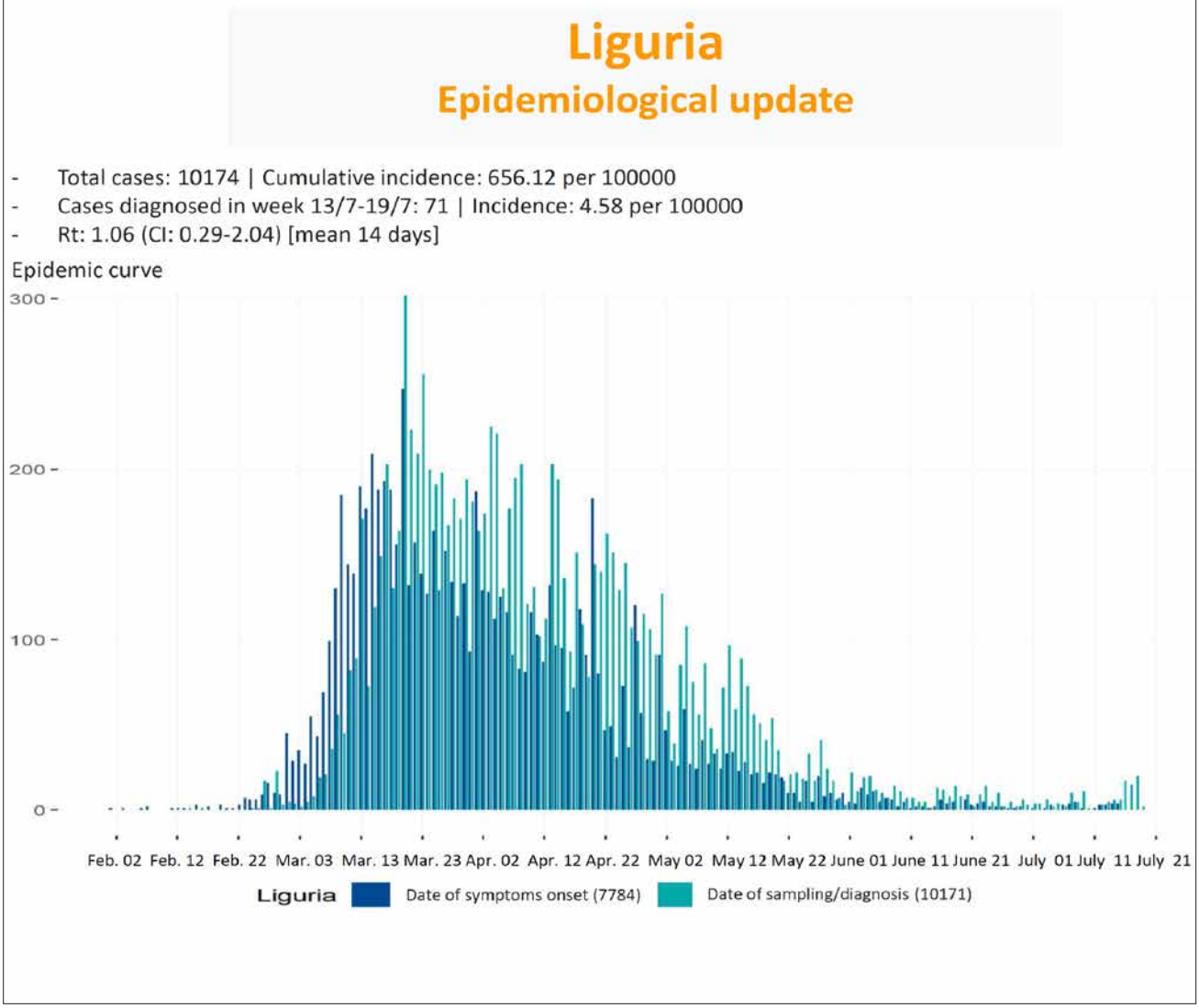


Fig. S2. Cases of COVID-19 in Liguria in 2020.



Research article

Knowledge, attitude, and practice of undergraduate medical students in Indonesia on the COVID-19 prevention

LEONARDUS YODI GIOVANNI[1], HENDARSYAH SURYADINATA[2], YULIA SOFIATIN[3], LULU EVA RAKHMILLA[3], ROVINA RUSLAMI[4]

[1] Faculty of Medicine, Universitas Padjadjaran, Bandung, Indonesia; [2] Department of Internal Medicine, Faculty of Medicine, Universitas Padjadjaran/Dr. Hasan Sadikin General Hospital Bandung, Bandung, Indonesia; [3] Department of Epidemiology and Biostatistics, Faculty of Medicine Universitas Padjadjaran, Bandung, Indonesia; [4] Department of Biomedical Sciences, Division of Pharmacology & Therapy, Faculty of Medicine Universitas Padjadjaran, Bandung, Indonesia

Keywords

Attitude • COVID-19 • Knowledge • Practice • Undergraduate medical students

Summary

Background. *Coronavirus Disease 2019 (COVID-19) caused a global pandemic since March 2020. Undergraduate medical students were encouraged to educate Indonesian society about COVID-19. This study aimed to evaluate the knowledge, attitude, and practice of Indonesian students on COVID-19 prevention.*

Methods. *An online cross-sectional study was conducted online between August 22 and September 2, 2020, with a minimum sample size of 1,068 subjects. The questionnaire was sent to 86 Faculty of Medicine (FoM) in Indonesia. The questionnaire consisted of knowledge, attitude, and practice section, with the scores above median were considered as sufficient knowledge, positive attitude, and positive practice. Association between knowledge, attitude, and practice, which were dependent variables, with gender, year of study, location of FoM, and source of information, which were independent variables, were tested using Chi-Square Test. Correlation among knowledge, attitude, and practice scores was tested using Spearman Rank Test.*

Results. *Among 1,390 participated students, 51.4, 55.7, and 56.3% had sufficient knowledge, positive attitude, and, positive practice, respectively. There were associations between knowledge and gender ($p = 0.005$), year of study ($p = 0.000$), location of FoM ($p=0.000$), and source of information ($p = 0.000$); between attitude and gender ($p = 0.022$), year of study ($p = 0.004$), and source of information ($p = 0.015$); and between practice and gender ($p = 0.000$) and source of information ($p = 0.000$). There were weak correlations between knowledge and attitude ($r = 0.246$, $p<0.001$); and between attitude and practice ($r = 0.272$, $p < 0.001$).*

Conclusions. *Half of Indonesian medical students showed sufficient knowledge, positive attitude, and positive practice on COVID-19 prevention. Hence, improvement towards COVID-19 prevention is required.*

Introduction

Coronavirus Disease 2019 (COVID-19) is an infectious disease caused by a newly discovered coronavirus, Severe Acute Respiratory Syndrome-Coronavirus-2 (SARS-CoV-2). COVID-19 was presumed to be originated from the fish market in the central Chinese city of Wuhan, Hubei province, in late December 2019 and has spread to several surrounding countries very rapidly [1, 2]. World Health Organization (WHO) declared this outbreak as a pandemic on March 11, 2020 [3]. Based on the latest data from February 6, 2021, there were 1.134.854 confirmed positive cases of COVID-19 in Indonesia, with a total number of deaths of 31.202. Indonesia still becomes the country with the highest number of cases in Southeast Asia [4].

SARS-CoV-2 is transmitted through droplets from an infected person. This droplet can infect the mucosa of the mouth, nose, or conjunctiva of the eye [5]. The most common symptoms are fever, dry cough, and malaise [6]. Due to the rapid spread and no specific treatment in place, several local governments in Indonesia set Large Scale-Social Restrictions [7].

News about COVID-19 is always broadcasted every day with the latest updated information. Various media with various credibility might mask the actual information about COVID-19. This often results in a lot of misinformation, stigma, or public panic [8]. All healthcare workers were mobilized to deal with COVID-19 patients. Education and Culture Ministor also encouraged university student to join the volunteer to prevent COVID-19 transmission [9]. Many undergraduate medical students, who would later be referred to as students, took the initiative to volunteer this program for providing counseling, information, and education about COVID-19 in order to solve misinformation circulating in the community [10]. This initiative of students to a pandemic situation encouraged them to know the essential information about COVID-19 to be role models in implementing COVID-19 prevention for the society.

Therefore, the objective research of this study was meant to explore the knowledge, attitude, and practice among medical students about preventing COVID-19 transmission. By this finding, we can measure the capability of medical students regarding a new outbreak

https://doi.org/10.15167/2421-4248/jpmh2021.62.3.1885

and can provide the policymakers to encourage the students to contribute to new oubtreaks such as COVID-19. There has been no study investigating knowledge, attitude, and practice about COVID-19 prevention only among the medical students in Indonesia to date.

Methods

This cross-sectional study used an online questionnaire distributed between August 22nd to September 2nd, 2020, to all Faculty of Medicines (FoM) in Indonesia. The questionnaire was created with Google form and distributed to representatives of each FoM via LINE, Whatsapp, and Instagram, then distributed to each batch via group chat. The subjects of this study were 1st, 2nd, and 3rd-year undergraduate medical students' batch 2019/2020 in Indonesia. All subjects were given information about the purpose of the study, confidentiality clauses, and informed consent forms. Subjects who agreed the informed consent were included in this study. The exclusion criteria were the non-response subjects and those who were not completely fulfilling the questionnaire would automatically not be submitted by the system. The required sample size was 1068 calculated for descriptive formula with confidence level of 95 and 3% margin of error. The measured variables were knowledge, attitude, and practice for dependent variables and gender, year of study, location of FoM, and source of information for independent variables.

The questionnaire consisted of respondent's characteristic, 15 knowledge questions, 12 attitude statements, and eight practice statements. Questionnaire for Knowledge assessment were multiple choices, containing aspects of epidemiology, risk factors, transmission, clinical manifestations, diagnosis, prevention, and stigma. Each correct answer was given a score of 1 and 0 for an incorrect answer, with the total score being 15. Attitude and practice were measured using five-point Likert scale (strongly agree = 5, agree = 4, neutral = 3, disagree = 2, strongly disagree = 1 for positive attitude; very frequently = 5, frequently = 4, occasionally = 3, rarely = 2, never = 1 for positive practice; in case of negative attitude and practice, reverse scoring was used). The total score for attitude and practice were 60 and 45, respectively.

Knowledge score was categorized as sufficient (if ≥ median) and insufficient (if < median). Attitude and practice scores were categorized as positive (if ≥ median) and negative (if < median). The questionnaire's validity was tested using the Pearson correlation product moment test, and the reliability test used Cronbach's Alpha test. The questionnaire had done the face validity and content validity with the research team consisted of two internists and two epidemiologists. This questionnaire has an adequate reliability and internal consistency for the practice statements, with the α Cronbach was 0.771. Data were presented descriptively and analyzed using IBM-SPSS version 25. The normality distribution of numerical data was tested using the Kolmogorov Smirnov Test. Numerical data were presented with median and interquartile range (IQR). Categorical data were presented with frequency and proportion. Data were analyzed with Chi-Square Test to elaborate association between knowledge, attitude, and practice with gender, year of study, location of FoM, and source of information; and with Spearman's Rank Test to elaborate correlation between the scores of knowledge, attitude, and practice. p-value < 0.05 was considered statistically significant.

This study has been approved by the Health Research Ethics of Universitas Padjadjaran Bandung with the ethical number 578/UN6.KEP/EC/2020.

Results

Between August 22nd to September 2nd, 2020, from 86 out of 88 FoM in Indonesia, 1,390 students responded and agreed to join this study. Almost three-quarters of respondents were female. All respondents were distributed into all years (years 1-3). Half of them were residing outside of Java Island. The majority got information about COVID-19 from unofficial sources (Tab. I).

Median (IQR) score of knowledge, attitude, and practice were 9 (9-12), 50 (47-52), and 33 (31-36), respectively. More than half of the respondents had a sufficient level of knowledge, positive attitude, and positive practice toward COVID-19 prevention (Tab. II).

Tab. I. Characteristics of undergraduate medical students (n = 1,390)

Variables	N, %
Gender	
Female	978 (70.4)
Male	412 (29.6)
Year of study	
1st-year	502 (36.1)
2nd-year	441 (31.7)
3rd-year	447 (32.2)
Location of faculty of Medicine	
Outside Java island	739 (53.2)
Java island	651 (46.8)
Source of information	
Unofficial sources	929 (66.8)
Official sources	461 (33.2)

Tab. II. Knowledge, attitude, and practice of undergraduate medical students on COVID-19 prevention.

Knowledge	
Score (median (IQR))	9 (9-12)
Sufficient (n, %)	715 (51.4)
Insufficient (n, %)	675 (48.6)
Attitude	
Score (median, IQR)	50 (47-52)
Positive (n, %)	774 (55.7)
Negative (n, %)	616 (44.3)
Practice	
Score (median (IQR))	33 (31-36)
Positive (n, %)	782 (56.3)
Negative (n, %)	608 (43.7)

Tab. III. Comparisons between knowledge, attitude, and practice with characteristic variables (n = 1,390).

Variables	Knowledge			Attitude			Practice		
	Sufficient (n, %)	Insufficient (n, %)	P-value	Positive (n, %)	Negative (n,%)	P-value	Positive (n, %)	Negative (n, %)	P-value
Gender									
Female	527 (53.9)	451 (46.1)	0.005	564 (57.7)	414 (42.3)	0.022	589 (60.2)	389 (39.8)	0.000
Male	188 (45.6)	224 (54.4)		210 (51.0)	202 (49.0)		200 (48.5)	212 (51.5)	
Year of study									
1st-year	215 (42.8)	287 (57.2)	0.000	253 (50.4)	249 (49.6)	0.004	297 (59.2)	205 (40.8)	0.200
2nd-year	231 (52.4)	210 (47.6)		248 (56.2)	193 (43.8)		253 (57.4)	188 (42.6)	
3rd-year	269 (60.2)	178 (39.8)		273 (61.1)	174 (38.9)		239 (53.5)	208 (46.5)	
Location of faculty of Medicine									
Java island	369 (56.7)	282 (43.3)	0.000	359 (55.1)	292 (44.9)	0.705	364 (55.9)	287 (44.1)	0.549
Outside of Java island	346 (46.8)	393 (53.2)		415 (56.2)	324 (43.8)		425 (57.5)	314 (42.5)	
Source of information									
Unofficial sources	443 (47.7)	486 (52.3)	0.000	496 (53.4)	433 (46.6)	0.015	492 (53.0)	437 (47.0)	0.000
Official sources	272 (59.0)	189 (41.0)		278 (60.3)	183 (39.7)		297 (64.4)	164 (35.6)	

All statistical testing used Chi-Square.

With respect to the knowledge, there were associations between knowledge and gender, year of study, location of FoM, and source of information (Tab. III). More than 60% of students answered the questions correctly on the aspects of risk factors, transmission, clinical manifestations, prevention, and stigma, except for epidemiology and diagnosis aspects (Tab. IV). With regards to the attitude, there were associations between attitude and gender, year of study, and source of information (Tab. III). Almost two-third of the students answered the questions correctly on the aspects of risk factors, transmission, clinical manifestations, diagnosis, and prevention, except for epidemiology and stigma aspects (Tab. IV). Related to the practice, there were

Tab. IV. Responses to knowledge and attitude (n = 1,390).

Knowledge		Attitude	
Aspects and questions	Correct (n, %)	Aspects and statements	Positive (n, %)
Epidemiology		**Epidemiology**	
Definition of COVID-19 death	865 (62.33)	Suitability of daily case reports of COVID-19	465 (33.5)
Aims of flattening the curve	283 (20.34)	Updating the number of deaths in suspected case daily	1,232 (88.6)
Risk factors		**Risk factors**	
Highest risk group for containing severe COVID-19	1,205 (86.69)	Not visiting grandparents if having respiratory symptoms	1,314 (94.5)
Transmission		**Transmission**	
Main route of transmission of COVID-19	1,192 (85.76)	Keeping social distancing outside	1,299 (93.5)
Clinical manifestations		**Clinical manifestations**	
Incubation period of COVID-19	1,240 (89.21)	Isolation if have COVID-19 symptoms	1,311 (94.3)
Main clinical manifestations of COVID-19	1,258 (90.5)	**Diagnosis**	
Diagnosis		COVID-19 screening by rapid test antibody	1,288 (92.7)
Category of suspect case	844 (60.71)	**Prevention**	
Category of probable case	542 (38.99)	Going outside during the rise of COVID-19 cases	842 (60.4%)
Category of close contact	868 (62.45)	Medical mask for elderly when going outside	977 (70.3%)
Category of confirmed case	1,131 (81.37)	Using mask when going outside	1,291 (92.9)
Prevention		**Stigma**	
Application of new normal	975 (70.14)	Refusing COVID-19 corpse	959 (69.0)
Preventive actions to limit COVID-19 transmission	830 (59.71)	Opening up to doctors if having COVID-19 symptoms	1,337 (96.2)
Application of large scale-social restrictions	1,073 (77.19)	COVID-19 confirmation in the whole family if 1 of their member was contracted	432 (31.1)
Criteria for resticting large-scale social restrictions	939 (67.55)		
Stigma			
Efforts to reduce stigma of COVID-19	1,097 (78.92)		

Tab. V. Responses to practice (n = 1,390).

Statements	Positive (n,%)
Giving health education about COVID-19	1,032 (74.2)
Disinfecting frequently used stuff	1,157 (83.2)
Washing hands with WHO 6 steps	1,312 (94.4)
Covering nose and mouth when sneezing or coughing	1,301 (93.6)
Touching face when hands are not washed	977 (70.3)
Eating healthy food	1,138 (81.9)
Interacting with someone who does not live with	797 (57.3)
Going outside from house	711 (51.2)

associations between practice with gender and the source of information (Tab. III). Seven out of 10 students answered the questions correctly, except for interacting with someone who did not live with and going outside from house (Tab. V).

We also elaborated the correlation among these three variables (knowledge, attitude, and practice). We found that there were weak correlations between the score of knowledge and that of attitude ($r = 0.246$, $p < 0.001$) and between the score of attitude and that of practice ($r = 0.272$, $p < 0.001$), but there was no correlation between the score of knowledge and that of practice ($r = 0.02$, $p = 0.93$).

Discussion

To our knowledge, this is the first study conducted on all undergraduate medical students throughout Indonesia about COVID-19 prevention. This study was conducted in mid-2020, five months after the COVID-19 pandemic was announced. We managed to contact 86 out of 88 FoM across Indonesia, 651 (46.8%) of the respondents resided in Java island and 739 (53.2%) of them lived outside of Java island. We classified this categorization because Java island has around half of all FoM in Indonesia. Also, since the first COVID-19 case in Indonesia arose at one spot in Java island, making the pandemic situation in Indonesia was more pronounced in many provinces in Java island [11]. Seven out of ten respondents were female. All respondents were distributed almost equally into all year of studies. The respondents mostly got information about COVID-19 from unofficial sources.

In this study, half (51.4%) of students had sufficient knowledge. This finding was lower than similar studies conducted in India, Iran, Iraq, and Uganda, where 92.7, 79.6, 91.8, and 91% of medical students had sufficient knowledge on the COVID-19, respectively [12-15].

These major differences might be due to the differences in the format of the answer to knowledge questions, in which this study was using multiple choice format. We chose this approach because this format has distractor options and therefore it can evaluate the knowledge of the students more.

Out of 15 questions related to the knowledge about COVID-19, most of the students understood about the highest risk group for containing severe COVID-19, the main route for transmission, the incubation period of COVID-19, the main clinical symptoms of COVID-19, and how to reduce the stigma of COVID-19. However, more than 60% of them answered incorrectly on the aspects of epidemiology and diagnosis, especially on the questions about flattening the curve and criteria of probable case, respectively. This information implies the necessity of education to the students about the operational definition for surveillance and the epidemiologic aspect in preventing COVID-19.

Furthermore on the knowledge, there were associations between knowledge about COVID-19 and gender, year of study, location of FoM, and source of information. Study in India did not find an association between knowledge about COVID-19 and gender among medical students [12]. Likewise, study in Iran did not find association between knowledge and gender, but found association between knowledge and source of information [13]. Study in Iraq also did not find association between knowledge and gender, but showed an association between knowledge and year of study [14].

Study in Uganda also did not find association between knowledge and gender, but found associations between knowledge and the year of study, and the source of information [15]. Regarding the association between knowledge and gender, the number of female respondents in this study might contribute to the difference with other studies, and contribute to the higher percentage of sufficient knowledge than males. In regard to the year of study, senior year students tend to have a higher percentage of sufficient knowledge, because it might be easier for them to comprehend this new disease.

Regarding the source of information, differences in the categories of this variable might contribute to the distinction to Iranian study [13]. Students who got information from the official sources had a more sufficient knowledge. This result might be due to the official sources, such as official websites of government and WHO have a more reliable and actual information [16]. Meanwhile, the unofficial sources such as social media might contain misinformation [17]. It implies that students must be encouraged to use the official sources to seek information about COVID-19, as it can be seen in this study that most students used unofficial sources and had a more insufficient knowledge about COVID-19 prevention. Location of FoM on Java island had a higher percentage of sufficient knowledge. Almost two-third of all FoM in Indonesia who are accredited with A reside in Java island [18]. The accreditation process improves the quality of medical education [19]. In addition, four out of six provinces on Java island were among ten provinces with the highest cases of COVID-19 in Indonesia during the time this study took place [20]. This might trigger medical students on Java island to learn more about COVID-19.

Regarding attitude, around half of the students (55.7%) had a positive attitude toward COVID-19 prevention. This finding was lower than that of in other studies in

India, Iraq, and Uganda, where more than 80, 90.8, and 74% had a positive attitude, respectively [12, 14, 15]. The differences in the aspects contained in the attitude statements might contribute to these findings, such as in the study in India and Uganda where there were aspects about confidence in the government for controlling COVID-19 pandemic [12, 15]. Study in Iraq also had aspects about beliefs and concerns in getting COVID-19 infections [14].

Seven out of 12 statements about attitude, which were related to the aspects of risk factors, transmission, clinical manifestations, diagnosis, and prevention were answered correctly by all the students. The students agreed on not visiting grandparents if they have respiratory symptoms during this pandemic, keeping social distance, isolating themselves when having COVID-19 symptoms, COVID-19 screening by rapid test antibody on healthy people, staying at home when COVID-19 cases still increasing, and using masks for elderly and for going outside. In spite of those aspects, 7 of 10 students answered incorrectly on the epidemiology and stigma aspects regarding the suitability of daily case reports and the contamination of COVID-19 in the whole family if one of their members is COVID-19 positive, respectively.

In this study, we found associations between attitude with gender, year of study, and source of information, which was not the case in the similar studies performed in India, Iraq, and Uganda [12, 14, 15]. Study in India did not find an association between attitude on COVID-19 prevention and gender [12]. Likewise, study in Iraq also did not find association between attitude and gender, but it showed an association between attitude and year of study [14]. Study in Uganda did not find association between attitude and year of study, but they found associations between attitude and source of information and gender: females had more negative attitude than males [15]. Concerning the association between attitude and gender, this study found that there were more females with a positive attitude than males, although both genders had a high percentage of positive attitudes. The number of female respondents could contribute to this result in this study and compared to other studies [12, 14]. This study also found a higher percentage of a positive attitude as the year of study getting more senior, which was in line with their knowledge. In addition, the number of students who used official sources with a positive attitude was higher than the unofficial sources-users, which was in line with their knowledge. Besides, this study was not found an association between attitude and location of FoM. This could be influenced by widely distributed COVID-19 news and information [21].

With respect to practice, half of the students had positive practice (56.3%). This result was similar to the finding of the study in Uganda (57%) but was lower than studies in Iran and Iraq, where 94.2 and 87% had positive practice, respectively [13-15]. Recruitment of clinical senior year students in Iran and Iraq could contribute to this finding [13, 14]. Almost three-quarter of the students implemented the positive practice in giving health education to their surroundings, routinely disinfecting stuff and washing hands with WHO 6 steps, covering nose and mouth while sneezing or coughing, rarely touching face when hands were not washed, and eating healthy food. However, around half of students frequently interacting with someone outside and going outside from home.

In this study, there was association between practice and gender, and source of information. Study in India found an association between practice towards COVID-19 and gender among medical students [12]. Likewise, study in Iraq also found associations between practice and gender, and year of study [14]. On the other hand, study in Iran did not find assocations between practice and gender, and source of information [13]. Study in Uganda also did not find association between practice and gender, and year of study, but they found associations between practice and source of information [15]. Regarding the association between practice and gender, this study found that females had a more positive practice. This might be due to a higher concern in females about COVID-19 [22]. Females were also found to have a higher fear of COVID-19 [23]. This could affect their health behavior compliance [24]. This finding was inconsistent to the studies in Iran and Uganda, as it might be caused by the different aspects in practice questions of Iranian study [13]. Also, over four-fifth of the medical students in Uganda were invloved in health education about COVID-19 [15]. As well as for the knowledge and attitude, more students with a positive practice used official sources than unofficial sources, even though both sources had a higher percentage of positive practice. No association between practice and year of study was found in this study. This was in contrast to the study in Iraq, and might because of the difference in the study population [14]. This study also showed that there was no association between practice and the location of FoM. Massive COVID-19 news could contribute to these findings [21].

Theoretically, attitude has a cognitive component (knowledge). This attitude affects the individual's intention which influences their practice [25]. In addition, practice is affected by the cognitive factors [26]. Therefore, we evaluated the correlation between knowledge and attitude, attitude and practice, and knowledge and practice. We found that knowledge on COVID-19 prevention was weakly correlated with attitude. Likewise, attitude was weakly correlated with practice. Surprisingly, knowledge was not correlated with practice. The explanation might be the strength of the correlation between knowledge and attitude as well as between attitude and practice. This study found the correlation between knowledge and attitude was weak ($r = 0.24$), and also for attitude and practice ($r = 0.21$). This explained there were a lot of factors affecting attitude, as well as practice. Another explanation might be due to the lack of awareness in this study population on implementing COVID-19 prevention. In addition, during this study, the information about COVID-19 was still developing, along with the rapid spread of updated

information and no specific vaccine or treatment available, they might contribute to the skeptical attitude in this study population. Hence, it could be accepted that correlation was not found between knowledge and practice in this study.

This study is not free from the limitations. As this is an online survey, we could not ensure whether there were fraudulent acts when the respondents answered the questionnaire [27]. However, this type of study would be justifiable to be conducted because of the ongoing pandemic situation. Second, as this is a cross-sectional study design, which capture the data at one point in time, the determinants found in this study need to be further verified [28]. Third, the presence of temporal influences, where this study was conducted five months after the COVID-19 pandemic was announced. The results of this study might be different if it were carried out the study later.

Conclusions

Only around half of undergraduate medical students in Indonesia had sufficient level of knowledge, positive attitude, and positive practice toward COVID-19 prevention. This indicated that only half of the students had a notable concern this new pandemic. Knowledge on COVID-19 prevention was associated with gender, year of study, location of FoM, and source of information. Attitude toward the COVID-19 prevention was associated with gender, year of study, and source of information. Meanwhile the practice of COVID-19 prevention was associated with gender and source of information. There were weak correlations between knowledge and attitude and between attitude and practice.

This study implied that efforts are needed to improve knowledge, attitude, and practice of the medical students in Indonesia about COVID-19 prevention, before they can be deployed to provide proper counselling, information, and education to Indonesian society. Hence, they could have the capacity to play a role through health education about preventing COVID-19 transmission to Indonesian society. Students could be encouraged to use credible sources for actual and more accurate information about COVID-19.

Increasing students' knowledge might contribute to increasing attitude and practice in preventing COVID-19 transmission. These findings can be used as a parameter for making public policy to prepare the students in the prevention of COVID-19 pandemic or other outbreaks.

Acknowledgements

Funding sources: this research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

The authors thank to all the participants for their contribution in this study.

Conflict of interest statement

The authors declare no conflict of interest.

Authors' contributions

LYG was responsible for preparation of the study, data collection, data analysis, and writing the manuscript. YS contributed in the study design and preparation of the questionnaire. LER contributed in the study design. HS and RR contributed in the conception and design of the study, data analysis, and finalizing the writing of the manuscript [1].

References

[1] Lu H, Stratton CW, Tang YW. Outbreak of pneumonia of unknown etiology in Wuhan China: the mystery and the miracle. J Med Virol 2020;92:401-2. https://doi.org/10.1002/jmv.25678

[2] Ge H, Wang X, Yuan X, Xiao G, Wang C, Deng T, Ge H, Wang X, Yuan X, Xiao G, Wang C, Deng T, Yuan Q, Xiao X. The Epidemiology and Clinical Information about COVID-19. Eur J Clin Microbiol Infect Dis 2020;39:1011-9. https://doi.org/10.1007/s10096-020-03874-z

[3] Cucinotta D, Vanelli M. WHO Declares COVID-19 a pandemic. Acta Biomed 2020;91:157-60. https://doi.org/10.23750/abm.v91i1.9397

[4] World Health Organization. WHO Coronavirus Disease (COVID-19) Dashboard. https://covid19.who.int/table (accessed on 02/07/2021).

[5] Han Y, Yang H. The transmission and diagnosis of 2019 novel coronavirus infection disease (COVID-19): a Chinese erspective. J Med Virol 2020;92:639-44. https://doi.org/10.1002/jmv.25749.

[6] Rothan HA, Byrareddy SN. The epidemiology and pathogenesis of coronavirus disease (COVID-19) outbreak. J Autoimmun 2020;109:497-506. https://doi.org/10.1016/j.jaut.2020.102433

[7] Ariawan I, Jusril H. COVID-19 in Indonesia: where are we? Acta Med Indones 2020;52:193-5.

[8] Shimizu K. 2019-nCoV, fake news, and racism. Lancet 2020;395:685-6. https://doi.org/10.1016/S0140-6736(20)30357-3

[9] The Jakarta Post. 'Our country is at war': Education Minister Nadiem Makarim calls on students to join fight against COVID-19. https://www.thejakartapost.com/news/2020/03/26/our-country-is-at-war-education-minister-nadiem-makarim-calls-on-students-to-join-fight-against-covid-19.html (accessed on 02/07/2021).

[10] Lazarus G, Mangkuliguna G, Findyartini A. Medical students in Indonesia: an invaluable living gemstone during coronavirus disease 2019 pandemic. Korean J Med Educ 2020;32:237-41. https://doi.org/10.3946/kjme.2020.165

[11] Eryando T, Sipahutar T, Rahardiantoro S. The risk distribution of COVID-19 in Indonesia: a spatial analysis. Asia Pacific J Public Health 2020;32:1-3. https://doi.org/10.1177/1010539520962940

[12] Maheshwari S, Gupta P, Sinha R, Rawat P. Knowledge, attitude, and practice towards coronavirus disease 2019 (COVID-19) among medical students: a cross-sectional study. J Acute Dis 2020;9:100-4. https://doi.org/10.4103/2221-6189.283886

[13] Hossein Taghrir M, Borazjani R, Shiraly R. COVID-19 and Iranian medical students; a survey on their related-knowledge, preventive behaviors and risk perception. Arch Iran Med 2020;23:249-54. https://doi.org/10.34172/aim.2020.06

[14] Khalil NS, Al-Yuzbaki DB, Tawfeeq RS. Covid-19 - knowledge,

attitude and practice among medical undergraduate students in Baghdad city. EurAsian J Biosci 2020;14:4179-86.

[15] Olum R, Kajjimu J, Kanyike AM, Chekwech G, Wekha G, Nassozi DR, Olum R, Kajjimu J, Kanyike AM, Chekwech G, Wekha G, Nassozi DR, Kemigisa J, Mulyamboga P, Muhoozi OK, Nsenga L, Lyavala M, Asiimwe A, Bongomin F. Perspective of medical students on the COVID-19 pandemic: survey of nine medical schools in Uganda. JMIR Public Heal Surveill 2020;6:e19847. https://doi.org/10.2196/19847

[16] World Health Organization. Mental health and psychosocial considerations during the COVID-19 outbeak. Geneva: WHO 2020.

[17] Lai CC, Shih TP, Ko WC, Tang HJ, Hsueh PR. Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) and coronavirus disease-2019 (COVID-19): the epidemic and the challenges. Int J Antimicrob Agents 2020;55:105924. https://doi.org/10.1016/j.ijantimicag.2020.105924

[18] Indonesian Accreditation Agency for Higher Education in Health. Directory of Accreditation Results - IAAHEH. https://lamptkes.org/en/Search-Result-of-Accreditation-Result-Database?_token=B2Dv0ZqYGWF6dnVMqZwfmyTAMHVMaoIrZLEfitRF&_method=patch&jenjang=sarjana&nama_pt=&nama_ps=pendidikan+Dokter&thn=&cek=masih+berlaku&ok= (accessed on 02/07/2021).

[19] Al Mohaimeed A, Midhet F, Barrimah I. Academic accreditation process: experience of a medical college in Saudi Arabia. Int J Health Sci (Qassim) 2012;6:23-9. https://doi.org/10.12816/0005970

[20] World Health Organization (WHO) Indonesia. Coronavirus disease 2019 (COVID-19) situation report - 22. Jakarta: WHO 2020.

[21] Rathore FA, Farooq F. Information overload and infodemic in the COVID-19 pandemic. J Pakistan Med Assoc 2020;3:S162-5. https://doi.org/10.5455/JPMA.38

[22] Fancourt D, Steptoe A. COVID-19 Social study results release 8. London: University College 2020.

[23] Broche-Pérez Y, Fernández-Fleites Z, Jiménez-Puig E, Fernández-Castillo E, Rodríguez-Martin BC. Gender and fear of COVID-19 in a Cuban population sample. Int J Ment Health Addict 2020;1-9. https://doi.org/10.1007/s11469-020-00343-8

[24] Harper CA, Satchell LP, Fido D, Latzman RD. Functional fear predicts public health compliance in the COVID-19 pandemic. Int J Ment Health Addict 2020;1-14. https://doi.org/10.1007/s11469-020-00281-5

[25] Jain V. 3D model of attitude. Int J Adv Res Manag Soc Sci 2014;3:1-12.

[26] Glanz K, Rimer BK, Viswanath K. Health behavior theory, research, and practice. Vol. 38. United States: Jossey-Bass 2009.

[27] Ball HL. Conducting online surveys. J Hum Lact 2019;35:413-7. https://doi.org/10.1177/0890334419848734

[28] Wang X, Cheng Z. Cross-sectional studies: strengths, weaknesses, and recommendations. Chest 2020;158:S65-71. https://doi.org/10.1016/j.chest.2020.03.012

Received on February 23, 2021. Accepted on April 30, 2021.

Correspondence: Rovina Ruslami, Department of Biomedical Sciences, Division of Pharmacology & Therapy, Faculty of Medicine Universitas Padjadjaran, Bandung, Indonesia - E-mail: rovina.ruslami@unpad.ac.id

How to cite this article: Giovanni LY, Suryadinata H, Sofiatin Y, Rakhmilla LE, Ruslami R. Knowledge, attitude, and practice of undergraduate medical students in Indonesia on the COVID-19 prevention. J Prev Med Hyg 2021;62:E598-E604. https://doi.org/10.15167/2421-4248/jpmh2021.62.3.1885

Research article

COVID-19 pandemic: determinants of workplace preventive practice among primary healthcare workers in Sabah, Malaysia

SAM FROZE JIEE, ANISAH JANTIM, AHMAD FIRDAUS MOHAMED, MUHAMMAD EZMEER EMIRAL
Penampang District Health Office, Sabah State Health Department, Ministry of Health Malaysia

Keywords

COVID-19 pandemic • Burnout • Preventive practice • Primary healthcare workers • Sabah • Malaysia

Summary

Introduction. *COVID-19 pandemic has placed the entire world, including Malaysia in a state of fear. The rising burden on healthcare facilities has put healthcare workers consistently at risk of healthcare-associated infection. We sought to identify determinants of preventive practice against COVID-19 at work among primary healthcare professionals in Sabah, Malaysia.*
Method. *This was a cross-sectional study involving healthcare workers of the Penampang and Putatan districts of Sabah, Malaysia. A total of 167 health professionals from primary healthcare settings took part in this study via a self-administered questionnaire from November 2020 until January 2021. Independent t-test and Analysis of Variance were used to determine differences in preventive practice for categorical independent variables. Pearson product-moment correlation was applied to assess the relationship between Job Satisfaction, burnout, and preventive practice. Subsequently, predictors of preventive practice at work among healthcare workers in Sabah were identified through Binomial Logistic Regression.*
Results. *The prevalence of good preventive practice among health professionals at work was 71.3%. There was no difference in preventive practice between professions. Almost all participants reported having good personal protective equipment compliance and hand hygiene practice at work. Marital status (AOR = 4.170, 95% CI = 1.787, 9.733; p = 0.001), average sleep hours (AOR = 1.775, 95% CI = 1.144, 2.754; p = 0.01), and pandemic-related burnout (AOR = 0.905, 95% CI = 0.847, 0.967; p = 0.003) were identified as significant predictors of preventive practice at primary healthcare facilities.*
Conclusions. *The outcome of this study is beneficial to the healthcare organization. It can serve as a useful guide to tackle issues related to poor preventive practice against COVID-19 at work for health professionals.*

Introduction

The COVID-19 pandemic has caused great pressure on healthcare systems globally. Malaysia was experiencing a surge of cases with the state of Sabah reported a total of 51,115 cases (until 12th February 2021) since the first reported case in Malaysia on 4th February 2020 [1]. From 1st September 2020 until 31st January 2021, the districts of Penampang and Putatan reported a total of 2848 and 1528 COVID-19 cases respectively. Healthcare workers or more familiarly known as the *frontliners* are expected to adhere to strict safety and health guidelines in their daily tasks. Healthcare workers involved in the preventive, control, and treatment of COVID-19 are at risk of infecting themselves and others by inhaling droplets from sick patients and contact with contaminated surfaces [2]. When it comes to activities related to the management of COVID-19, the health and safety of the health workforce should take precedence. The Ministry of Health has provided guidelines on infection prevention and control (IPC) to lessen the risk of disease transmission. IPC guidelines include the proper usage of personal protective equipment (PPE) like face masks, face shields, gowns, gloves, and more stringent sanitization routines [3].

Failure to comply with the standard practice of occupational safety and health will put healthcare workers at great risk of getting Healthcare-Associated Infection (HAI) such as COVID-19, Middle East Respiratory Syndrome-Coronavirus, and tuberculosis [4]. On 18th December 2020, the Ministry of Health reported a total of 1771 healthcare workers were infected with COVID-19 [5]. Even though not all were attributed to nosocomial infection, the health setting is undeniably the most hazardous environment for every healthcare worker. Studies elsewhere have shown there are intrinsic and extrinsic factors that could jeopardize the practice of occupational safety and health in healthcare settings [6, 7]. Among the most significant factors is occupational burnout. Burnout is defined as a state of physical, emotional, and mental exhaustion that results from long-term involvement in work situations that are emotionally demanding [8]. In the past two decades, the world has witnessed several deadly viral outbreaks (SARS, MERS-CoV, Ebola) and their impact on the health workforce of the affected countries [9]. A study conducted in South Korea during the MERS-CoV outbreak in 2015 reported the presence of burnout among Emergency Department Nurses which were influenced by both exogenous and endogenous factors [10]. Regardless of the reason, if left unaddressed, it will affect the wellbeing of both the health workforce and the

organization. To date, there is no research to study the determinants of good compliance on preventive practice among the health workforce in the state of Sabah, in both primary healthcare and hospital settings.

International borders were closed with movement restrictions on state and district borders has affected healthcare workers and their families as well, causing excessive negative psychological effects [11]. Case overload could threaten the well-being of our health workforce. In this scenario, understanding factors that could influence healthcare workers' compliance towards the preventive practice of COVID-19 at work is vital to provide the necessary interventions. Therefore, the main objective of this study is to identify the determinants of preventive practice at work among primary healthcare workers in Sabah during the COVID-19 pandemic.

Methods

Study setting, design and sampling

Sabah is the second largest state in Malaysia and it is located in Borneo Island alongside Sarawak and neighboring countries namely Brunei and Indonesia [12]. Penampang is located on the west coast of Sabah, Malaysia with a size of 424.73 square kilometers. It is located approximately 9 km from the capital city of Sabah, Kota Kinabalu and about two-thirds of its area is highland and natural forest. Public primary healthcare facilities in Penampang are District Health Office, Penampang Health Clinics, Terian Health Clinic, two community clinics (Cyber Square and Bundusan), and four Rural Clinics (Nosoob, Limbanak, Moyog, and Babagon). The district of Putatan is also located at the west coast region of Sabah. Primary healthcare facilities in Putatan are the District Health Office, Putatan Health Clinic, Putatan Jaya Community Clinic, and Petagas Rural Clinic. Primary healthcare services comprise detection, prevention, and control activities of COVID-19.

This was a health facility-based cross-sectional study involving governmental primary healthcare workers of Penampang and Putatan Sabah. It was carried out from December 2020 until February 2021. Doctors, Nurses, Assistant Medical Officers, Assistant Environmental Health Officers, Pharmacists, Science Officers, Occupational/ Physiotherapists were recruited via convenience sampling. All primary healthcare workers of Penampang and Putatan districts were eligible to participate (n = 409). After participants were briefed on the research objective, self-administered questionnaires were given via online google form. Their daily tasks were not interrupted by this project. Out of 409 healthcare workers, a total of 167 took part in this study (response rate = 40.8%). Those who consented were briefed on this study. Then self-administered questionnaires (google form) were given to them.

Instrument

A structured questionnaire was generated from literature review and validated questionnaires. It consist of 6 constructs: sociodemographic characteristics, working environment, Risk assessment and information on Personal Protective Equipment, Copenhagen Burnout Inventory, Job Satisfaction, and preventive practice against COVID-19. Copenhagen Burnout Inventory contains 3 domains with a total question of 22: personal burnout (5 questions), work-related burnout (7 questions), and pandemic-related burnout (10 questions). The first and second domains were adopted from the Malay Version of the Copenhagen Burnout Inventory by Andrew Chin and Colleagues [13]. Simultaneously, Pandemic related burnout component was adopted from a study by Khasne R. and Colleagues on healthcare workers in India [14]. Job Satisfaction was a 5-point Likert scale measurement (strongly disagree, disagree, unsure, agree and strongly agree) questionnaire with a total of 7 questions and was adopted from Leggat, S., and Colleagues [15]. Questions on Preventive practice at work were adopted from the study by Asemahagn, M.'s study in Ethiopia which consists of 9 questions [6]. For every question, the respondents were required to choose one answer out of 3 options (never, occasionally, and always). The overall preventive practice score was computed from 9 questions with a possible maximum score of 27 and a minimum score of 0. Participants who scored less than the mean value were classified as having poor preventive practice. The higher the score, the better the preventive practice.

Statistical analysis

First, data were coded and analyzed using Statistical Package for Social Science (SPSS) version 23. All the data were carefully checked and cleaned in Microsoft Excel before analysis in SPSS. Descriptive analysis was performed to determine frequency, percentage, mean, median, and standard deviation. It was used to describe the basic features of the data in this study. Descriptive statistics provided a simple summary of the sample and its measures. Before logistic regression, bivariate analysis was performed and all the independent variables with a p-value of less than 0.2 were selected to be analyzed in multivariate analysis. For categorical data, the Chi-square test was used to assess the relationship between the independent variables and preventive practice. Pearson correlation coefficient was applied to measure the linear association between two continuous variables. Subsequently, Binomial logistics regression was used to determine the predictors of preventive practice at the workplace. The dependent variable consists of two categories: good and poor preventive practice. Outliers, assumptions, multicollinearity, and interactions were checked. An odd ratio of more than one indicates an increased odd that affects preventive practice at work among health professionals an odds ratio of less than one indicates the opposite result. A p-value of less than 0.05 was considered statistically significant.

Ethical consideration

Medical Research and Ethics Committee of the Ministry of Health Malaysia granted approval to conduct this research [NMRR-20-2554-57340 (IIR)]. Participation

in this research was voluntary and confidentiality of information was assured.

Results

A total of 167 respondents took part in this study and all of them were Malaysians. Sociodemographic characteristics were presented in Table I alongside the difference in preventive practice. All our respondents were healthcare workers, aged between 21 to 56 years old with an interval of 35 years. The mean age of respondents was 35.2 (7.36) years. Approximately half of the respondents (43.1%) were from the age group of 31 to 40 years old. A majority of respondents were married (70.1%) and more than half of them (65.3%) obtained cert/diploma/secondary education. Based on the profession, the majority of them were nurses (35.9%), followed by doctors (20.4%) and Assistant Medical Officers (17.4%). Other support staff such as Assistant Environmental Health Officer, Public Health Assistant comprised 26.3%.

Most of them (43.5%) have working experience of more than 10 years, average weekly working hours of 41-60 hours (53.3%), and average sleep of 6 hours or less daily (67.1%). A total of 40.7% of the respondents lived more than 10 km from their workplace. A vast majority of

Tab. I. Socio demographic characteristics of respondents.

Variables	Frequency (%)	Mean (SD)/median	Preventive practice at work		P-value
			Poor	Good	
Age					
Below 30	54 (32.3)	35.2(7.36) Median 34.0	17 (31.5)	37 (68.5)	0.747
31 to 40	72 (43.1)		21 (29.2)	51 (70.8)	
Above 40	41 (24.6)		10 (24.4)	31 (75.6)	
Mean (SD)					
Gender					
Male	54 (32.3)		21 (38.9)	33 (61.1)	**0.045***
Female	113 (67.7)		27 (23.9)	86 (76.1)	
Marital status					
Married	117 (70.1)		25 (21.4)	92 (78.6)	**0.001***
Unmarried	50 (29.9)		23 (46.0)	27 (54.0)	
Education					
Cert/diploma and below	109 (65.3)		31 (28.4)	78 (71.6)	0.906
Tertiary education	58 (34.7)		17 (29.3)	41 (70.7)	
Designation					
Doctor	34 (20.4)		11 (32.4)	23 (67.6)	0.070
Nurse	60 (35.9)		10 (16.7)	50 (83.3)	
Medical Assistant	29 (17.4)		10 (34.5)	19 (65.5)	
Others	44 (26.3)		17 (38.6)	27 (61.4)	
Working experience					
Less than 5 years	30 (17.9)	10.8(7.03) Median 9.0	9 (30.0)	21 (70.0)	0.632
5 to 10 years	65 (38.7)		21 (32.3)	44 (67.7)	
More than 10 years	72 (43.5)		18 (25.0)	54 (75.0)	
Comorbids					
Yes	33 (19.8)		8 (24.2)	25 (75.8)	0.524
No	134 (80.2)		40 (29.9)	94 (70.1)	
Average sleep hour					
6 hours and less	112 (67.1)	6.1 (1.07) Median 6.0	37 (33.0)	75 (67.0)	0.080
More than 6 hours	55 (32.9)		11 (20.0)	44 (80.0)	
Working duration (weekly)					
40 hours and below	38 (22.8)	54.1 (14.46) Median 50.0	7 (18.4)	31 (81.6)	0.230
41-60 hours	89 (53.3)		23 (25.8)	66 (74.2)	
More than 60 hours	40 (24.0)		18 (45.0)	22 (55.0)	
Elderly family members at home					
Yes	46 (27.5)		9 (19.6)	37 (80.4)	0.106
No	121 (72.5)		39 (32.2)	82 (67.8)	
PPE discomfort					
Yes	88 (52.7)		32 (36.4)	56 (63.6)	**0.022***
No	79 (47.3)		16 (20.3)	63 (79.7)	
House distance					
Less than 5 km	45 (26.9)		10 (22.2)	35 (77.8)	0.162
5-10 km	54 (32.3)		13 (24.1)	41 (75.9)	
More than 10 km	68 (40.7)		25 (36.5)	43 (63.2)	
Treated as PUI*					
Yes	90 (53.9)		28 (31.1)	62 (68.9)	0.465
No	77 (46.1)		20 (26.0)	57 (74.0)	

PUI: Person Under Investigation, * P < 0.05 is considered significant.

respondents have no comorbid (80.2%) and not staying with an elderly family member (72.5%). Half of the respondents claimed to have discomfort when wearing Personal Protective equipment at work (52.7%). Since the beginning of this pandemic (up to the end of the data collection phase), a total of 90 respondents (53.9%) had a history of quarantine due to contact with positive cases or interstate traveling.

Bivariate analysis reported several factors associated with good COVID-19 preventive practice at the workplace. Female respondents have better preventive practice compared to male respondents. Married participants were reported to have better preventive practice than the unmarried participants. Respondents with discomfort when wearing PPE reported to have poorer preventive practice than those without discomfort when wearing PPE. Pearson product-moment correlation was run to determine the relationship between preventive practice against COVID-19 and Job Satisfaction, personal burnout, work burnout and pandemic burnout. There was a correlation between Job Satisfaction and preventive practice against COVID-19 which was statistically significant ($r = 0.235$, $n = 167$, $p = 0.002$). Burnout was also found to have effect on preventive practice against COVID-19. Personal burnout ($r = .-0.242$, $n = 167$, $p = 0.002$), work burnout ($r = -.306$, $n = 167$, $p < 0.001$) and pandemic burnout ($r = -0.305$, $n = 167$, $p < 0.001$) has negative correlation towards preventive practice against COVID-19 and were statistically significant.

A vast majority of healthcare workers, 163 (97%) regularly throw used tissue into the dustbin when they were at work (Tab. II). Almost all respondents (98.2%) frequently wash their hands, regularly wear face masks/face shields (98.8%) at work, and no longer practice handshaking (91.7%). More than half of the respondents (60.7%) still occasionally practice table sharing during lunch break with their colleagues. A total of 71 (42.3%) participants claimed that their workplace/room/cubicle was occasionally crowded. Half of the respondents [89 (53.0%)] occasionally touch their eyes, nose, or mouth when they are at work and a total of 126 (75.0%) respondents always practice social distancing as recommended by World Health Organization. A total of 117 (69.9%) respondents always disinfect their belongings, table, and working room.

Binomial logistic regression was used to determine the predictors of good preventive practice among healthcare workers in Sabah (Tab. III). The logistic regression model

Tab. II. Preventive practice among healthcare workers.

Variables	Never n (%)	Occasionally n (%)	Always n (%)
Do you throw used tissue safely in a dustbin?	3 (1.8)	2 (1.2)	163 (97.0)
Do you use frequent handwashing with water and soap /or alcohol-based bund rub sterilizer as per recommended?	0 (0.0)	3 (1.8)	165 (98.2)
Do you routinely wear a facemask / face shields at work?	0 (0.0)	2 (1.2)	166 (98.8)
Do you and your colleague eat together at workplace (same table)?	33 (19.6)	102 (60.7)	33 (19.6)
Is your workplace/room/cubicle crowded?	57 (33.9)	71 (42.3)	40 (23.8)
Do you practice handshaking?	154 (91.7)	11 (6.5)	3 (1.8)
Do you touch your eyes, nose or mouth when you are at work?	71 (42.3)	89 (53.0)	8 (4.8)
Do you practice social distancing recommended by the WHO?	7 (4.2)	35 (20.8)	126 (75.0)
Do routinely disinfect your own belongings, surfaces table and working room?	10 (6.0)	41 (24.4)	117 (69.9)

Tab. III. Predictors of prevention practice against COVID-19 among healthcare workers at work.

Variables	Crude OR (95% CI)	Adjusted OR (95% CI)	P value
Gender	1.253 (0.410-3.836)		0.692
Marital status	5.788 (1.871-17.906)	4.170 (1.787-9.733)	**0.001**
Designation			
Doctor			0.058
AMO*	0.900		0.886
Nurse	1.504		0.616
Others	0.232		0.063
Average sleep hours	1.671 (1.011-2.763)	1.775(1.144-2.754)	0.010
Working duration	0.986 (0.956-1.017)		0.365
Elderly at home	3.108 (1.032-9.355)		0.059
PPE discomfort	0.787 (0.314-1.974)		0.610
House distance	1.600 (0.661-3.871)		0.297
Treated as PUI	1.385 (0.535-3.587)		0.503
Job satisfaction	1.207 (1.076-1.355)	1.145(1.050-1.248)	0.002
Personal burnout	1.018 (0.834-1.242)		0.864
Work related burnout	1.019(0.865-1.199)		0.825
Pandemic related burnout	0.882(0.781-0.996)	0.905(0.847-0.967)	0.003

AMO: Assistant Medical Officer; Model of chi square (df): 47.99 (4) p-value < 0.001; n = 167; Hosmer and Lemeshow Test p-value = 2.368 > 0.05; CI: Confidence Interval; OR: Odd Ratio; [a] Logistic Regression (no multicollinearity, assumptions were all met); Dependant variables: preventive practice against COVID-19 at work (poor *vs* good).

was statistically significant, $\chi^2(4) = 47.99$, $p < 0.001$. The model explained 35.7% (Nagelkerke R^2) of the variance in preventive practice and correctly classified 71.3% of cases. The outcome variable was dichotomous and selected independent variables from socio-demographic characteristics, working environment, risk assessment, and information of Personal Protective Equipment including continuous variables: Copenhagen Burnout Inventory and Job Satisfaction. Married respondents were 4.170 times more likely to have better preventive practice than unmarried respondents (95% CI: 1.787, 9.733; p = 0.001). Every unit of adequate sleep will increase preventive practice by 1.775 times (95% CI: 1.144, 2.754; p = 0.01). Every unit increase in burnout (pandemic related) score, there was a 10% decrease in odds of having good preventive practice (95% CI: 0.847, 0.967; p = 0.003). With every unit of increment in Job Satisfaction, preventive practice improves by 1.15 times with AOR: 1.145 (95% CI: 1.050-1.248). However, the 95% CI of the OR was reported to be 1.050 times and 1.24 times. Therefore, Job Satisfaction was not a significant predictor for the preventive practice among primary healthcare workers in Sabah because the lowest point of 95% CI was near 1.0.

Discussion

To the best of our knowledge, this study was one of the first to assess the level of preventive practice at the workplace among primary healthcare workers in Malaysia. Compliance with good occupational safety and health protocols among healthcare workers is vital to reduce the risk of contracting COVID-19. Healthcare workers are the most important resources in the war against this devastating pandemic. Good workplace health and safety practice against infection is important to prevent health professionals from contracting Healthcare-Associated Infection (HAI) such as COVID-19. Our analysis discovered substantial determinants of preventive practice against COVID-19 among healthcare workers at the workplace.

In this study, the prevalence of good overall preventive practice against COVID-19 in healthcare settings was 71.3%. However, it is vital to acknowledge that almost all health professionals who took part in this study constantly wear personal protective equipment such as face mask/face shield at work and regularly practice good hand hygiene. Similar findings were reported in other developing countries namely Ethiopia, Nepal, and China [16-18]. Good hand hygiene practice and adherence to personal protective equipment were two of the most important preventive measure to repel nosocomial infection. Even though gloves were worn during certain clinical procedures and disease control activities in the field, it is not a substitute for handwashing. The World Health Organisation (2009) reported that a simple procedure such as hand hygiene can reduce the global burden of Healthcare-Associated Infection [19]. Furthermore, supplies of alcohol-based sanitizers and personal protective equipment in healthcare settings have been consistently sufficient throughout this pandemic.

Chi-square analysis reported that there was a significant difference in preventive practice at work between males and females. Female respondents have better preventive practices than male respondents. Similar findings were reported among healthcare workers in Saudi Arabia whereby female nurses practice better infection control practice compared to male nurses [20]. Nevertheless, logistic regression indicated that gender was not a predictor of preventive practice among healthcare workers in Sabah. A similar finding was reported among healthcare workers in Lebanon and Pakistan [21, 22].

It is not surprising that the education level of healthcare workers did not influence COVID-19 preventive practice as studies in other developing countries reported similar findings [16, 20]. The preventive practice among healthcare was also not influenced by their profession. Furthermore, it is worth noting that respondents with higher educational backgrounds such as tertiary education are in the management and professional group. Thus, an intervention can be focused on healthcare workers in general regardless of their rank and position. Marital status significantly affects preventive behaviours in our study. Married healthcare workers have better preventive practices than unmarried healthcare workers. A study in Saudi Arabia reported a similar finding [20]. Al-Dossary and colleagues conducted studies among nurses in Saudi Arabia and postulated that married healthcare workers have better preventive practice than unmarried healthcare workers. This might be attributed to one's responsibility to prevent infecting family members.

Job Satisfaction improves preventive practice at work for healthcare providers. Our study reported that healthcare workers with good Job Satisfaction practice better COVID-19 preventive behaviour. It was not surprising to discover that burnout affects the preventive practice of health professionals other than their work performance. This was supported by the findings of Appleton K and Colleagues in their study on the general practitioners in Leeds, England [23]. Job Satisfaction can be influenced by the level of motivation. One study in Indonesia demonstrated that Infection Prevention Control Practice among healthcare workers improves with better motivation levels [24]. Good sleeping habit promotes better preventive behaviours, job performance and quality of service [25, 26]. Sleeping disorders can also cause metabolic disturbances. Our study reported that lack of sleep leads to the poor preventive practice of health professionals at the workplace. Sleep deprivation leads to error which lead to poor infection control practice among healthcare workers. It is interesting to note that certain demographic variables like age and working experience do not significantly affect one's preventive behaviour.

Our study suggested that pandemic-related burnout negatively influenced preventive practice among healthcare workers. Burnout can seriously affect the physical and mental health of health professionals which can lead to low productivity, absenteeism, and accident

at the workplace [27]. Experience from the SARS pandemic revealed that burnout during a pandemic can be devastating and long-lasting which leads to serious effects on the well-being of healthcare providers [28]. Failure to address issues related to burnout can lead to low productivity, reduced Job Satisfaction, and intention to leave a job. Burnout can be addressed according to its severity [29]. The work-life balance needs to be optimized. Several issues such as flexible schedule, childcare, and work hours need to be taken into consideration to address the well-being of employees. Early prevention of burnout is important to avoid the need of pharmacological intervention. Health services managers should be attentive and those who are having burnout must get adequate rest. Counselling service should be provided as well. At the same time, we must monitor for alcohol and substance abuse. Some health facilities have taken the initiative to provide portable beds for their healthcare workers to rest on their break. A power nap as short as 10-20 minutes can help healthcare workers with extended working hours to rejuvenate [30]. Discomfort when wearing PPE significantly affects preventive behaviour among healthcare workers. This was supported by findings from studies in Nigeria and Saudi Arabia [31, 32]. However, PPE discomfort was not a significant predictor in logistic regression. It has been almost a year since the first reported COVID-19 case in Malaysia. Thus, we can expect that awareness of the importance of PPE compliance at work has been relatively increased. Adherence to face masks and face shields also reduce face touching behaviours, supported by Chen, Y., and colleagues who reported similar findings among healthcare workers in China [33]. PPE such as face masks could be contaminated especially during the process of doffing. Thus, constant awareness is important to educate on the importance of hand hygiene before touching their face, nose, eyes, or mouth after removing PPE. Correspondingly, proper disposal of clinical waste needs to be regularly monitored by the designated Infection Control team in health facilities.

Having comorbidities did not significantly influence preventive practice among healthcare workers. This contradicted the finding of Asemahagn who conducted a study on health professionals in Ethiopia. Coincidentally there were no disparities in preventive practice between people who were treated as Person Under Investigation for COVID-19 (PUI) and those who never undergo quarantine. The magnitude of fear among those with chronic illness in contracting COVID-19 was higher compared to those without any comorbid. Furthermore, people with chronic illnesses were considered as a high-risk group and at risk of serious outcomes from the infection [34]. This finding reflects the lack of concern among those with comorbidities. There is a need to educate them on the importance of being extra cautious and that COVID-19 can be fatal in high-risk groups. Handshaking is considered a cultural value in many nations, including Malaysia. Understandably, such a tradition will be difficult to avert. It is good to note that the huge majority of healthcare workers avoid handshaking.

The main strength of the study was it serves as baseline data of preventive behaviours among healthcare workers to formulate intervention strategies. Further study is needed to include health professionals from the hospital setting. Additionally, mental health and the risk of metabolic diseases among healthcare workers also require appropriate attention. A qualitative study on job satisfaction among healthcare workers could serve as a good method to explore its determinants. Good job satisfaction will optimize the health system service delivery. It will be interesting to assess preventive behaviours at the workplace which include other communicable diseases such as tuberculosis. Sedentary lifestyle habits among healthcare workers which resulted from overwork should be assessed as well to address non-communicable diseases.

Several limitations of this study should be acknowledged. First, a cross-sectional study only allows us to obtain independent and dependant variables concurrently. Hence only association can be identified but causality could not be inferred. Secondly, since the study was carried out in District Health Office and Health Clinics, the generalizability of research findings is limited to governmental primary healthcare facilities. Another limitation that warrants an explanation was in a self-reported questionnaire, respondents might be biased in expressing their opinion.

Conclusions

The current study revealed that the prevention practice among health professionals still requires optimization to prevent Healthcare-Associated infection. Marital status, average hours of sleep daily, job satisfaction, and burnout were significant predictors of preventive practice against COVID-19 among healthcare workers. The outcome of this study is beneficial to the policymakers of healthcare. It can serve as a guide to tackle issues related to poor preventive practice against COVID-19 at work. Focused intervention can be delivered according to the significant findings by aiming at specific target groups. This will be more cost-effective and at the same time able to provide an efficient service.

Acknowledgements

Funding sources: this research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

We gratefully appreciate all respondents of this research. Special thanks to all who were involved in the recruitment of participants. We would also like to thank the Director-General of Health Malaysia for the permission to publish this paper.

Conflict of interest statement

The authors declare no conflict of interest.

Authors' contributions

SFJ designed and directed the project. AJ helped to supervise the study. AFM and MEE were involved in data collection. SFJ performed the analysis, results interpretation and wrote the manuscript with the support of AJ, AFM, and MEE. All authors reviewed and approved the final version of the manuscript.

References

[1] Sabah COVID-19 Daily Situation. Sabah State Health Department Infographic. 2021. Available from: https://web.facebook.com/jknsabah (accessed 13 February 2021).

[2] Ashinyo ME, Dubik SD, Duti V, Amegah KE, Ashinyo A, Larsen-Reindorf R, Kaba Akoriyea S, Kuma-Aboagye P. Healthcare workers exposure risk assessment: a survey among frontline workers in designated COVID-19 treatment centers in Ghana. J Prim Care Community Health 2020;11:2150132720969483. https://doi.org/10.1177/2150132720969483

[3] Infection prevention and control [Internet]. World Health Organization. 2020. Available from: https://www.who.int/westernpacific/emergencies/COVID-19/technical-guidance/infection-prevention-control (accessed 5 February 2021).

[4] Haque M, Sartelli M, McKimm J, Abu Bakar M. Healthcare-associated infections & ndash; an overview. Infect Drug Resist 2018;11:2321-33. https://doi.org/10.2147/idr.s177247

[5] 1,771 healthcare workers in Malaysia infected with COVID-19. CNA 2021. Available from: https://www.channelnewsasia.com/news/asia/COVID-19-malaysia-healthcare-workers-nurses-infected-13801794 (accessed 13 February 2021).

[6] Asemahagn M. Factors determining the knowledge and prevention practice of healthcare workers towards COVID-19 in Amhara region, Ethiopia: a cross-sectional survey. Tropical Medicine and Health 2020;48(1). https://doi.org/10.1186/s41182-020-00254-3

[7] Zhang M, Zhou M, Tang F, Wang Y, Nie H, Zhang L et al. Knowledge, attitude, and practice regarding COVID-19 among healthcare workers in Henan, China. J Hosp Infect 2020;105:183-7. https://doi.org/10.1016/j.jhin.2020.04.012

[8] Ofei-Dodoo S, Kellerman R, Gilchrist K, Casey E. Burnout and Quality of life among active member physicians of the Medical Society of Sedgwick County. Kansas Journal of Medicine. 2019;12(2):33-39. https://doi.org/10.17161/kjm.v12i2.11701

[9] Khasne R, Dhakulkar B, Mahajan H. Burnout among Healthcare Workers during COVID-19 Pandemic in India: Results of a Questionnaire-based Survey. Indian J Crit. Care Med 2020;24:664-71. https://doi.org/10.5005/jp-journals-10071-23518

[10] Kim J, Choi J. Factors influencing emergency nurses' burnout during an outbreak of middle east respiratory syndrome coronavirus in Korea. Asian Nurs. Res 2016;10:295-9. https://doi.org/10.1016/j.anr.2016.10.002

[11] Cao W, Fang Z, Hou G, Han M, Xu X, Dong J, et al. The psychological impact of the COVID-19 epidemic on college students in China. Psychiatry Res 2020;287:112934. https://doi.org/10.1016/j.psychres.2020.112934

[12] Official website of the Sabah State Government. Sabah.gov.my 2021. Available from: https://www.sabah.gov.my/cms/?q=en/content/geography (accessed 1 February 2021).

[13] Andrew Chin R, Chua Y, Chu M, Mahadi N, Wong M, Yusoff M et al. Investigating validity evidence of the Malay translation of the Copenhagen Burnout Inventory. J Taibah Univ Med Sci 2018;13:1-9. https://doi.org/10.1016/j.jtumed.2017.06.003

[14] Khasne R, Dhakulkar B, Mahajan H. Burnout among healthcare workers during COVID-19 pandemic in India: results of a Questionnaire-based Survey. Indian J Crit Care Med 2020;24:664-71. https://doi.org/10.5005/jp-journals-10071-23518

[15] Leggat S, Karimi L, Bartram T. A path analysis study of factors influencing hospital staff perceptions of quality of care factors associated with patient satisfaction and patient experience. BMC Health Serv Res 2017;17:739. https://doi.org/10.1186/s12913-017-2718-x

[16] Assefa J, Diress G, Adane S. Infection prevention knowledge, practice, and its associated factors among healthcare providers in primary healthcare unit of Wogdie District, Northeast Ethiopia, 2019: a cross-sectional study. Antimicrob Resist Infect Control 2020;9:136. https://doi.org/10.1186/s13756-020-00802-w

[17] Limbu D, Piryani R, Sunny A. Healthcare workers' knowledge, attitude and practices during the COVID-19 pandemic response in a tertiary care hospital of Nepal. PloS One 2020;15:e0242126. https://doi.org/10.1371/journal.pone.0242126

[18] Lai X, Wang X, Yang Q, Xu X, Tang Y, Liu C, Tan L, Lai R, Wang H, Zhang X, Zhou Q, Chen H. Will healthcare workers improve infection prevention and control behaviors as COVID-19 risk emerges and increases, in China? Antimicrob Resist Infect Control 2020;9:83. https://doi.org/10.1186/s13756-020-00746-1

[19] World Health Organization. First global patient safety challenge clean care is safer care. WHO Guidelines on Hand Hygiene in Healthcare 2009.

[20] Al-Dossary R, Alamri M, Albaqawi H, Al Hosis K, Aljeldah M, Aljohan M, Aljohani K, Almadani N, Alrasheadi B, Falatah R, Almazan J. Awareness, Attitudes, Prevention, and Perceptions of COVID-19 Outbreak among Nurses in Saudi Arabia. Int J Environ Res Public Health 2020;17:8269. https://doi.org/10.3390/ijerph17218269

[21] Abou-Abbas L, Nasser Z, Fares Y, Chahrour M, El Haidari R, Atoui R. Knowledge and practice of physicians during COVID-19 pandemic: a cross-sectional study in Lebanon. BMC Public Health 2020;20:1474. https://doi.org/10.1186/s12889-020-09585-6

[22] Hussain I, Majeed A, Imran I, Ullah M, Hashmi FK, Saeed H, Chaudhry MO, Rasool MF. Knowledge, Attitude, and Practices Toward COVID-19 in Primary Healthcare Providers: A Cross-Sectional Study from Three Tertiary Care Hospitals of Peshawar, Pakistan. J Community Health 2021;46:441-449. https://doi.org/10.1007/s10900-020-00879-9

[23] Appleton K, House A, Dowell A. A survey of job satisfaction, sources of stress and psychological symptoms among general practitioners in Leeds. Br J Gen Pract 1998;48:1059-63.

[24] Asmara A, Hariyati R, Handiyani H, Avia I. Analysis of infection prevention control nurse performance: a descriptive study. enfermería clínica 2019;29:36-40. https://doi.org/10.1016/j.enfcli.2019.04.006

[25] Frost P, Kolstad H, Bonde J. Shift work and the risk of ischemic heart disease – a systematic review of the epidemiologic evidence. Scand J Work Environ Health 2009;35:163-79. https://doi.org/10.5271/sjweh.1319

[26] Puttonen S, Härmä M, Hublin C. Shift work and cardiovascular disease - pathways from circadian stress to morbidity. Scand J Work Environ Health 2010;36:96-108. https://doi.org/10.5271/sjweh.2894

[27] Ramírez M, Otero P, Blanco V, Ontaneda M, Díaz O, Vázquez F. Prevalence and correlates of burnout in health professionals in Ecuador. Compr Psychiatry 2018;82:73-83. https://doi.org/10.1016/j.comppsych.2017.11.011

[28] Maunder RG, Lancee WJ, Balderson KE, Bennett JP, Borgundvaag B, Evans S, Fernandes CM, Goldbloom DS, Gupta M, Hunter JJ, McGillis Hall L, Nagle LM, Pain C, Peczeniuk SS, Raymond G, Read N, Rourke SB, Steinberg RJ, Stewart TE, VanDeVelde-Coke S, Veldhorst GG, Wasylenki DA. Long-term psychological and occupational effects of providing hospital healthcare during SARS outbreak. Emerg Infect Dis 2006;12:1924-32. https://doi.org/10.3201/eid1212.060584

[29] Farmilo K. Power napping for nurses. Am J Nurs 2014;114:11. https://doi.org/10.1097/01.naj.0000446754.24180.03

[30] De Hert S. Burnout in healthcare workers: prevalence, impact and preventative strategies. Local Reg Anesth 2020;13:171-83. https://doi.org/10.2147/LRA.S240564

[31] Alao M, Durodola A, Ibrahim O, Asinobi O. Assessment of health workers' knowledge, beliefs, attitudes, and use of personal protective equipment for prevention of COVID-19 infection in low-resource settings. Adv Public Health 2020;2020:1-10. https://doi.org/10.1155/2020/4619214

[32] Bazaid A, Aldarhami A, Binsaleh N, Sherwani S, Althomali O. Knowledge and practice of personal protective measures during the COVID-19 pandemic: a cross-sectional study in Saudi Arabia. PloS One 2020;15:e0243695. https://doi.org/10.1371/journal.pone.0243695

[33] Chen YJ, Qin G, Chen J, Xu JL, Feng DY, Wu XY, Li X. Comparison of face-touching behaviors before and during the coronavirus disease 2019 pandemic. JAMA Network Open 2020;3:e2016924. https://doi.org/10.1001/jamanetworkopen.2020.16924

[34] Li J, Gong X, Wang Z, Chen R, Li T, Zeng D, Li M. Clinical features of familial clustering in patients infected with 2019 novel coronavirus in Wuhan, China. Virus Res 2020;286:198043. https://doi.org/10.1016/j.virusres.2020.198043

Received on February 18, 2021. Accepted on July 14, 2021.

Correspondence: Sam Froze Anak Jiee, Penampang District Health Office, Sabah State Health Department, Ministry of Health Malaysia - E-mail: samfrozejiee@gmail.com

How to cite this article: Jiee SF, Jantim A, Mohamed AF, Emiral ME. COVID-19 pandemic: determinants of workplace preventive practice among primary healthcare workers in Sabah, Malaysia. J Prev Med Hyg 2021;62:E605-E612. https://doi.org/10.15167/2421-4248/jpmh2021.62.3.2031

Review

COVID-19 and Spanish flu-18: review of medical and social parallelisms between two global pandemics

OMAR SIMONETTI[1], MARIANO MARTINI[2], EMANUELE ARMOCIDA[3]
[1] Infectious Diseases Unit, University Hospital of Trieste, Trieste, Italy; [2] Department of Health Sciences, University of Genoa, Genoa; [3] Department of Medicine and Surgery, University of Parma, Parma, Italy

Keywords

COVID-19 • Spanish flu • Pandemic • Influenza

Summary

The intrusion of infectious diseases in everyday life forces humans to reassess their attitudes. Indeed, pandemics are able catalyze rapid transitions in scientific knowledge, politics, social behaviors, culture and arts. The current Coronavirus diesease-19 (COVID-19) outbreak has driven an unprecedented interest toward the influenza pandemic of 1918. The issue is whether history can shed light on the best preventive response and future scenarios. The aim of this review is to highlight the parallelism between the two pandemics. Starting from epidemiology and clinical features, but further focusing on social and cultural issues, it is possible to unreveal great similarities. Their outbreak pattern lead to hypothesize a similar duration and death burden in absence of effective vaccines or innovative treatments for COVID-19. Thus, then as now, preventive medicine represents the first and most effective tool to contain the course of the pandemic; being treatments available only supportive. At the same time,both pandemics shared the same pattern of narration (e.g. scapegoating) and the same impact on minorities in high-income countries. Furthermore, visual art responded to pandemic issues in 2020 in the form of Graffiti art, while similar role was ruled by Expressionism movement during the Spanish flu. Photography also was capable to document both catastrophic scenarios. Thus, it is possible to find a lot of clinical and social similarities between the two pandemics. Nevertheless, if the Spanish flu was not unforseen, COVID-19 spillover was partially predictable and its global impact will hopefully not be overshadowed by a major crisis such as World War I.

Introduction

Among the numerous challenges that human health has faced, infectious diseases have stood out for their ability to profoundly impact multiple aspects of human life. In fact, there is an intimate connection between the spread of infectious agents and the complexity of human behavior. Pathogens directly reflect who we are, what we do, and how we live and interact with other people, animals, and the environment [1]. Furthermore, great pandemics and local epidemics have influenced the course of wars, determined the fates of nations and empires, and affected the progress of civilization. All in all, infections have been supporting actors in the drama of human history [2, 1]. This intrusion in everyday life forces humans, without social, national or gender distinction, to ask themselves existential questions and stimulate cultural progress.

Pandemics are ubiquitous by definition and hence they lead us to re-think the socio-cultural issues of the communities we live in. This happened with the bubonic plague of the fourteenth century, which, according to historians represented a *primum movens* to transit from the dark Middle Ages towards Humanism and the Renaissance [3, 4].

Similarly, the appearance of syphilis in the fifteenth-sixteenth century changed the dogmatic beliefs of medicine and encouraged the investigation of experimental approaches and practices. More recently, the XX Century has seen the advent of HIV, which led to a profound re-assessing of socio-cultural issues and impacted multiple aspects of everyday life life [5].

Now, the XXI Century challenges us with a pandemic caused by a previously unknown virus. How deep will its socio-cultural impact be on humanity? How long will it last? Will it be different from previous pandemics? And importantly, can history help us to make previsions?

The current worldwide COVID-19 outbreak has driven an unprecedented increase in the public and scientific interest toward the influenza outbreak of 1918. A first look at the Google search trends since 2004 (https://trends.google.com) revealed marked increases in searches for Spanish flu on the web and on media in March and April 2020. Furthermore, according to a non-systematic PubMed search using the tool PubMed by Year, the search terms Spanish flu or influenza 1918 in their abstract/title reached an all-time high in 2020 [6].

Many of these publications tried to identify similarities and differences between the two pandemics in order to learn some lessons from the past. We are still in a similar situation than then, as we still don't fully understand the new virus, the characteristics of its disease, and which drugs to use against it.

As we write, our hopes are focused on the arrival of the vaccine, which in 2021 could change the natural history of this virus. Nevertheless, the socio-cultural impact that this experience has had on a global level has yet to be fully

comprehended. This paper aims to carry out analysis of the literature to verify the actual similarities between the Spanish flu pandemic and that of COVID-19.

Epidemiology

The most probable origin of 1918-20 Flu pandemic was the rural area of Texas with different reported cases of severe flu-like symptoms between January and February 1918. The disease disappeared rapidly only to strike with vengeance different US military camps on March. It seem to have travelled with soldiers into the battlefields of France and Belgium before spreading all over the world. The epidemic wave registered in autumn 1918 was the most destructive one; with even Eskimos decimated and twenty percent of Wester Samoans perished. 1918 Flu killed more people than any other disease in a period of similar duration in high-income countries [7, 8]. COVID-19 pandemic probably started in a Wet Market in Wuhan, China, in November 2019. When the first case of pneumonia of unknown origin was registered outside of the market it was evident that inter-human transmission was possible. The death toll is high: Spanish Flu killed 5 million (mln) people in 3 years; while up to Dicember 2020 COVID-19 death count was around 55.000 with 1,6 mln people infected [9]. Other waves of COVID-19 have been registered since than worldwide in the form of the so-called "second and third wave", similar to the one of Autumn 1918 for Flu.

Both viruses had basic reproductive numbers ranging from 2 to 4 and similar patterns of viral shedding; thus presumably comparable generation intervals. Specifically, Petersen et al. reported a R0 of SARS-CoV-2 of 2,5 while the R0 for H1N1 pandemic influenza of 1918 was 2.0 [10]. A key difference is the fact that age was a protective factor for Flu deaths in 1918 (probably for a partial immunity caused by the less known Russian Flu), while it is strongly related to worse outcomes for COVID-19 [9].

The similarities of waves of recrudescence have brought some authors to overlap historical trends of Spanish Flu and recent COVID-19 outbreaks. Indeed, weekly numbers of COVID-19-associated pneumonia deaths up to May 2020 and Influenza deaths up to May 1919 in England and Wales show comparable trends [11]. Also, the devastating 1918 Spanish Flu saw a 10% increase in mortality in large coal-capacity cities from baseline flu-related mortality; meanwhile nowadays it is estimated that about 15% of deaths worldwide from COVID-19 could be attributed to long-term exposure to air pollution [12].

As emerged from afore mentioned analysis, SARS-CoV-2 and H1N1 showed similar transmission features and an overlapping pandemic pattern, with periodic waves of recrudescence. This assumption lead us to hypothesize a similar duration and death burden of COVID-19 in absence of effective vaccines or innovative treatments able to break SARS-CoV-2 transmission chain all over the world.

Clinical features of the two pandemics

From a virological point of view, SARS-CoV-2 and H1N1 virus, the causative agent of Spanish Flu, are extremely different; with the first being an Influenza A (IA) virus and the latter being the seventh coronavirus known to infect humans [13]. H1N1 etiology of Spanish flu was confirmed in 1936 thanks to sierological investigation using neutralizing antibodies for swine influenza virus in human serum [14].

IA caused onia "superinfection" [15]. As for H1N1 infection SARS-CoV-2 causes COVID-19, characterized by direct lung damage in the form of ARDS. The latter is also capable of triggering a strong immune response which cause cytokine storm syndrome, which is the main cause of respiratory insufficiency [16].

A few medicines were used to relieve IA symptoms and aid their recovery, but drugs were considered less important than factors like regular meals, warmth, and plenty of fresh air and sunlight [17]. Among the first advocates of what was later to become known as the "*open-air method*" was the English physician John Coakley Lettsom (1744-1815), who demonstrated its efficacy against tuberculosis. In 1919 the physiologist Sir Leonard Hill (1866-1952) wrote in the British Medical Journal that the best way to limit influenza infection was deep breathing of cool air and sleeping in the open. Thus, sun exposure may have kept infection rates down because ultraviolet radiation capacity to partially inactivate IA viruses. Another advantage of placing patients outside in the sun was that they synthesized vitamin D in their skin. Thus, it has been hypothesized that low levels of vitamin D may increase susceptibility to respiratory viruses such as H1N1. Interestingly close to 30 or studies have demonstrated that optimal 25(OH)-vitamin D blood levels reduces COVID-19 risk of infection as well, risk of severe disease and ameliorate the outcome; thus suggesting vitamin D3 4-5,000 IU for adults as oral integrator [18].

During Spanish Flu specific treatments were lacking. Noteworthy, the guidelines used at the time suggested a therapy that we now know to be dangerous. As a matter of fact, Aspirin was widely used to relief Flu symptoms and the high doses prescribed between 1918-20 could have indeed increased IA mortality rates. The loss of Bayer's patent on aspirin in February 1917 opened the doors for many manufacturers into the lucrative aspirin market while ignorance of the nonlinear kinetics of salicylate (unknown until the 1960s) predisposed its overdosing. Indeed, the molecule is capable of inducing pulmonary vascular bed permeability to fluid and protein leading to pulmonary insufficiency when prescribed at dosages suggested for IA (reaching also 1000 mg per day) [15].

Since the start of COVID-19 pandemic, different drug trials have been carried out in order to discover the applicability of knew molecules in limiting SARS-CoV-2 infection and in reducing its morbility and mortality. The first drugs investigated from the available arsenal have been: Lopinavir/ritonavir (LPV/RTV), Hydroxychloroquine and Azitromycin. LPV/RTV is an old generation boosted

protease inhibitor prescribed to control HIV infection, having antiretroviral efficacy. Such molecule was showed to be effective against SARS-CoV virus in 2003 [19] and hence it was suggested for treatment of SARS-CoV-2 pneumonia. Hydroxychloroquine and Azytromicin were utilized for COVID-19 admitted patients during the first months of pandemic for their anti-viral and anti-inflammatory activities; evidence reinforced in a small trial by Gautret and collegues [20]. However, to date the hopes of success of these old drugs have been partially abandoned and none of such molecules have been recommended in COVID-19 guidelines. As a matter of fact, the only antiviral drug included in different guidelines on COVID-19 management is Remdesivir; a inhibitor of SARS-CoV-2 RNA polymerase. As for H1N1 in XX Century, nowadays the strongest scientific evidence is on supportive therapies rather than virus-targeted drugs. Indeed, oxygen supplement, heparin and dexamethasone are the pillars of COVID-19 hospitalized patients treatment [21].

So no effective virus-specific treatment was prescribed in the case of H1N1 pandemic, as well as SARS-CoV-2 pandemic. However, in XXI Century there is another weapon to limit bacteria and viruses, only partially developed in the first decades of XX Century; namely the "*vaccine"*. In the case of SARS-CoV-2, an efficacious vaccine might prevent infection, disease, or transmission. With different SARS-CoV-2 vaccine candidates in phase III trials already and others approved from regulatory international agencies, the situation can be described as cautiously optimistic. However, there are many unknowns moving forward; the first is the fact that phase III trials need to demonstrate effectiveness and safety in a very large population. To conclude, first months of 2021 will be crucial to discover if available vaccines will halve COVID-19 pandemic, a hope not existing for H1N1 during 1918-20 biennium. As a matter of fact, the causative agent of Spanish Flu was thought to be *Bacillus influenzae*, isolated from the first time from Pfeiffer during a previous Flu pandemic (Russian Flu 1989-90) [9].

Infection control and prevention attempts

The public health measures considered to control the COVID-19 infection in 2020 overlap more than any other the ones taken for Spanish flu [22].Pasteaur and Lister and the acceptance of the hygienic principles postulated by Sammelweis. Indeed, then as now, it is good habit to isolate the sick, avoid crowding, especially in communities, and disinfect the environments. For example, it was proposed to avoid contact with the sick and convalescents, as well to limit unnecessary crowds and travels. Specifically, was decided to close the taverns in the evening and the closure of the cinemas, suspend the funeral processions, and limit access to public transport. Moreover, it was widely recommended to wash hands several times a day to avoid the virus spread [23].

Of interest is the fact that in 1918 the systematic use of masks as protective equipment appeared for the first time in history. Initially, masks were widely used in hospitals in the United States, made with "*half a yard of gauze, folded like a triangular bandage, covering the nose, mouth and chin, and tied at the back of the head*". Later, their use was extended to the general population (Figure 1) until they were imposed as in the case of the city of San Francisco. The Stanford University website reports contradicting results of two studies; the first, published in JAMA, reported a rapid decline in the number of cases of influenza among those wearing the mask, while the results of the latter did not show similar success in the Great Lakes region [24]. In fact, there was a small difference in the development of the disease between hospital staff who wore them and those who did not (8% *vs* 7.5%) in favour of the latter [24]. Contrary, some measures mirrored the misconceptions of past times. As a matter of fact, the BMJ on 2nd November 1918 published the suggestions of the Paris Medical Academy for the prophylaxis of influenza, giving importance to mildly disinfectant mouthwash [25].

Preventive medicine, then as now, certainly represents the first and most effective tool to halve the course of a pandemic. Furthermore, nowadays we can take advantage of new technological possibilities to enhance hygiene measures, for example the contact tracing programs on smartphones.

Social implications of the two pandemics

Both pandemics have generated a big amount of myths behind their origins. Spanish Flu was believed to be a new weapon of war. Some stated that the germs causing it were inserted into aspirin made by the German drug company Bayer. Others believed that the plagued arrived in US on a camouflage German ship that had crept into Boston Harbor under cover of darkness and released the germs that seeded the city [7]. The most viral myth on COVID-19 origin is that SARS-CoV-2 was artificially created in a lab by a rogue government with an agenda; while seems to be demonstrated that it evolved from animal hosts [26].

Fear and frustration for both viruses led communities to identify *scapegoats* during their first months of pandemics. In the months since the coronavirus pandemic began, thousands of Asian Americans in the US have become targets of verbal assaults. As infection appeared, US politicians and citizenship repeatedly referred to COVID-19 as the "*China virus*" and "*Chinese flu*"; while also the term "*Kung flu*" was widely used to describe the syndrome [27]. Back to 1918 it is possible to use the nomenclature given to the pandemic—the Spanish flu—as a window into the role that xenophobia, stigmatization, and the scapegoating of vulnerable populations play in pandemic social responses. As Hoppe and colleagues explains, giving a disease the name of a foreign or minority community is inherently related to the desire to wall off those who are viewed as sources of contagion

Fig. 1. Example of a present and past ethnicisation of the pandemic. The National Flag of the People's Republic of China adapted with the SARS-CoV-2 shape, encountered on the web. A poster issued by Alberta's Provincial Board of Health alerting the public to the 1918 influenza epidemic, called Spanish as undertitled in the photo.

[28, 29]. As a matter of fact, Spain was the only country where, because of its neutrality in warfare, it was possible to advise the population against the new viruses while for the countries in war a strong censorship was the rule (Fig. 1). Nevertheless, unlike previous epidemics or pandemics, in 1918 only few cases of personal stigmatization were registered. Indeed, only 2 newspaper clips are available blaming Italian immigrants. Probably influenza spread so quickly across various levels of the population that it was hard to scapegoat anybody [7, 30].

Pandemics exact disproportionate toll on minority groups and magnify existing disparities. The broader context of the 1918 pandemic is critical for understanding the historical, as well as contemporaneous, landscape of health disparities. One interesting example is the fact that the few studies examining racial differences in the 1918 pandemic found that the population of African-Americans in US had lower influenza incidence but higher case fatality. Structural inequities have historically contributed and continue to compound disparate health outcomes in minority communities [31]. Recently, the Johns Hopkins University and American Community Survey showed that in US the infection rate and the death rate of COVID-19 in predominantly Black counties were respectively 3-fold higher and 6-fold higher than that in predominantly white counties [32]. One Century passed, but Black and Brown people continue to die at a disproportionate rates because of such viruses.

In both pandemics science and politics were entangled in complicated battles; at the point that in USA in some towns, cities and states, the act of wearing a mask became a statement of political allegiance in anticipation of presidential elections of November 2020. Back in 1918 wearing a mask was described as a wartime symbol of patriotism [33].

To conclude from false myths behind their origins, through scapegoating and political and ethnical implications both pandemics seem to share a similar pattern of narration and the same impact on minorities in high-income countries.

Mass culture

The COVID-19 pandemic is shaping the XXI Century from its beginning. How will this event be remembered by arts? How will paintings and pictures represent the human emotion and tragedy resulting from the suffering, death, and fears of an invisible enemy called SARS-CoV-2? To make such predictions it would be interesting to start analyzing how visual arts responded to Spanish Flu in 1918-20 period. The pain, the terror of illness, the fearful stress that gained people's minds were not an easy context for the flourishing of arts. It was a pandemic consisting of different personal tragedies and artists, as the general population, balanced their need to forget and the need to create some form of memories. Edvard Munch (1863-1944), a Norwegian painter, author of the well-known "*The Scream*"- 1893, painted two self-portraits after having contracted the disease. In the first canvas, "*Self-portrait with the Spanish Flu*"- 1919, Munch portrayed himself as a sick person in the middle of his room, while in the second "*Self-portrait after the Spanish Flu*"- 1919-20, the focus shifted on his sunken dark face: probably due to the lack of oxygenation because of bronchopulmonary complications [34, 35]. On 7th January 1918, the Austrian artist Egon Schiele (1890-1918) had to visit his mentor, the famous Gustav Klimt (1862-1918), in the Allgemeines Krankenhaus in Vienna. The day before, Klimt had died of a stroke that many

Fig. 2. a) Banksy new masterpiece "Game Changer" - 2020. The objective of his work is to replace fiction super-heroes with real superheroes, the ones working in NHS and facing day by day SARS-CoV-2. b) of the same opinion is the famous writer Fake who dedicated the "Super Nurse"- 2020 to healthcare workers in difficulties during COVID-19 management.

believe was a result of the flu, suffering simultaneously from pneumonia. The visit sadly resulted in three haunting drawings of a deceased Klimt's head, showing his face deformed from the stroke [36, 37]. As briefly reported above, the Expressionism seems to have been the most sensible art movement to return IA pandemic struggles in the form of visual art. The term *expressionism* refers to the art tendency of returning a reality distorted in order to make it expressive of the artist's inner feelings or ideas. As expressionism back in early XX Century was able to freely deliver author's thoughts to the audience, nowadays Graffiti permits feelings to be *expressed* without boundaries of space and age. Flourished thanks to hip hop culture, Graffiti art refers to images or text painted usually onto buildings, typically using spray paint [38]. During COIVD-19 pandemic this movement, and in general street art, have striking works, creating temporally *mementos* in the urban context. The most famous examples came from Banksy (1974-) pens and stencils. On 6th May 2020 he donated a one meter by one meter work to the University Hospital of Southampton (UK). In the print, titled "*Game Changer*"- 2020 and showed in Figure 2a, a child is dressed in an onesie and next to him a basket contains abandoned Batman and Spider-Man puppets. The child holds, with his arm raised, his new super hero: a nurse with her arms in the classic posture of Superman in action. The artist desired to homage doctors, nurses, nursing staff, ambulance teams and in general people working in hospitals with grueling shifts. During the first months of the ongoing pandemic Healthcare Systems personnel was at the center of attention and its workers depicted as "*angels*". Other gifts showing the love to healthcare workers are "*NHS Heroes*"- 2020 by John D'oh and "*Super Nurse*"- 2020 by Fake (Fig. 2b), both perfectly capturing the heroism of the nurses on the pandemic frontline. Another image become a redundant topic in street art is the face mask and protective personal equipment (PPE) in general [39]. One example came again from Banksy and is the addition of a blue surgical face mask to the well-known "*Girl with a Pierced Eardrum*"- 2014, a take on Dutch artist Johannes Vermeer's painting but with a security alarm replacing the pearl.

Although the 1918 flu pandemic was a human disaster, its cultural legacy was overshadowed by that of the First World War and soon forgotten. Indeed, artists were more interested in depicting war than collapsing healthcare systems [35]; probably only the Expressionist movement left a portrait of the past suffering. By contrast, during the COVID-19 crisis, it is possible to denote an inner bound between arts; mainly modern tendencies and the struggle to contain the ongoing pandemic. Such images are being fixed in the world's collective consciousness owing to the pervasive capacity of the Internet. Will they last, or will they survive only until the struggle ends?

Ever since its invention, photography, like painting, has been used to document catastrophic scenarios. In this regard, photographic reports and masterpieces of visual art were produced both during the 20th century's most devastating pandemic and during the current COVID-19 outbreak.

The so-called "Spanish Flu" was the first major pandemic of the modern era; and it was also the first to be widely photographed. In army camps, in hospitals, in streets and in workplaces, photographers captured the struggle to deal with the crisis.

From the mundane to the grand, these photographs constitute a visual archive of people racked by the disease [40]. As shown in Figures 3 and 4, photography has documented clinical situations and moments of

Fig. 3. a) Paramedics with PPE transporting a corpse during the COVID-19 pandemic. b) The influenza ward at the Walter Reed Hospital in Washington, 1918. Simply-to-make protective masks were worn by healthcare workers.

a)

b)

daily life during both pandemics; in the light of the current pandemic, the concept of normality has been revised. Since the first COVID-19 lockdown, several cultural initiatives have featured photography. One example is the foundation of the Covid Photo Museum (CPM), the world's first virtual museum dedicated to the photography of the COVID-19 pandemic [41].

Conclusions

Emerging infectious diseases are a significant and growing threat to global health, the global economy and global security. They mainly originate in wild animals, and their emergence often involves dynamic interactions among populations of wildlife, livestock and people within rapidly changing environments. The COVID-19 pandemic was fairly predictable. Bats are known to harbor zoonoses and, as recently reported by Deszak and colleagues, 13,000 coronaviruses are silently waiting for possible spillovers [42, 9].

Although only 0.1% of the 1,600,000 viruses capable of causing epidemics and/or pandemics are known, the 2020 pandemic was randomly forecast by Johns Hopkins Center for Health Security. Indeed, a model of an imminent pandemic was created and called CAPS

Fig. 4. a) Everyday life in 2020 means face mask adoptance in public places included flight. b) Football match audience wearing protective masks during the Spanish Flu epidemic of 1918.

a)

b)

– Coronavirus-Associated Pulmunary Syndrome. The setting was New York in October 2020, a couple of weeks before the first cases of COVID - Coronavirus Disease. This simulation correctly captured both the family of the virus which then caused the actual pandemics, and the circumstances of the spillover [9, 43].

By contrast, Spanish Flu was not predictable, for the simple reason that viruses were not known at the time. It was a destructive disease of unknown origin. Today, however, we are certainly to blame for ignoring the increasing risk of spillover caused by human exploitation of the biosphere. The risks of anthropization were not so deeply known during Spanish Flu pandemic. Thus, we had a whole century of training and scientific development in order to prepare for this latest pandemic. The question that arises is whether our society is ready to bear its responsibilities and learn from present errors. Indeed, as Rudolf Virchow (1821- 1902), the father of modern pathological anatomy, used to say: "An epidemic is a social phenomenon that has some medical aspects" [44]. As recently stated by a colleague, we, as physicians, "are uniquely positioned to discuss what is important to improving the health of our communities and [...] to recover from this pandemic and prepare for the next" [45]. Our best hope is to find ways to cure the patients affected worldwide and to repair the damage to society.

Availability of data

Figure 1 taken from https://unsplash.com/, created by visuals and from https://commons.wikimedia.org/. Figure 2a and 2b usage under the personal permission of the two authors. Figure 3a is an image of Isaac Quesada on https://unsplash.com/. Figure 3b is taken from Public domain CC0 pictures on https://www.rawpixel.com/. Figure 4a is an image of ismail mohamed - SoviLe on https://unsplash.com/. Figure 4b is taken from https://commons.wikimedia.org/ and is of Public domain.

Acknowledgements

Funding sources: this research did not receive any specific grant from funding agencies in the public, commercial, or not for profit sectors.

Conflict of interest statement

The authors declare no conflict of interest.

Authors' contributions

OS and EA designed and conceived the study; OS and EA drafted the manuscript; OS, MM and EA revised the manuscript, performed a search of the literature. All authors critically revised the manuscript. All authors have read and approved the latest version of the paper.

References

[1] Fauci AS, Morens DM. The perpetual challenge of infectious diseases. N Engl J Med 2012;366:454-61. https://doi.org/10.1056/NEJMra1108296. Erratum in: N Engl J Med 2012;366:868.

[2] Simonetti O, Armocida E. El Alamein: the battle in the battle. How infectious disease management changed the fate of one of the most important battle of the World War II. Infez Med 2020;28:441-9.

[3] Ziegler P. The Black Death. Wolfeboro Falls (NH): Alan Sutton Publishing 1969.

[4] Stenseth NC, Atshabar BB, Begon M, Belmain SR, Bertherat E, Carniel E, Gage KL, Leirs H, Rahalison L. Plague: past, present, and future. PLoS Med 2008;5:e3. https://doi.org/10.1371/journal.pmed.0050003

[5] Martini M, Gazzaniga V, Barberis I, Bragazzi NL, Parodi A, Armocida E. De morbo gallico omnia quae extant apud omnes medicos cuiuscunque nationis: the sixteenth-century collection of Luigi Luigini. Infez Med 2019;27:350-2.

[6] Kaspar S, Floris J. Down memory lane: Unprecedented strong public and scientific interest in the" Spanish flu" 1918/1919 during the COVID-19 pandemic. Influenza Other Respir Viruses 2021;15:318-9. https://doi.org/10.1111/irv.12806

[7] Gina Kolata. Flu: The Story Of The Great Influenza Pandemic of 1918 and the Search for the Virus that Caused It. Simon and Schuster 9 gen 2001.

[8] Ashton J. COVID-19 and the 'Spanish' flu. J R Soc Med 2020;113:197-8. https://doi.org/10.1177/0141076820924241

[9] Mark Honigsbaum. The Pandemic Century – A History of Global Contagion from the Spanish Flu to Covid-19. Penguin June 2020.

[10] Petersen E, Koopmans M, Go U, Hamer DH, Petrosillo N, Castelli F, Storgaard M, Al Khalili S, Simonsen L. Comparing SARS-CoV-2 with SARS-CoV and influenza pandemics. Lancet Infect Dis 2020;20:e238-44. https://doi.org/10.1016/S1473-3099(20)30484-9

[11] He D, Zhao S, Li Y, Cao P, Gao D, Lou Y, Yang L. Comparing COVID-19 and the 1918-19 influenza pandemics in the United Kingdom. Int J Infect Dis 2020;98:67-70. https://doi.org/10.1016/j.ijid.2020.06.075

[12] Karan A, Ali K, Teelucksingh S, Sakhamuri S. The impact of air pollution on the incidence and mortality of COVID-19. Glob Health Res Policy 2020;5:39. https://doi.org/10.1186/s41256-020-00167-y

[13] Corman VM, Landt O, Kaiser M, Molenkamp R, Meijer A, Chu DK, Bleicker T, Brünink S, Schneider J, Schmidt ML, Mulders DG, Haagmans BL, van der Veer B, van den Brink S, Wijsman L, Goderski G, Romette JL, Ellis J, Zambon M, Peiris M, Goossens H, Reusken C, Koopmans MP, Drosten C. Detection of 2019 novel coronavirus (2019-nCoV) by real-time RT-PCR. Euro Surveill 2020;25:2000045. https://doi.org/10.2807/1560-7917.ES.2020.25.3.2000045. Erratum in: Euro Surveill 2020;25(14). Erratum in: Euro Surveill 2020;25(30).

[14] Shope RE. The incidence of neutralizing antibodies for swine influenza virus in the sera of human beings of different ages. J Exp Med 1936;63:669-84. https://doi.org/10.1084/jem.63.5.669

[15] Starko KM. Salicylates and pandemic influenza mortality, 1918-1919 pharmacology, pathology, and historic evidence. Clin Infect Dis 2009;49:1405-10. https://doi.org/10.1086/606060

[16] Esakandari H, Nabi-Afjadi M, Fakkari-Afjadi J, Farahmandian N, Miresmaeili SM, Bahreini E. A comprehensive review of COVID-19 characteristics. Biol Proced Online 2020;22:19. https://doi.org/10.1186/s12575-020-00128-2

[17] Hobday RA, Cason JW. The open-air treatment of pandemic influenza. Am J Public Health 2009;99(Suppl 2):S236-42. https://doi.org/10.2105/AJPH.2008.134627

[18] Ali N. Role of vitamin D in preventing of COVID-19 infection,

progression and severity. J Infect Public Health 2020;13:1373-80. https://doi.org/10.1016/j.jiph.2020.06.021

[19] Chan KS, Lai ST, Chu CM, Tsui E, Tam CY, Wong MM, Tse MW, Que TL, Peiris JS, Sung J, Wong VC, Yuen KY. Treatment of severe acute respiratory syndrome with lopinavir/ritonavir: a multicentre retrospective matched cohort study. Hong Kong Med J 2003;9:399-406.

[20] Gautret P, Lagier JC, Parola P, Hoang VT, Meddeb L, Mailhe M, Doudier B, Courjon J, Giordanengo V, Vieira VE, Tissot Dupont H, Honoré S, Colson P, Chabrière E, La Scola B, Rolain JM, Brouqui P, Raoult D. Hydroxychloroquine and azithromycin as a treatment of COVID-19: results of an open-label non-randomized clinical trial. Int J Antimicrob Agents 2020;56:105949. https://doi.org/10.1016/j.ijantimicag.2020.105949

[21] WHO Therapeutics and COVID-19. https://www.who.int/publications/i/item/therapeutics-and-covid-19-living-guideline. Accessed on 01/01/2021

[22] Munnoli PM, Nabapure S, Yeshavanth G. Post-COVID-19 precautions based on lessons learned from past pandemics: a review. Z Gesundh Wiss. 2020 Aug 4:1-9. https://doi.org/10.1007/s10389-020-01371-3

[23] Franchini AF, Auxillia F, Galimberti P, et al. COVID 19 and Spanish flu pandemics: All it changes, nothing changes. Acta Biomed 2020;91:245-50. https://doi.org/10.23750/abm.v91i2.9625

[24] https://virus.stanford.edu./uda/fluresponse.html. Accessed on 101/01/2021

[25] French advice on the prevention of influenza mortality. BMJ 1918 Nov 2 (3018):496. https://www.jstor.org/stable/i20336119. Accessed on 01/01/2021.

[26] Andersen KG, Rambaut A, Lipkin WI, Holmes EC, Garry RF. The proximal origin of SARS-CoV-2. Nat Med 2020;26:450-2. https://doi.org/10.1038/s41591-020-0820-9

[27] America's long history of scapegoating its Asian citizens When leaders call COVID-19 the "China virus," it harkens back to decades of state-sanctioned discrimination against Asian Americans. https://www.nationalgeographic.com/. Accessed on 01/01/2021.

[28] Parmet WE, Rothstein MA. The 1918 Influenza Pandemic: Lessons Learned and Not-Introduction to the Special Section. Am J Public Health 2018;108:1435-6. https://doi.org/10.2105/AJPH.2018.304695

[29] Hoppe T. "Spanish Flu": When Infectious Disease Names Blur Origins and Stigmatize Those Infected. Am J Public Health 2018;108:1462-4. https://doi.org/10.2105/AJPH.2018.304645.

[30] Desai A. Twentieth-Century Lessons for a Modern Coronavirus Pandemic. JAMA 2020;323:2118-9. https://doi.org/10.1001/jama.2020.4165

[31] Krishnan L, Ogunwole SM, Cooper LA. Historical Insights on Coronavirus Disease 2019 (COVID-19), the 1918 Influenza Pandemic, and Racial Disparities: Illuminating a Path Forward. Ann Intern Med 2020;173:474-81. https://doi.org/10.7326/M20-2223

[32] Yancy CW. COVID-19 and African Americans. JAMA 2020;323:1891-92. https://doi.org/10.1001/jama.2020.6548

[33] https://www.influenzaarchive.org/. Accessed on 01/11/2020.

[34] Martini M, Gazzaniga V, Bragazzi NL, Barberis I, The Spanish Influenza Pandemic: a lesson from history 100 years after 1918. J Prev Med Hyg 2019;60:E64-7. https://doi.org/10.15167/2421-4248/jpmh2019.60.1.1205

[35] Goldstein JL. The Spanish 1918 Flu and the COVID-19 Disease: The Art of Remembering and Foreshadowing Pandemics. Cell 2020;183(2):285-289. https://doi.org/10.1016/j.cell.2020.09.030

[36] How Art Movements Tried to Make Sense of the World in the Wake of the 1918 Flu Pandemic. Anna Purna Kambhampaty, may 2020. TIME. https://time.com/. Accessed on 01/11/2020.

[37] The 1918 Spanish Flu Wreaked Havoc on Nearly Every Country on Earth. So Why Didn't More Artists Respond to It in Their Work? Taylor Dafoe, April 16, 2020. Artnet. https://news.artnet.com/ Accessed on 01/11/2020.

[38] https://www.tate.org.uk/art/art-terms/ Accessed on 01/11/2020

[39] Xavier Tapes. La street art ai tempi del Coronavirus. Ippocampo Sept 2020.

[40] Navarro JA. Influenza in 1918: an epidemic in images. Public Health Rep 2010;125(Suppl 3):9-14. https://doi.org/10.1177/00333549101250S304

[41] A virtual museum of COVID-19 photography. https://www.covidphotomuseum.org/. Accessed on 01/01/2021.

[42] Allen T, Murray KA, Zambrana-Torrelio C, Morse SS, Rondinini C, Di Marco M, Breit N, Olival KJ, Daszak P. Global hotspots and correlates of emerging zoonotic diseases. Nat Commun 2017;8:1124. https://doi.org/10.1038/s41467-017-00923-8

[43] The Event 201 scenario. https://www.centerforhealthsecurity.org/event201/scenario.html Accessed on 01/11/2020.

[44] Ce virus qui rend fou. Bernard Henri-Lévy. Grasset, June 2020.

[45] Person AK. Infectious Diseases and Advocacy: This Is our Lane. Open Forum Infect Dis 2020;7:ofaa510. https://doi.org/10.1093/ofid/ofaa510

Received on April 27, 2021. Accepted on July 20, 2021.

Correspondence: Omar Simonetti, Azienda Sanitaria Universitaria "Giuliano Isontina" (ASU GI), Via G. Puccini 50, 34148 Trieste - Email: omarsimonetti89@gmail.com

How to cite this article: Simonetti O, Martini M, Armocida E. Covid-19 and Spanish flu-18: review of medical and social parallelisms between two global pandemics. J Prev Med Hyg 2021;62:E613-620. https://doi.org/10.15167/2421-4248/jpmh2021.62.3.2124

Review

SARS-CoV-2 (COVID-19) and the Teaching of Ignaz Semmelweis and Florence Nightingale: a Lesson of Public Health from History, after the "Introduction of Handwashing" (1847)

MARIANO MARTINI[1], DONATELLA LIPPI[2]
[1] Department of Health Sciences, University of Genoa, Genoa, Italy;
[2] Department of Experimental and Clinical Medicine, University of Florence, Florence, Italy

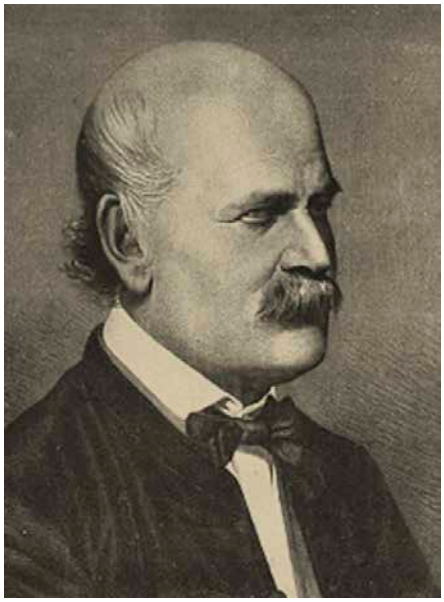
Keywords

History of public health • Hand washing • I. Semmelweis • F. Nightingale • Hand hygiene • SARS-CoV-2 (COVID-19)

Summary

Ignác Fülöp Semmelweis (1818-1865) and Florence Nightingale (1820-1910) were two important personalities in the history of medicine and public health. They dealt with the problem of handwashing. Semmelweis is also known as the "father of hand hygiene"; just in 1847 he discovered the etiology and prophylaxis of puerperal sepsis and imposed a new rule mandating handwashing with chlorine for doctors. He also tried to persuade European scientific community of the advantages of handwashing. During the Crimean War, in Scutary (Turkey), Florence Nightingale strengthened handwashing and other hygiene practices in the war hospital where she worked and her handwashing practices reached a reductions in infections. Unfortunately the hygiene practices promoted by Semmelweis and Nightingale were not widely adopted. In general handwashing promotion stood still for over a century. During current pandemic SARS-CoV-2 (COVID-19) one of the most important way to prevent the spread of the virus is still to wash the hands frequently.

Ignác Fülöp Semmelweis (1818-1865) [Wikipedia commons]



Florence Nightingale (1820-1910)2 [Wikipedia commons]

Historical background

In the middle of the 19th century, two great personalities in the history of medicine, dealt with the problem of hand washing.

On one side, Florence Nightingale (1820-1910), the founder of modern nursing; on the other one, the Hungarian doctor Ignác Fülöp Semmelweis (1818-1865).

Florence Nightingale, was born in Italy, in Florence in

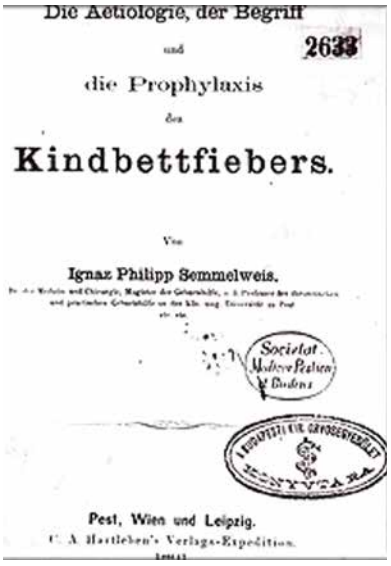
[Florence Nightingale, *An angel of mercy*.
Scutari hospital 1855
[Wikipedia commons]

Statue of Semmelweis in front of Szent Rókus Hospital,
Budapest, Hungary (erected in 1904, work of Alajos Stróbl)
[Wikipedia commons]

1820 (Florence Nightingale's wealthy parents were on a leisurely trip through Europe after their marriage).
Florence Nightingale revolutionized conditions in hospitals around the world, established nursing as a profession, and helped inspire the foundation of the Red Cross. She was known for her night rounds to aid the wounded, establishing her image as the "Lady with the Lamp".
As a matter of fact, the original nickname was the 'Lady with the hammer', but the journalist of the Times, who described Nightingale's activity in Scutari, decided that a hammer was not suitable for a young lady and transformed it into a lamp. Florence had received this nickname after having opened a cupboard with a hammer, as a doctor had refused to give her medicines for the wounded [1].
Ignác F. Semmelweis was born on 1 July 1818, in Buda (now Budapest), across the Danube River from Pest, before both cities became one. Educated at the universities of Pest and Vienna, Semmelweis received his doctor's degree in Vienna in 1844 and was appointed assistant at the obstetric clinic of Vienna; he soon became involved in the problem of puerperal infection.
Germs were yet to be revealed, and in the 1840s it was still supposed that disease was caused and spread by corrupt smells in the air (miasma), originating from rotting corpses, dirt or shrubbery.
There was no theoretical impediment for doctors to perform autopsies in the morgue and then go to the maternity ward to visit a pregnant woman or deliver a baby, without washing their hands.
Semmelweis, who worked as an assistant at the First Obstetric Clinic of the Vienna General Hospital, did not understand why mortality for puerperal fever was higher in the wards frequented by medical students than in those where midwives were trained [2].

When, in 1847, Jakob Kolletschka (1803-1847), one of Semmelweis' colleagues, died after having pricked his finger with the knife that was being used in the autopsy, developing the same symptoms of puerperal fever, Semmelweis noted the similarity between these circumstances.
He postulated that cadaverous particles from the morgue were to blame, and that such particles on the hands of doctors were making their way also into women's bodies during childbirth [3, 4].
Therefore, he required students and doctors to wash their hands in a chlorinated lime solution before every

Semmelweis's main work:
Die Ätiologie, der Begriff und die Prophylaxis des Kindbettfiebers, 1861 (front page)
[Wikipedia commons]


Die Aetiologie, der Begriff
und 2633
die Prophylaxis
des
Kindbettfiebers.
Von
Ignaz Philipp Semmelweis.
Pest, Wien und Leipzig.

patient contact and in particular after leaving the autopsy room. The results were amazing; following implementation of this measure, the mortality rate dramatically declined [5-7].
Despite these results, Semmelweis' theory was rejected, above all because it undermined the prestige of the medical profession. Sadly this life-saving contribution by Semmelweis went unappreciated and he was forced to step down from his position and returned to Hungary [8].
In the same years, Florence Nightingale, during the Crimean war, pointed out that the unsanitary conditions of the soldiers were a major cause of death: she implemented hand washing and other hygiene practices in British army hospitals and her work led to reduced death rates from 42% to 2%.
Florence Nightingale wrote in her book about nursing: "Every nurse ought to be careful to wash her hands very frequently during the day. If her face, too, so much the better" [9].
Both Ignac Semmelweis and Florence Nightingale seized on statistics as a way of demonstrating the efficacy of different interventions and provided the evidence of their statements, but after almost two centuries, it is still necessary to remind the importance in maintaining a clear environment to best promote the health of patients.

Evolution of hand hygiene and health care: the pivotal role of "handwashing"

In 1847 Semmelweis demonstrated that the mortality rate among mothers delivering at the First Obstetrics Clinic at the General Hospital of Vienna was significantly lower when hospital staff cleaned their hands with an antiseptic agent [10].
Semmelweis is considered not only the father of hand hygiene, but his crucial intervention became also a model of epidemiology driven strategies to prevent infection [10].
Unfortunately, the "hand hygiene practices" promoted by Semmelweis and Nightingale were not commonly adopted. Handwashing promotion stood still for over a century. It was not until the 1980s, when a string of foodborne outbreaks and healthcare-associated infections led to public concern that the United States Centers for the Disease Control and Prevention identified hand hygiene as an important way to prevent the spread of infection.
The 1980s represent a milestone in the historical evolution of concepts of "hand hygiene" in health care, as the first national hand hygiene guidelines were published, followed by many others over the years in different countries [11, 12].
We must also remember that healthcare workers' hands are the most common vehicle for the transmission of healthcare-associated pathogens from patient to patient and within the healthcare environment.
Contact transmission occurs when contaminated hands touch the mucosa of the mouth, nose, or eyes; a virus can also be transferred from one surface to another by contaminated hands, which facilitates indirect contact transmission.
Hand hygiene is the leading measure for preventing the spread of antimicrobial resistance and reducing healthcare-associated infections (HCAIs), but healthcare worker compliance with optimal practices remains low in most settings [13]
Nowadays, handwashing remains the number one tip during current pandemic for preventing the spread of Coronavirus (COVID-19). To make it work well, however, it must be done properly, with soap and water and chlorine solutions [14].
Droplets that come from coughing and sneezing spread many of the germs that cause respiratory (breathing) diseases, but some people may become infected by touching surfaces or objects that might be contaminated with respiratory droplets, or after touching persons who suffer from respiratory symptoms [15].
Therefore, hand hygiene is really important to prevent the spread of the COVID- 19 virus. It also interrupts transmission of other viruses and bacteria causing common colds, flu and pneumonia, thus reducing the general burden of disease.
Although awareness of the importance of hand hygiene in preventing infection with the COVID-19 virus is high, access to hand hygiene facilities that include alcohol-based hand rubs as well as soap and water is often suboptimal in the community and in health care facility settings, especially in low-and middle-income countries [15].
For this reason, hands must be washed regularly: proper handwashing not only reduces the spread of COVID-19, as it can prevent the spread of other viral illnesses such as cold and flu. Handwashing also reduces the risk of getting other easily spread infections.
During a global pandemic, one of the cheapest, easiest, but most important ways to prevent the spread of a virus is, first of all, to wash the hands frequently with soap and water, as Ignàc Semmelweis and Florence Nightingale demonstrated more than half a century ago, in the mid-nineteenth century [16].
Semmelweis and Nightingale's teaching is still topical today; but after over more than a century and a half, did we really learn the lesson?

Acknowledgements

Funding sources: this research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Conflict of interest statement

The authors declare no conflict of interest.

Authors' contributions

MM and DL conceived the study, drafted the manuscript, revised the manuscript and performed a search of the literature. Both authors critically revised the manuscript, have read and approved the latest version of the manuscript.

References

[1] Borghi L, Lippi D. La penna di Florence Nightingale (Firenze 1820 - Londra 1910). Aforismi e riflessioni. Firenze: A. Pontecorboli ed. 2020.

[2] McIntyre N. Ignác Fülöp Semmelweis (1818-65). J Med Biogr 2009;17:22. https://doi.org/10.1258/jmb.2008.008008

[3] Semmelweis, Ignaz (1861). Etiology, concept and prophylaxis of childbed fever. K. Codell Carter (translator and extensive foreword). University of Wisconsin Press 1983, pp. 87-8.

[4] Lancaster HO. Semmelweis: a rereading of Die aetiologie. Part I: Puerperal sepsis before 1845. Die aetiologieJ Med Biogr 1994;2:12-21. https://doi.org/10.1177/096777209400200104

[5] Raju TN. Ignác Semmelweis and the etiology of fetal and neonatal sepsis. J Perinatol 1999;19:307-10.

[6] La Rochelle P, Julien AS. How dramatic were the effects of handwashing on maternal mortality observed by Ignaz Semmelweis? J R Soc Med 2013;106:459-60. https://doi.org/10.1177/0141076813507843

[7] Sonja Schreiner. Ignaz Semmelweis: a victim of harassment? Med Wochenschr 2020;170:293-302. https://doi.org/10.1007/s10354-020-00738-1

[8] Citrome L. Happy birthday Ignác Semmelweiss! Now, let's all wash our hands! Int J Clin Pract 2018;72:e13256. https://doi.org/10.1111/ijcp.13256

[9] Nightingale F. Notes on nursing: what it is and what it is not. London: Harrison and Sons 1860.

[10] WHO Guidelines on Hand Hygiene in Health Care. First global patient safety challenge clean care is safer care. World Health Organization, WHO Library Cataloguing-in-Publication Data, 2009.

[11] Simmons BP. Guidelines for hospital environmental control. Section 1. Antiseptics, handwashing, and handwashing facilities. In: Centers for Disease Control and Prevention (CDC), ed. CDC Hospital infections program (HIP) guidelines for prevention and control of nosocomial infections. Atlanta, GA, Springfield 1981, pp. 6-10.

[12] Garner JS, Favero MS. CDC guideline for handwashing and hospital environmental control, 1985. Infect Control 1986;7:231-43. https://doi.org/10.1017/s0195941700084022

[13] Allegranzi B, Pittet B. Role of hand hygiene in healthcare-associated infection prevention. J Hosp Infect 2009;73:305-15. https://doi.org/10.1016/j.jhin.2009.04.019

[14] Abigail M, Shannon H, Tiffany W, Emma B. Hand hygiene: a quality improvement project. Biomed J Sci & Tech Res 2017;1(7). https://doi.org/10.26717/BJSTR.2017.01.000601

[15] WHO. Interim Recommendation. 1 April 2020.

[16] Hillier MD. Using effective hand hygiene practice to prevent and control infection. Nurs Stand 2020;35:45-50. https://doi.org/10.7748/ns.2020.e11552

Received on May 16, 2021. Accepted on July 21, 2021.

Correspondence: Mariano Martini, Department of Health Sciences, largo R. Benzi 10, 16132 Genoa, Italy - E-mail: mariano.yy@gmail.com; mr.martini@unige.it

How to cite this article: Martini M, Lippi D. SARS-CoV-2 (COVID-19) and the Teaching of Ignaz Semmelweis and Florence Nightingale: a Lesson of Public Health from History, after the "Introduction of Handwashing" (1847). J Prev Med Hyg 2021;62:E621-E624. https://doi.org/10.15167/2421-4248/jpmh2021.62.3.2161

Research article

The use of respirators and its impact on the COVID-19 pandemic in Europe between 1 June and 14 October 2020

JANNE BURMAN
University of Helsinki and Helsinki University Hospital, Finland

Keywords

COVID-19 • Respirator • Correlation • Europe • Pandemic

Summary

Background. *Cases of COVID-19 infection have increased sharply in Europe since August 2020, and the WHO recommend the use of respirators in situations where keeping distance is not possible. The purpose of this study was to evaluate the impact of the use of respirators on infection cases and viral deaths in European countries.*
Methods. *COVID-19 cases and related deaths in 29 countries relative to population were searched through the WHO database on 15.10.2020. Recent 14-day cases in relation to the population were retrieved from the European Center for Disease Prevention and Control's website, covering the period from 1 to 14 October 2020. Information related to the use of respirators was retrieved from the IHME database of the University of Washington at time point, 1.6.2020.*
Results. *The proportion of people using of respirators at 1.6.2020 correlate negatively to the reported cases of disease (Rs = -0.528) and to deaths (Rs = -0.553). No significant correlation was found for recent cases or mortality. Countries with at least 60% respirator use did not differ from other countries.*
Conclusion. *Long-term use of respirators appears to reduce disease incidence and death in the population.*

Introduction

The COVID-19 pandemic has had a profound and global impact on society. Since August 2020, cases in Europe have risen sharply. The use of respirators for SARS1 and COVID prevention appears to be effective [1]. However, most studies have been conducted in a healthcare setting [1]. It has been suggested that the reduced viral load resulting from the use of a respirator in an exposure situation could affect the severity of the disease [2]. In a study of 49 volunteers with influenza, the primary viral load at exposure affected the onset of the disease [3]. The appropriate kind of fabric respirator is also effective [4]. However, the use of respirators is associated with the possibility of contamination and, for example, improper washing can predispose users to respiratory infection [5]. In Denmark, a randomised control trial indicated no protective value for the user [6]. The World Health Organization (WHO) recommends the use of respirators in situations where distance cannot be maintained [7], but the use of respirators has varied widely across European countries.[8] The aim of this study was to investigate the significance of the use of respirators for identified cases of COVID-19 and the associated deaths and mortality rates.

Methods

The study was conducted on 15 October 2020 using publicly available data [8-10]. Information searched the European Centre for Disease Prevention and Control's website for data on cases of COVID-19 occurring over the previous 14 days in the European Union (EU), the European Economic Area (EEA), and the United Kingdom [9]. In practice, the preceding 14 days covered the period 1-14 October 2020. The cumulative numbers of cases and deaths per 1,000,000 inhabitants were retrieved from the WHO COVID-19 database [10].
Information on the use of respiratory protective equipment was retrieved from the University of Washington Institute for Health Metrics and Evaluation (IHME) COVID-19 database [8]. Data from 1 June 2020 were used in the analysis because the effect of respirator use would be seen over the longer time period. Data from 29 European countries were used in the analysis and were analysed using SPSS version 22 (IBM Corp, Armonk, NY, USA). A correlation analysis was performed using Spearman's correlation test. The Mann-Whitney U test was used to analyse the differences between groups.

Results

The reported use of respirators ranged from 1 to 94% in different countries. The lowest use was observed in Sweden, Norway, and Denmark (1%), and the most frequent use was documented in Spain (94%). At the beginning of June, in five countries, at least 60% of respondents indicated they had always used a respirator in public. The highest number of infections per million inhabitants was 18,147 in Spain, and the lowest was

1,505 in Latvia. The highest mortality was observed in Spain (704 deaths per million inhabitants), and the lowest was in Slovakia (11 deaths per million inhabitants). The lowest mortality percentages were observed in Iceland and Slovakia at 0.3%, and the highest was in Italy at 9.9% (Tab. I).

The use of respirators had a significant negative correlation to disease cases (Spearman's r_s = -0.528), deaths (r_s = -0.553), and deaths within the last 14 days (r_s = -0.467). The negative correlation obtained for recent cases was not statistically significant (r_s = -0.390, p = 0.099), nor was the correlation for mortality (r_s = -0.238, p = 0.327). Countries with respiratory protection utilisation rates of at least 60% did not differ from other countries except for the latter's higher mortality (median = 288 *vs* 89, p = 0.037).

Discussion

Under the right conditions, the use of respirators will undoubtedly protect against infection, [1], but most of the research material has been obtained from healthcare contexts. In daily life, many things, such as face contact, affect the use of respirators, re-use of a dirty respirator (after a meal, for example), the type of respirator (fabric protector or disposable respirator), and the handling and washing of an old respirator. Therefore, research into the widespread use of respirators by the general public has less impressive results [6].

The protective effect of respirators may also be impaired if people engage in unsafe behaviours during the lockdown, such as gathering in groups, in violation of government guidelines. Keeping distance seems to be the most important way to prevent the spread of the disease. It should be remembered that respirators do not protect well against aerosolised contagion.

Respirators have consistently been used in public by about half of the European population. In five countries (Spain, Hungary, Portugal, Romania, and Italy), use exceeded 60%, but those countries did not have better results than other nations. A possible reason for this may be the "wrong" sense of security created by respirators, thus, no other key actions were taken, such as keeping distance, hand hygiene, and isolation when symptoms appear. This supports the findings of a Danish study indicating that respirators did not protect users [6].

A limitation in the study is the collection of data on respirator

Tab. I. Respiratory protection use, reported cases and deaths, cumulatively and during the previous 14 days (1-14 October 2020).

Country	Use of mask 1.6 (%)[1]	Cases (number)[2]	Deaths (number)[2]	Recent cases (number)[3]	Recent deaths (number)[3]	Mortality (%)[4]
Austria	45	6,413.4	97.6	148.5	0.9	1.5
Belgium	33	14,939.8	386.5	469.5	2.0	5.9
Bulgaria	44	3,709.3	132.8	74.7	1.6	3.6
Croatia	5	5,113.7	80.4	113.2	1.3	1.6
Cypros	43	1,695.4	20.7	34.7	0.3	1.2
Czech Republic	42	12,115.7	103.3	581.3	4.4	0.9
Denmark	1	5,714.8	116.4	97.1	0.4	2.0
Estonia	57	1,505.7	21.7	57.9	0.2	1.7
Finland	2	2,255.8	62.5	47.2	0.1	2.8
France	38	11,164.5	500.7	307.1	1.6	4.4
Germany	50	3,993.4	115.5	54.6	0.2	2.9
Greece	20	2,212.4	44.3	46.0	0.7	2.0
Hungary	61	4,221.6	105.9	146.5	2.6	2.5
Iceland	43	10,748.9	29.3	272.6	0.0	0.3
Ireland	10	8,943.1	370.6	171.7	0.6	4.1
Italy	79	6,044.6	599.5	86.9	0.6	9.9
Latvia	57	1,505.7	21.7	57.9	0.2	1.4
Lithuania	57	2,338.5	38.9	64.0	0.5	1.7
Luxembourg	43	15,719.4	212.5	229.5	1.5	1.6
Norway	1	2,884.8	51.1	34.7	0.1	1.8
Poland	53	3,574.4	81.9	119.3	1.6	2.3
Portugal	67	8,740.2	206.9	140.2	1.4	2.4
Romania	75	8,341.0	287.7	180.5	3.8	3.5
Slovakia	57	3,825.5	11.2	207.5	0.3	0.3
Slovenia	48	4,400.3	179.9	179.9	0.4	1.6
Spain	75	18,417.6	704.3	293.8	3.4	3.7
Sweden	1	9,966.5	584.1	79.3	0.2	5.9
Netherlands	3	11,010.4	386.5	412.2	1.4	3.5
United Kingdom	9	9,352.8	633.7	283.2	1.4	6.8

[1] Percentage of inhabits wearing a mask in public; [2] Cases per 1,000,000 people; [3] Cases per 100,000 people, 1-14 October 2020; [4] COVID deaths (% of diagnosed cases).

use through the IHME COVID database and through Facebook. However, the information can be considered as indicative and corresponds well to our understanding of respirator use in different countries. Moreover, the different lockdown conditions employed in each country (*e.g.* school closures) can be considered a limitation of the present study. In addition to respiratory protection recommendations, it is important to share information on the proper use of respirators while recalling other principles of communicable disease control. These data on the benefits of respirators provide evidence for both disease prevention and COVID death prevention.

Ethics

Using only publicly available worldwide data, the approval of Ethics Committee was not needed.

Acknowledgements

Funding sources: this research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Conflict of interest statement

The authors declare no conflict of interest.

Authors' contributions

The study protocol, manuscript and analysis were made JB.

References

[1] Chu DK, Akl EA, Duda S, Solo K, Yaacoub S, Schünemann HJ. Physical distancing, face masks, and eye protection to prevent person-to-person transmission of SARS-CoV-2 and COVID-19: a systematic review and meta-analysis. Lancet 2020;395:1973-87. https://doi.org/10.1016/S0140-6736(20)31142-9

[2] Střížová Z, Bartůňková J, Smrz D. Can wearing face masks in public affect transmission route and viral load in COVID-19? Cent Eur J Public Health 2020;28:161-2. https://doi.org/10.21101/cejph.a6290

[3] Memoli MJ, Czajkowski L, Reed S, Athota R, Bristol T, Proudfoot K, Fargis S, Stein M, Dunfee RL, Shaw PA, Davey RT, Taubenberger JK. Validation of the wild-type influenza A human challenge model H1N1pdMIST: an A(H1N1)pdm09 dose-finding investigational new drug study. Clin Infect Dis 2015;60:693-702. https://doi.org/10.1093/cid/ciu924.

[4] Wilson AM, Abney SE, King MF, Weir MH, Lopez-Garcia M, Sexton JD, Dancer SJ, Proctor J, Noakes CJ, Reynolds KA. COVID-19 and use of non-traditional masks: how do various materials compare in reducing the risk of infection for mask wearers? J Hosp Infect 2020;105:640-2. https://doi.org/10.1016/j.jhin.2020.05.036

[5] MacIntyre CR, Dung TC, Chughtai AA, Seale H, Rahman B. Contamination and washing of cloth masks and risk of infection among hospital health workers in Vietnam: a post hoc analysis of a randomised controlled trial. BMJ Open 2020;10:e042045. https://doi.org/10.1136/bmjopen-2020-042045

[6] Bundgaard H, Budgaard JS, Raaschou-Pedersen DET, von Buchwald C, Todsen T, Norsk JB, Pries-Heje MM, Vissing CR, Nielsen PB, Winslow UC, Fogh K, Hasselbalch R, Kristensen JH, Ringgaard A, Andersen MP, Goecke NB, Trebbien R, Skovgaard K, Benfield T, Ullum H, Torp-Pedersen C, Iversen K. Effectiveness of adding a mask recommendation to other public health measures to prevent SARS-CoV-2 infection in Danish mask wearers: a randomized controlled trial. Ann Intern Med 2020;M20-6817. https://doi.org/10.7326/M20-6817

[7] World Health Organization. When and how to use masks. Available at: https://www.who.int/emergencies/diseases/novel-coronavirus-2019/advice-for-public/when-and-how-to-use-masks (accessed on November 30, 2020).

[8] Washington University IHME (Institute for Health Metrics and Evaluation). COVID database. Available at: https://covid19.healthdata.org/global?view=total-deaths&tab=trend (accessed on November 30, 2020).

[9] European Centre for Disease Prevention and Control. COVID-19 situation update for the EU/EEA, as of week 1 2021. Available at: https://www.ecdc.europa.eu/en/cases-2019-ncov-eueea (accessed on November 30, 2020).

[10] WHO. Coronavirus disease (COVID-19) dashboard. Available at: https://covid19.who.int (accessed on November 30, 2020).

Received on December 9, 2020. Accepted on January 25, 2021.

Correspondence: Janne Burman, Skin and Allergy Hospital, Meilahdentie 2, 00250 Helsinki, Finland - E-mail: janne.burman@hus.fi

How to cite this article: Burman J. The use of respirators and its impact on the COVID-19 pandemic in Europe between 1 June and 14 October 2020. J Prev Med Hyg 2021;62:E625-E627. https://doi.org/10.15167/2421-4248/jpmh2021.62.3.1909

Review

Emerging and re-emerging viral infections in India

MAMTA PATEL[1], AKHIL DHANESH GOEL[2], PANKAJ BHARDWAJ[3], NITIN JOSHI[1], NITESH KUMAR[2], MANOJ KUMAR GUPTA[2], VIDHI JAIN[4], SUMAN SAURABH[2], KAMLESH PATEL[5]
[1] School of Public Health, AIIMS Jodhpur; [2] Department of Community and Family Medicine, AIIMS Jodhpur; [3] Additional Professor; [4] Department of Microbiology, AIIMS Jodhpur; [5] Department of Anaesthesia, SNMC Jodhpur

Keywords

Nipah • KFD • CCHF • Zika • COVID-19

Summary

The number of outbreaks have progressively increased since many years in India. In this era of globalization and rapid international travel, any infectious disease in one country can become a potential threat to the entire globe. Outbreaks of Nipah, Zika, Crimean-Congo Haemorrhagic Fever and Kyasanur Forest Disease have been reported since a decade and now we are facing COVID-19 pandemic. One of the challenges in the prevention of these outbreaks is that as the cases decrease, the felt need declines, the public demand decreases and the mitigation responses get overshadowed by the need of emergency responses elsewhere. The One Health approach is a movement to promote alliance between medicine field, veterinary medicine and environmental sciences to upgrade the health of humans, animals, and ecosystem. The data in this article is compiled from different websites and publications of World Health Organization (WHO), Centre for Disease Control and Prevention (CDC), Integrated Disease Surveillance Programme (IDSP), grey literature and media. There is an urgent need for better surveillance and disease burden assessments in the country and to gain detailed insights into vector biology, factors of environment influencing the diseases, mapping of endemic areas, strengthen intersectoral coordination, infection control practices, and ensure use of Personal Protective Equipment's (PPE) and availability of drugs and vaccines to handle the outbreaks in a better way.

Introduction

Man is in a continuous battle with emerging and re-emerging diseases. In past, the incidence of these diseases in humans has increased and threatens to increase in future. The number of reported outbreaks have progressively increased from 553 in 2008 to 1,611 in 2018 [1] (Fig. 1).

Infectious diseases do not respect international borders. Especially in this era of globalization and rapid international travel, any infectious disease in one country can become a potential threat to the entire globe. India being a country with massive population and extreme geo-climatic diversity, faces a persistent threat of viral infections of public health importance.

The emerging diseases are threat to community as it increases morbidity and mortality and even increases bioterrorism potential. The categorization of bioterrorist agents have been done as A, B and C based on priority of agents posing risk and ease with which they can be disseminated [2].

One of the challenges in the prevention of outbreak is that as the cases decrease, the fear declines, the public demand decrease and the mitigation responses get overshadowed by the need of emergency responses elsewhere. And it is known that if a pathogen is not eliminated, it may become endemic. Low socio-economic status, impoverished environment, lack of affordability and accessibility all contribute towards risk of infectious disease outbreaks. Poor surveillance system and lack of understanding of the diverse epidemiological factors necessary for the emergence make control and prevention of these outbreaks challenging.

It has been almost a decade since the first PHEIC (Public Health Emergency of International Concern) was declared. WHO has declared six PHEIC till date-Swine flu in 2009, Polio in 2014, Ebola and Zika in 2016, Kivu Ebola in 2019 and the ongoing 2019-20 coronavirus pandemic [3, 4]. In the last decade, various viral diseases have had a serious health impact in India. The objective of the current narrative review is to explore the various characters of emerging infectious disease seen in recent past in India.

Methods

The current narrative article reviews some recent viral outbreaks that have occurred in India. The data is compiled from World Health Organization (WHO), Centre for Disease Control and Prevention (CDC), Integrated Disease Surveillance Programme (IDSP), grey literature and media. Two of the authors were engaged in writing the review article, two in conceptualizing and investigating the data and two in validation. Two of them were occupied in finding the resources and one author did the data curation (Tab. I). The database used are scopus, Pubmed and Google scholar.

NIPAH

The recent outbreak of Nipah in Kerala India had sent panic ripples across the world. Nipah virus outbreak was

https://doi.org/10.15167/2421-4248/jpmh2021.62.3.1899

Fig. 1. Line graph showing number of reported outbreaks from 2008 to 2018 (source: IDSP, original to the manuscript).

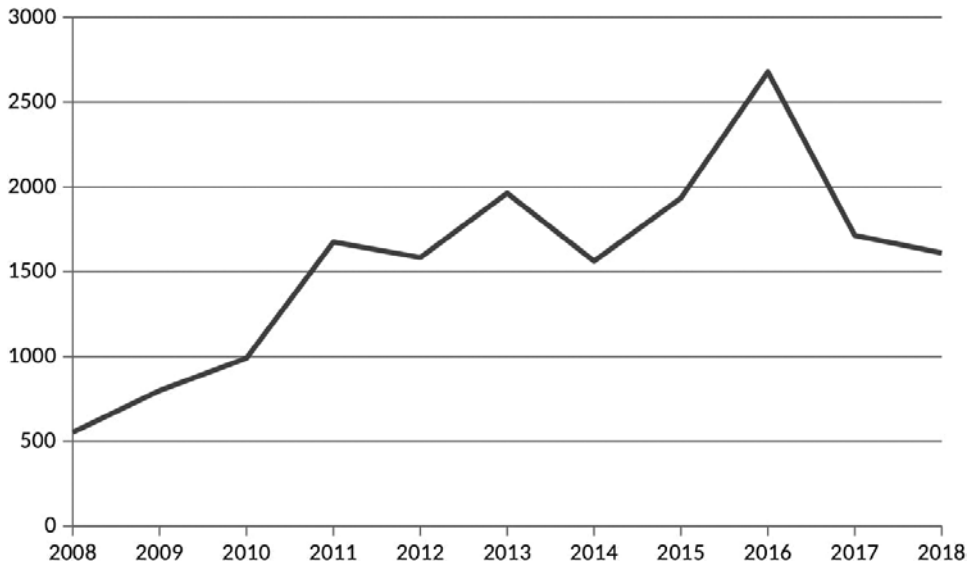
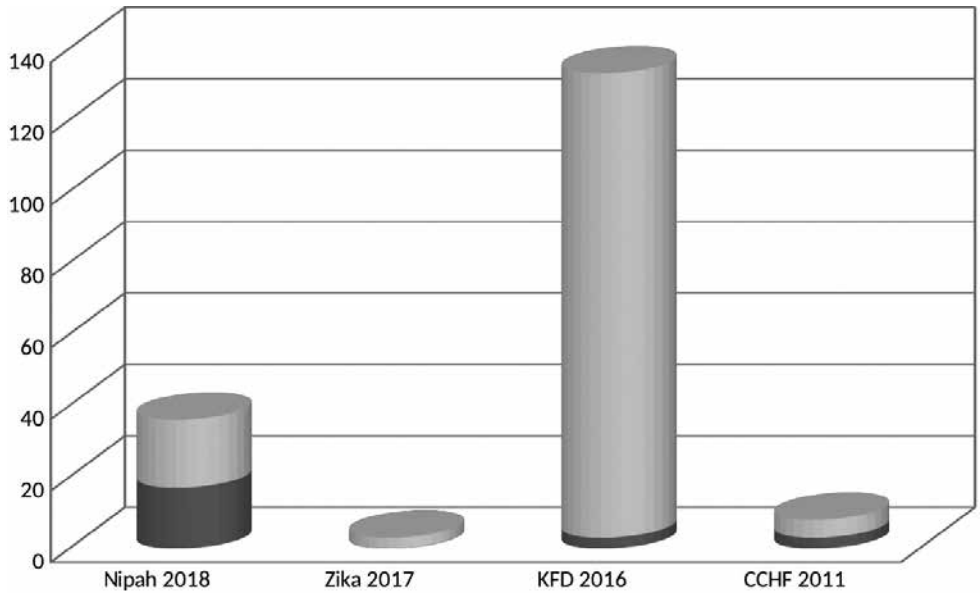


Fig. 2. Graph depicting cases confirmed and died in the reported outbreaks(source: IDSP, original to the manuscript).



reported on 17th July 2018 in Kozhikode and Malappuram districts of Kerala state. A total of 19 cases were seen of which 17 died [5] (Fig. 2).

The causative agent is Nipah virus (family Paramyxoviridae) and host being pigs and bats. Nipah virus emerged as a new virus 21 years ago i.e. in 1998 in Malaysia which caused morbidity and deaths and demolished the pig-farming industry in Malaysia. This virus caused outbreaks in Bangladesh and Siliguri, India in 2001 where bats of the Pteropodidae family were incriminated as potential reservoirs [6].

Nipah virus outbreak should be suspected in relevant epidemiological settings, considering history of travel or contact with pigs or bats in patients presenting with acute encephalitis. If an outbreak is suspected, the animal premises should be quarantined instantly.

Nipah is classified as category C of bioterrorism potential which includes emerging pathogens that could be engineered for mass dissemination, are easily produced and disseminated, and have capacity for high morbidity and mortality rates [7].

Tab. I. Details of some viral outbreaks in India.

	CCHF outbreak	KFD outbreak	Zika outbreak	Nipah virus outbreak	COVID-19 outbreak
Year and place of outbreak	2011, 2012, 2013 - Gujarat 2014 - Gujarat and Rajasthan 2015 - Gujarat, Rajasthan and Uttar Pradesh 2019 - Gujarat and Rajasthan	1957 - Karnataka 2012-2013 - Karnataka, Tamil Nadu, Kerala 2014 - Karnataka 2015 - North Goa 2016 - Maharashtra 2017 - Goa and Maharashtra	2017 - Gujarat	2001, 2007 - West Bengal 2018- Kerala	2019-2020 Asia (China, Japan, India, Malaysia, Thailand, Indonesia, South Korea and many other countries), Europe, Middle East, North Africa
Causative agent (family)	Nairovirus (Bunyaviridae)	KFD virus (Flaviviridae)	Zika virus (Flaviviridae)	Nipah virus (Paramyxoviridae)	Novel Corona virus (Coronaviridae)
Host	Range of domestic animals (cattle, sheep and goats)	Rodents, shrews, and monkeys	Monkeys and Humans	Pigs and bats	Most likely to be of zoonotic origin
Mode of transmission	Tick bite, human to human spread by contact with infectious blood or body fluids	Tick bite, contact with an infected animal, no person-to-person transmission	Bite of infected Aedes mosquito, from mother to fetus during pregnancy, through sexual contact, transfusion of blood and blood products	Direct contact with bodily fluids of infected bats or pigs, contaminated foods, directly from human-to-human through close contact with secretions and excretions	Person to person contact through small droplets from the nose or mouth which are spread when a person with COVID-19 coughs or exhales
Symptoms					
• General symptoms	Fever, chills, severe headache, sore eyes, neck pain, myalgia, arthralgia, petechial rash	High fever, frontal headache, , vomiting, muscle stiffness, tremors	Fever, rash, itching, headache, joint and muscle pain, lower back pain	Fever, headache, , resp. illness, myalgia, vomiting	Fever, difficulty in breathing tiredness, and dry cough aches and pains, nasal congestion, runny nose, sore throat, diarrhoea
• Haemorrhagic	+	+	-	-	-
• Ocular complications	Photophobia	Photophobia	Conjunctivitis	-	-
• Neurological complications	-	Encephalitis	Microcephaly	Encephalitis, drowsiness, mental confusion	-
Incubation period	Infection with tick bite: 1-3 days Infection with infected blood or tissue: 5-6 days	3 to 8 days	3 to 12 days	4 to 14 days	1 to 14 days
Case fatality rate	As per literature: 30-50% As per the outbreaks: 2011-66.6% 2012-50% 2013-38.8% 2014-75% 2015 (up to March) - 50%	As per literature: 3-5% As per the outbreaks: 1999 to 2017 - 2.42%	As per literature: 8.3% As per the outbreak: 2017-0%	As per literature: 40-75% As per the outbreaks: 2001-68% 2007-100% 2018-89%	Estimated to be 3-4% but exact CFR will require some time to be deciphered
High risk groups	Contact with livestock Agricultural workers Slaughterhouse workers Veterinarians	People living/working in and around forest areas of endemic regions	Travellers	Family and caregiver of Nipah virus infected patients	Older persons and persons with pre-existing medical conditions (such as high blood pressure, heart disease, lung disease, cancer or diabetes)

Tab. I. Details of some viral outbreaks in India.

	CCHF outbreak	KFD outbreak	Zika outbreak	Nipah virus outbreak	COVID-19 outbreak
Immuno prophylaxis	No	Yes (formalin inactivated tissue culture vaccine)	No	No	No
Vaccine efficacy	-	60-65%	-	-	-
Chemo Prophylaxis	No proven role of Ribavirin as chemoprophylaxis	No specific treatment	No specific treatment	No specific treatment	Hydroxy-chloroquine for high risk population
Biosafety level	Level 4	Level 4	Level 2	Level 4	Level 2
Classifi cation of infective microorganisms by risk group	Risk group 4	Risk group 4	Risk group 3	Risk group 4	Risk group 4
Critical steps in containment	Robust surveillance system Entomological studies undertaken Tick vector control measures Health education	Human, monkey and tick surveillance Awareness regarding use of PPE Vaccination campaigns Routine IEC activities Spraying of insecticides Inter-sectoral coordination	Robust surveillance system International airports and ports displayed information for travellers Inter-Ministerial Task Force set up Tracking for clustering of acute febrile illness in the community	House to house active case search and contact tracing Infection control protocol strengthened Isolation, quarantine medical camps for awareness	Country knockdown Cluster Containment Strategy Robust surveillance system House to house active case search and contact tracing Isolation, quarantine Travel advisories Buffer stock of Personal Protective Equipment (PPE) Inter-Ministerial coordination Expanding laboratory capacity Deployment of Rapid Response Teams (RRT)
One health concept applied	+	+	+	+	+

Source: IDSP, WHO, CDC, MOHFW.

ZIKA

The Zika outbreak has captivated a global audience. It is transmitted by mosquito vector and possibly by sexual transmission [8]. On 15th May 2017, Ministry of Health and Family Welfare reported 3 laboratory confirmed cases of Zika in Bapunagar, Ahmedabad, Gujarat [9] (Fig. 2).

Zika virus was first isolated in 1947 in Uganda from a rhesus macaque. The first outbreak of Zika virus disease has been reported from the Island of Yap, Western Pacific region of WHO in 2007. Zika is one of the four PHEIC and is unique as it is incriminated in causing congenital anomalies [10].

The agent is Zika virus *(family* Flaviviridae) and host are monkeys and humans. There is scientific agreement that the Zika virus can cause microcephaly, Guillain–Barré syndrome (GBS) and other congenital brain deformities [11]. In adult cases it is not severe but it can have an impact on foetal development and lead to severe neurodevelopmental abnormalities.

KYASANUR FOREST DISEASE (KFD)/ MONKEY FEVER

KFD was reported in 2016 in Sindhuburg, Maharashtra, India where 488 suspected cases, 130 confirmed cases and 3 deaths occurred [12] (Fig. 2).

It was first discovered in 1957 in Kyasanur forest of Shimoga district, Karnataka, India. KFD is a public health problem along the belts of Western Ghats of India. Deforestation results in occupation of shrubs which gives a favourable environment to rodents and birds. And these rodents act as hosts for the growing larvae and nymphs which increases hosts, reservoirs and vector interaction [13]. To control the tick population, forest floor is treated with gamma-hexachlorocyclohexane. Tick repellents like N, N-diethyl-meta-toluamide (DEET) and dimethyl phthalate (DMP) oil can be used to avoid tick bites. The first vaccine for this was made by Indian Council of Medical Research (ICMR) that is Russian spring-summer encephalitis virus (RSSEV) because of the nearly antigenic resemblance between KFD virus and RSSEV [14].

Karnataka state government is following KFD

vaccination policy in endemic areas. The vaccine is formalin inactivated tissue culture vaccine. It is recommended for age group of 5-75 years with a dose of 1ml for age above 6 years and 0.5 ml below 6. There are 3 scheduled doses at 0,1,6 months [15].

CRIMEAN-CONGO HAEMORRHAGIC FEVER (CCHF)

First case of CCHF in India was diagnosed in 2011 and again the disease re-emerged in 2019 in Gujarat and Rajasthan. 5 cases of the disease including 3 deaths in Gujarat were reported [16] (Fig. 2).

It was first described in Crimea in 1944. In 1956 the pathogen causing Crimean haemorrhagic fever was found to be the same as that responsible for an illness recognized in Congo, and so it was named as Crimean–Congo haemorrhagic fever [17]. It is a serious threat for community as well as for health workers mainly in countries with poor resources. CCHF and dengue share initial clinical features and so it is difficult to diagnose. The agent for CCHF is Nairovirus (family Bunyaviridae) and host being a range of domestic animals like cattle, sheep and goats. Patients with CCHF face bleeding from multiple sites as the disease progresses. Several case reports recommend that Ribavirin is effective for treating CCHF infections [18]. This is the only antiviral known to have some effect on the viruses causing viral haemorrhagic fever. Health care professionals should strictly follow barrier nursing care for undiagnosed haemorrhagic fever patients so that nosocomial transmission can be prevented [19]. Tick control measures should be used for the tick host and habitat. Insecticidal formulations like 0.5% Dichlorovos, 1% Carbaryl or 3-5% Malathion can be used on domestic animals to get free from ticks [20].

CHANDIPURA VIRUS

The epidemic of Chandipura virus started in June, 2003. In Andhra Pradesh, 329 children (9 months and 14 years) developed encephalitis, and the number of deaths were 183. The suffering children complained of vomiting, abdominal pain, symptoms like Japanese encephalitis virus. Chandipura virus was first isolated in 1965 in a village in Maharashtra, India. It is a member of family Rhabdoviridae and is transmitted by vectors such as mosquitoes, ticks and sand flies. There is no specific treatment available and symptomatic treatment is done [21].

JAPANESE ENCEPHALITIS

In Asia, the major cause of viral encephalitis is Japanese encephalitis virus. This flavivirus, is possessed by the same genus as dengue and yellow fever. The first case of Japanese encephalitis viral disease (JE) was registered in 1871 in Japan. As the vector population increases in rainy season, JE transmission becomes more intense. Approximately 1 in 250 cases results in severe clinical illness. Safe and effective JE vaccines are available to prevent this disease [22].

CORONAVIRUS DISEASE (COVID-19)

An unprecedented outbreak of Corona virus in Wuhan City, China emerged in December 2019. The second wave has also started in India in 2021. Hospital isolation of confirmed cases, contact tracing and home quarantine of contacts is ongoing [23, 24].

Discussion

To target the agent, host and environment triad in a better way, a concept named One Health approach arrived. The One Health approach is a movement to promote alliance between medicine field, veterinary medicine and environmental sciences to upgrade the health of humans, animals, and ecosystem. It is to educate and refine health outcomes. This concept of one health is for well being of human, animal and plants through a collaborative universal approach [25].

In November 2004 Integrated Disease Surveillance Project (IDSP) with financial help from World Bank commenced disease surveillance system for epidemic prone diseases to strengthen decentralized laboratory based Information Technology, to detect and respond to outbreaks in early phase with the help of Rapid Response Teams (RRTs). It presents weekly update on outbreaks in the country [26].

Diagnosis of these viruses is possible but is too expensive for a cost-effective commercial or routine use. VRC (Viral Research Centre) was redesignated as National Institute of Virology (NIV) Pune. It is identified today as WHO Collaborating Center for arboviruses and haemorrhagic fever reference. The centre studies about viral diseases, investigates outbreaks and provides diagnosis for viral diseases and development of indigenous diagnostic tests. Vaccination has played a crucial role in reducing morbidity and mortality from infectious diseases such as in case of Small pox. Vaccines are precious means to fight infections and even represents the much wanted achievement. But a vaccine takes time to come in public due to its side effects and manufacturing problems, lack of experimental animal models, faster developing, producing and licensing issues. Therefore a new or alternative approach in vaccine development is required to face pandemic situations [27].

The Department of Health Research (DHR), MOHFW, Government of India, in 2013 made a vision to establish and strengthen the network of laboratories across the country namely Viral Research and Diagnostic Laboratory Network (VRDLN). There is a network of about 100 laboratories in India with the objectives to create infrastructure and identify viruses, for capacity building, to develop diagnostics, trainings and meetings of health officials and professionals and for research [28].

The most essential aspects of prevention of viral outbreaks lies in surveillance of agent, host and environment. WHO since long has a mandate for promoting and supervising surveillance activities which has been emphasized further in recent times as evident from International Health Regulations (IHR) and pandemics of Public

Health Emergency of International Concern (PHEIC). An important limitation of the current review is that only the recorded data could be included in this review. There could be many other outbreaks which could have missed detection or underreported. Thus an essential recommendation is the need for a better surveillance and disease burden assessments in the country.

Conclusions

The past events strengthen the fact that infectious diseases will continue to emerge. If not controlled effectively, they will take a devastating toll on human life. There is an urgent need for better surveillance and disease burden assessments in the country. It is also required to gain detailed insights into vector biology, environmental factors, mapping of endemic areas, strengthen intersectoral coordination, infection control practices, and ensure use of Personal Protective Equipment's (PPE) and availability of drugs and vaccines to handle the outbreaks in a better way [29].

Ethics

Ethics permission from IEC committee of the institution AIIMS Jodhpur was not sort as it is a review article and secondary data is used.

Acknowledgements

Funding sources: this research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Conflict of interest statement

The authors declare no conflict of interest.

Authors' contributions

Mamta Patel: Writing- Original draft preparation. Akhil Dhanesh Goel: Writing, supervision. Pankaj Bhardwaj: Validation, visualization. Nitin Joshi: Conceptualizing. Nitesh Kumar: Conceptualizing, finding resources. Manoj Kumar Gupta: Validation, investigating data. Vidhi Jain: Finding resources, investigating data, Suman Saurabh: Data curation. Kamlesh Patel: Investigating data.

References

[1] Outbreaks: Integrated Disease Surveillance Programme (IDSP) Available at: https://idsp.nic.in/index4.php?lang=1&level=0&linkid=403&lid=3685. https://doi.org/10.1089/vbz.2020.2661

[2] Das S, Kataria VK. Bioterrorism : a public health perspective. Med Journal, Armed Forces India 2010;66:255-60. https://doi.org/10.1016/S0377-1237(10)80051-6.

[3] World Health Organization. Statement on the meeting of the International Health Regulations (2005) Emergency Committee for Ebola virus disease in the Democratic Republic of the Congo on 17 July 2019. Available at: https://WwwWhoInt/Ihr/Procedures/Statement-Emergency-Committee-Ebola-Drc-July-2019Pdf?Ua=1.2019;(July):1–6

[4] Coronavirus (COVID-19) events as they happen. Available at: https://www.who.int/emergencies/diseases/novel-coronavirus-2019/events-as-they-happen (last accessed: 2020 Apr 8).

[5] WHO. Emergencies preparedness , response Nipah Virus (NiV) Infection 2016;1-2. Available at: http://www.who.int/csr/disease/nipah/en

[6] Chattu VK, Kumar R, Kumary S, Kajal F, David JK. Nipah virus epidemic in southern India and emphasizing "One Health" approach to ensure global health security. J Fam Med Prim care 2018;7:275-83. https://doi.org/10.4103/jfmpc.jfmpc_137_18

[7] CDC. Bioterrorism/ Agents/Diseases (by category)/ Emergency Preparedness & Response. Available at: https://emergency.cdc.gov/agent/agentlist-category.asp (last accessed: 2019 Aug 31).

[8] Chang C, Ortiz K, Ansari A, Gershwin ME. The Zika outbreak of the 21st century. J Autoimmun 2016;68:1-13. https://doi.org/10.1016/j.jaut.2016.02.006

[9] World Health Organization. Emergencies preparedness , response Zika virus infection – Cape Verde. WHO 2016. Available at: http://www.who.int/csr/don/21-december-2015-zika-c

[10] Noorbakhsh F, Abdolmohammadi K, Fatahi Y, Dalili H, Rasoolinejad M, Rezaei F, Salehi-Vaziri M, Shafiei-Jandaghi NZ, Gooshki ES, Zaim M, Nicknam MH. Zika virus infection, basic and clinical aspects: a review article. Iran J Public Health 2019;48:20-31. https://doi.org/10.18502/ijph.v48i1.779

[11] Krauer F, Riesen M, Reveiz L, Oladapo OT, Martínez-Vega R, Porgo T, Haefliger A, Broutet NJ, Low N. Zika virus infection as a cause of congenital brain abnormalities and Guillain-Barré syndrome: systematic review. PLoS Med 2017;14:1-27. https://doi.org/10.1371/journal.pmed.1002203

[12] Gurav YK, Yadav PD, Gokhale MD, Chiplunkar TR, Vishwanathan R, Patil DY, Jain R, Shete AM, Patil SL, Sarang GD, Sapkal GN, Andhare MD, Sale YR, Awate PS, Mourya DT. Kyasanur forest disease prevalence in western ghats proven and confirmed by recent outbreak in Maharashtra, India, 2016. Vector-Borne Zoonotic Dis 2018;18:164.72. https://doi.org/10.1089/vbz.2017.2129

[13] Walsh JF, Molyneux DH, Birley MH. Deforestation effects on vector-borne disease. Parasitology 1993;106(S1):S55-75. https://doi.org/10.1017/s0031182000086121

[14] Shah SZ, Jabbar B, Ahmed N, Rehman A, Nasir H, Nadeem S, Jabbar I, Rahman Zu, Azam S. Epidemiology, pathogenesis, and control of a tick-borne disease-Kyasanur forest disease: Current status and future directions. Front Cell Infect Microbiol 2018;8. https://doi.org/10.3389/fcimb.2018.00149

[15] CDC. Kyasanur forest disease: a public health concern. 1957. Available at: https://idsp.nic.in/WriteReadData/l892s/60398414361527247979.pdf

[16] National Centre for Disease Control, Directorate General of Health Services. Integrated Disease Surveillance Programme. Disease alerts/ outbreaks reported and responded to by states/ UTs through integrated disease surveillance project (IDSP), 1 st week (ending 8 th January) 2012/ District wise disease alerts/ outbreaks reported in the 1 st week, 2012. Available at: https://idsp.nic.in/index4.php?lang=1&level=0&linkid=313&lid=1592

[17] World Health Organization. Emergencies Crimean-Congo haemorrhagic fever. WHO 2019;1-2. Available at: https://www.who.int/health-topics/crimean-congo-haemorrhagic-fever#tab=tab_1

[18] Branch E, Services M. Guideline for management of Crimean Congo hemorrhagic fever. 2013. Available at: https://www.cdc.gov/vhf/crimean-congo/treatment/index.html

[19] Patel AK, Patel KK, Mehta M, Parikh TM, Toshniwal H, Patel K. First Crimean-Congo hemorrhagic fever outbreak in India. J Assoc Physicians India 2011;59:585-9.

[20] NCDC newsletter, Volume 4, Issue 1, January-March 2015. Available at: https://www.ncdc.gov.in/linkimages/Newsletter-March20153160226752.pdf

[21] Van Ranst M. Chandipura virus: an emerging human pathogen? Lancet 2004;364:821-2 https://dx.doi.org/10.1016%2FS0140-6736(04)16995-X

[22] Erlanger TE, Weiss S, Keiser J, Utzinger J, Wiedenmayer K. Past, present, and future of Japanese encephalitis. Emerg Infect Dis 2009;15:1-7. https://doi.org/10.3201/eid1501.080311

[23] Coronavirus Disease. Available at: https://www.who.int/india/emergencies/novel-coronavirus-2019 MoHFW/ Home. Available at: https://www.mohfw.gov.in (last accessed: 2020 Apr 8).

[24] Mission /Goals - One Health Commission. Available at: https://www.onehealthcommission.org/en/why_one_health/mission__goals (last accessed: 2020 Apr 14).

[25] Home: Integrated Disease Surveillance Programme (IDSP). Available at: https://idsp.nic.in

[26] Trovato M, Sartorius R, Apice LD, Manco R. Viral emerging diseases: challenges in developing vaccination strategies. Front Immunol 2020;11:2130. https://doi.org/10.3389/fimmu.2020.02130

[27] Virus Research And Diagnostic Laboratory Network. Available at: http://112.133.207.124:82/vdln

[28] Mourya DT, Yadav PD, Ullas PT, Bhardwaj SD, Sahay RR, Chadha MS, Shete AM, Jadhav S, Gupta N, Gangakhedkar RR, Khasnobis P, Singh SK.Emerging/re-emerging viral diseases & new viruses on the Indian horizon. Indian J Med Res 2019;149:447-67. https://doi.org/10.4103/ijmr.IJMR_1239_18 (last accessed: 2019 Aug 22).

Received on December 2, 2020. Accepted on July 5, 2021.

Correspondence: Pankaj Bhardwaj, Community Medicine & Family Medicine, All India Institute of Medical Sciences, Jodhpur - Tel.: 8003996903 - E-mail: pankajbhardwajdr@gmail.com

How to cite this article: Patel M, Goel AD, Bhardwaj P, Joshi N, Kumar N, Gupta MK, Jain V, Saurabh S, Patel K. Emerging and re-emerging viral infections in India. J Prev Med Hyg 2021;62:E628-E634. https://doi.org/10.15167/2421-4248/jpmh2021.62.3.1899

RESEARCH ARTICLE

The Incidence and Geographical Distribution of Brucellosis in Iran Using Geographic Information System and Prediction of its Incidence in 2021

MOHAMMAD REZA SHIRZADI[1], PARVIN MOHAMMADI[2], GHOBAD MORADI[3], ELHAM GOODARZI[4], SALMAN KHAZAEI[5], LEILI MOAYED[6], ZAHER KHAZAEI[7]

[1] Communicable Diseases Management Center, Ministry of Health and Medical Education, Tehran, Iran; [2] Department of medical sciences, Sanandaj baranch, Islamic Azad University, Sanandaj, Iran; [3] Associate Professor, Social Determinants of Health Research Center, Research Institute for Health Development, Kurdistan University of Medical Sciences, Sanandaj, Iran; [4] Social Determinants of Health Research Center,Lorestan University of Medical Sciences, Khorramabad, Iran; [5] Research Center for Health Sciences, Hamadan University of Medical Sciences, Hamadan, Iran; [6] Iranian Research Center on Healthy Aging, Sabzevar University of Medical Sciences, Sabzevar, Iran; [7] Department of Public Health, School of Medicine, Dezful University of Medical Sciences, Dezful, Iran

Keywords

Incidence rate • Brucellosis • Geographic Information System • Iran

Summary

Background. *Brucellosis is one of the most challenging health issues in many developing countries including Iran. The purpose of this study is to investigate the incidence and geographical distribution of brucellosis using Geographic Information System (GIS) and to predict its incidence in Iran in 2021.*

Method. *This is a descriptive-analytical cross-sectional study, which contains spatial and climatic information along with the prevalence rate of brucellosis in Iran. Disease information was obtained from the National Center for Infectious Diseases Management during 2011-2015. Then, Arc GIS version 9.3 was used to plot the geographical maps for the incidence and frequency of the disease. Using the Raster calculator tool, the disease prediction map for the future was plotted. For proper spatial distribution of hot and cold spots, Getis-Ord-Gi statistic was employed.*

Findings. *The highest incidence of brucellosis during 2009-2015 was observed in the western provinces of Iran (North Khorasan, South Khorasan and Razavi Khorasan provinces). The incidence of brucellosis in Iran decreased from 2009 to 2011 but it exhibited an increasing trend from 2011 to 2014. The provinces of Kurdistan, Lorestan, Ilam, Zanjan and Kermanshah may be among the hot spots in terms of brucellosis incidence in 2021.*

Conclusion. *We predicted significant variations in brucellosis risk distribution in Iran in the coming years. In the western and northwestern provinces, which are among the high risk areas for the incidence of this disease in the future, this disease can pose a serious health threat to the residents of these areas.*

Introduction

Brucellosis is not only the most common zoonotic disease, but as a newly emerging disease, poses serious challenge to health policy makers worldwide [1]. Brucellosis is a major economic and public health issue with diverse geographical distributions worldwide [2].

The incidence of brucellosis is about 200 per 100,000 population in some parts of the world [3]. This disease is still endemic in the Mediterranean, Middle East and Central Asian countries [4]. In some European and North American countries, the disease has been eradicated due to restrictions posed on international trade of animals and animal products [5]. Compared to Europe, North America and other developed areas of the world, the main burden of the disease is felt in the Mediterranean, South and Central America, Africa, Asia, the Indian subcontinent, Eastern Europe and the Middle East, especially Syria, Iraq, Egypt, Turkey and Iran [6, 7]. In addition, brucellosis care data often remains unknown due to diagnostic errors and lack of reporting and diversity of clinical cases [8].

There are significant differences in the incidence of this disease among countries. Iraq and Egypt have witnessed a 4 to 5-fold increase compared to other areas. This difference in incidence rates across regions reflects disparity in geographic, environmental, social, and economic factors and lifestyle [9].

Iran has the second highest prevalence of the disease worldwide [1]. However, the disease rate is not uniformly distributed throughout Iran, and this figure is higher in the western and northwestern provinces, so that this disease is endemic in some parts of Iran [10]. According to the latest statistics, the highest prevalence of the disease in Iran, ranging from 31 to 41 in 100,000 people, belongs to the provinces of Lorestan, Markazi, East Azarbaijan and Kermanshah [11, 12].

Location and time are two important factors in the distribution of brucellosis in Iran. Hence, many studies have used GIS to investigate the distribution of this disease in Iran and elsewhere in the world [13, 14].

The GIS is utilized in two health spheres of epidemiology and health care [15, 16]. Therefore, since public health issues and disease spread are directly related to the geography of a region and always possess a spatial dimension, GIS can play a crucial role in managing and

planning public health issues and studying disease spread [17]. Therefore, as with other epidemics, gaining insights into the geographical pattern of brucellosis incidence is vital to interventions and disease management. The purpose of this study is to evaluate the incidence and geographical distribution of brucellosis using GIS in Iran.

Method

This is a descriptive-analytical cross-sectional study. The study includes spatial and climatic information as well as information on the prevalence rate of brucellosis in Iran. Initially, data on brucellosis from 2009 to 2015 were collected and categorized from the Centers for Disease Control. The tables of brucellosis frequency and incidence were drawn for each year. The incidence rate for 100,000 people in the country was calculated. Then, GIS software was used to plot the map of the incidence and frequency of disease. The 2017 map of political divisions of Iran in vector format, developed by Iranian Mapping Organization, was used to develop a spatial database of the disease (To link descriptive information of the disease to the spatial data, a database is designed in GIS, and then verified by determining its geographical location using Google earth software).

Since data on incidence are obtained based on the findings of routine healthcare system, the difference in incidence that was observed in different provinces can be largely dependent on the sensitivity of the healthcare system to record and report cases in these provinces.

Laboratory diagnostic criteria for this disease are based on:

A) Separation of the agent (Brucella spp.) from clinical specimens in the culture site;
B) Brucella agglutination titers (STAT≥1/80) or seroagglutination test in one or more serum samples prepared after the onset of symptoms, or an at least four-fold increase in Brucella agglutination titers 2 weeks after the initial test;
C) Testing 2-ME ≥ 1/40 (2-mercaptoethanol);
D) Coombs Wright test with 3 dilutions greater than Wright.

In order to make laboratory diagnostics at health centers, public and private laboratories across the country, directly on patient serum samples due to inadequate distribution and inadequate maintenance of Rose Bengal antigen, following clinical suspicion and physician testing. The Wright T test is also called standard agglutination test tube (STAT), and called agglutination test serum (SAT) will be done.

In order to make laboratory diagnostics at health centers, public and private laboratories across the country uniform, due to inadequate distribution and inadequate maintenance of Rose Bengal antigen, following clinical suspicion and physician request for testing, The Wright T test, also called standard agglutination test tube (STAT), and called agglutination test serum (SAT), will be done directly.

By preparing the geographic database of the disease, descriptive information such as incidence and frequency of disease was included in the GIS descriptive information table by Microsoft Excel software. Subsequently, spatial analysis was performed to map the distribution of disease incidence and frequency in Iran from 2009 to 2015.

With the information of each province available, the incidence and frequency of disease was developed for the whole country. In order to plot the map of interpolation, the inverse distance interpolation (IDW) method was used [18]. Interpolation map was plotted according to the total frequency and incidence of the disease. In order to plot the disease prediction map, we assumed that in regions with the highest incidence or frequency of the disease and the highest recurrence in a given period, the disease is more likely to spread. The fuzzy map of the disease over a specific period were multiplied by recurrence map of the disease in a given period by the Raster calculator, and finally the projection map of disease in future was plotted. In this map, the most likely areas of disease are shown in red.

Hotspot analysis

The Getis-Ord-Gi* statistic was used for appropriate spatial distribution of hot and cold spots. A disease is recognized as a hot spot when its figures and those of its surrounding conditions are fairly high. When Getis-Ord-Gi* statistic is calculated to be 1, 2, 3, the confidence interval is estimated at 99%, 95%, 90%, respectively. The Getis-Ord-Gi* statistic is computed as follows [19].

Results

The results of the study revealed that brucellosis incidence in males was significantly higher females (59% vs 41%).

About 78% of patients lived in rural areas and 21% in urban areas. The incidence was 21% (1%) in the nomadic population, which may be due to the lack of reporting of the disease in the nomadic population.

A history of contact with livestock was reported in 78.7% of cases. 60% of patients had a history of consuming non-pasteurized dairy products and about 19% reported a history of contact with an infected person in the family as a source of contamination.

According to the results of study, the highest incidence of brucellosis was observed in the age group of 59-30 (42.98%), and of all cases of brucellosis, 5.61% was related to children under 8 years of age and 11.22% to people aged above 60 (Tab. I).

The results of the study exhibited that the highest incidence of brucellosis during 2009-2015 was in Lorestan, Hamedan and Kurdistan, Markazi, Kermanshah, East and West Azerbaijan and North, South and Razavi Khorasan provinces, with 28 to 103 cases per 100,000 people (Tab. II).

The results showed that the trend of brucellosis in Iran from 2009 to 2015 has been decreasing and increasing (Fig. 1).

The GIS maps show the incidence of brucellosis in different provinces during 2009-2015 (Fig. 2).

As displayed in Figure 3, the southern provinces (regions with higher temperatures, rainfall, vegetation and lower

Tab. I. Demographic information of patient with brucellosis in Iran from 2011 to 2015.

Frequency (%)	Variable	
28137 (41)	Female	Gender
40612 (59)	Male	
53371 (78)	Rural	Living environment
14314 (21)	Urban	
459 (1)	Nomadic	
54683 (78.7)	Yes	Domestic animals contact
11648 (16.8)	No	
3163 (4.6)	Indistinctive	
41303 (59.4)	Yes	History of non-pasteurized dairy products
10441 (15)	No	
17750 (25.6)	Indistinctive	
13276 (19.1)	Yes	History of contact with affected person
49732 (71.6)	No	
6486 (9.3)	Indistinctive	
3798 (5.61)	0-8	Age group
9831 (14.53)	9-18	
17330 (25.61)	19-29	
29080 (42.98)	30-59	
7593 (11.22)	60 ≤	
463 (0.7)	Yes	Complications of the disease
20103 (28.9)	No	
48925 (70.4)	Indistinctive	

livestock grazing) had the lowest incidence rates, and the northern, western, and northwestern provinces (regions with lower temperatures but rainfall, vegetation and higher livestock grazing) had the highest incidence of brucellosis during 2009-2015 period.

The incidence rate was projected for 2021 using ARC GIS software version 9.3, as shown in Figure 4. The prediction results for 2021 suggest that these provinces may witness a higher incidence rate in 2021, but this rising trend may be variable between provinces, with Lorestan, Hamedan and Kurdistan provinces facing a more steeped upward trend. Sistan and Baluchestan, Hormozgan and Khuzestan provinces may see slight variations in the incidence rate. In other words, tropical provinces are less likely to demonstrate any increasing or decreasing trends whereas cold and mountainous provinces (Lorestan, Hamedan, Kurdistan, East and West Azerbaijan, etc.) may experience a high incidence of brucellosis in 2021.

Overall, the results regarding brucellosis incidence rate in 2009–2015 and the prediction of its incidence rate in 2021 suggest the absence of comprehensive measures to control the disease. With the current trend, we may observe a substantial increase in the incidence rate in most provinces of Iran.

Tab. II. Brucellosis incidence per 100,000 people in Iran during 2009-2015 period.

2015	2014	2013	2012	2011	2010	2009	Year	ID
							Province	
44.24	44.55	41.35	35.05	21.40	41.39	43.85	East Azerbaijan	1
50.22	50.86	56.49	56.67	34.47	32.07	31.52	West Azerbaijan	2
19.69	19.83	20.13	14.55	14.90	16.41	16.96	Ardabil	3
16.53	16.68	19.21	13.27	10.47	8.17	9.42	Isfahan	4
5.24	5.34	6.47	3.42	3.19	1.45	0.00	Alborz	5
25.99	26.26	23.73	22.38	20.61	16.58	25.14	Ilam	6
4.99	5.09	3.06	2.94	2.71	1.00	2.06	Bushehr	7
2.74	2.77	2.55	2.01	1.52	2.62	1.58	Tehran	8
23.69	23.94	21.99	24.67	28.72	16.14	11.96	Chaharmahal and Bakhtiari	9
53.97	54.61	33.07	23.21	29.26	36.53	21.20	South Khorasan	10
39.48	40.05	42.23	35.24	32.65	30.75	30.09	Razavi Khorasan	11
44.44	44.94	39.08	29.16	23.73	15.54	16.35	North Khorasan	12
6.60	6.69	9.42	7.33	7.35	10.19	15.64	Khuzestan	13
58.32	58.93	43.01	30.99	27.95	22.79	26.36	Zanjan	14
31.05	31.57	33.79	19.50	18.54	15.57	24.27	Semnan	15
3.51	3.60	6.09	4.31	6.08	7.54	4.47	Sistan and Baluchestan	16
24.36	24.60	24.87	28.05	20.54	14.75	18.75	Fars	17
35.84	36.19	29.53	26.52	26.04	16.74	18.45	Qazvin	18
7.45	7.58	11.90	6.31	6.86	6.64	3.61	Qom	19
103.19	103.94	64.46	50.66	35.88	24.78	28.25	Kurdistan	20
16.33	16.57	19.17	15.96	14.32	16.60	19.89	Kerman	21
62.77	62.99	53.92	39.10	39.74	37.44	43.85	Kermanshah	22
27.17	27.60	12.92	10.16	9.26	9.04	17.90	Kohgiluyeh and Boyer-Ahmad	23
27.59	28.06	32.08	19.08	11.14	16.28	16.77	Golestan	24
2.36	2.37	2.63	3.04	2.66	2.84	1.80	Gilan	25
96.86	97.67	71.54	65.48	48.18	37.86	48.02	Lorestan	26
11.19	11.28	16.69	18.23	14.15	14.85	12.68	Mazandaran	27
34.69	35.03	41.33	51.47	42.36	37.64	46.50	Markazi	28
1.05	1.07	1.71	1.37	1.08	2.66	3.32	Hormozgan	29
93.65	94.12	84.30	64.71	47.50	37.55	32.78	Hamedan	30
15.24	15.56	26.86	13.95	15.08	12.30	13.76	Yazd	31
25.6	25.94	24.83	21.11	16.96	16.52	17.61	Total country	---

Fig. 1. Trend of Brucellosis in Iran during 2009-2015.

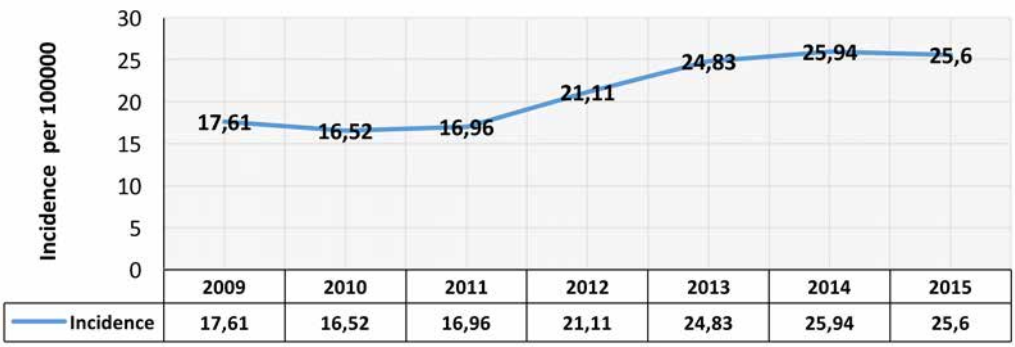


Fig. 2A. The incidence of brucellosis from 2009 to 2015.

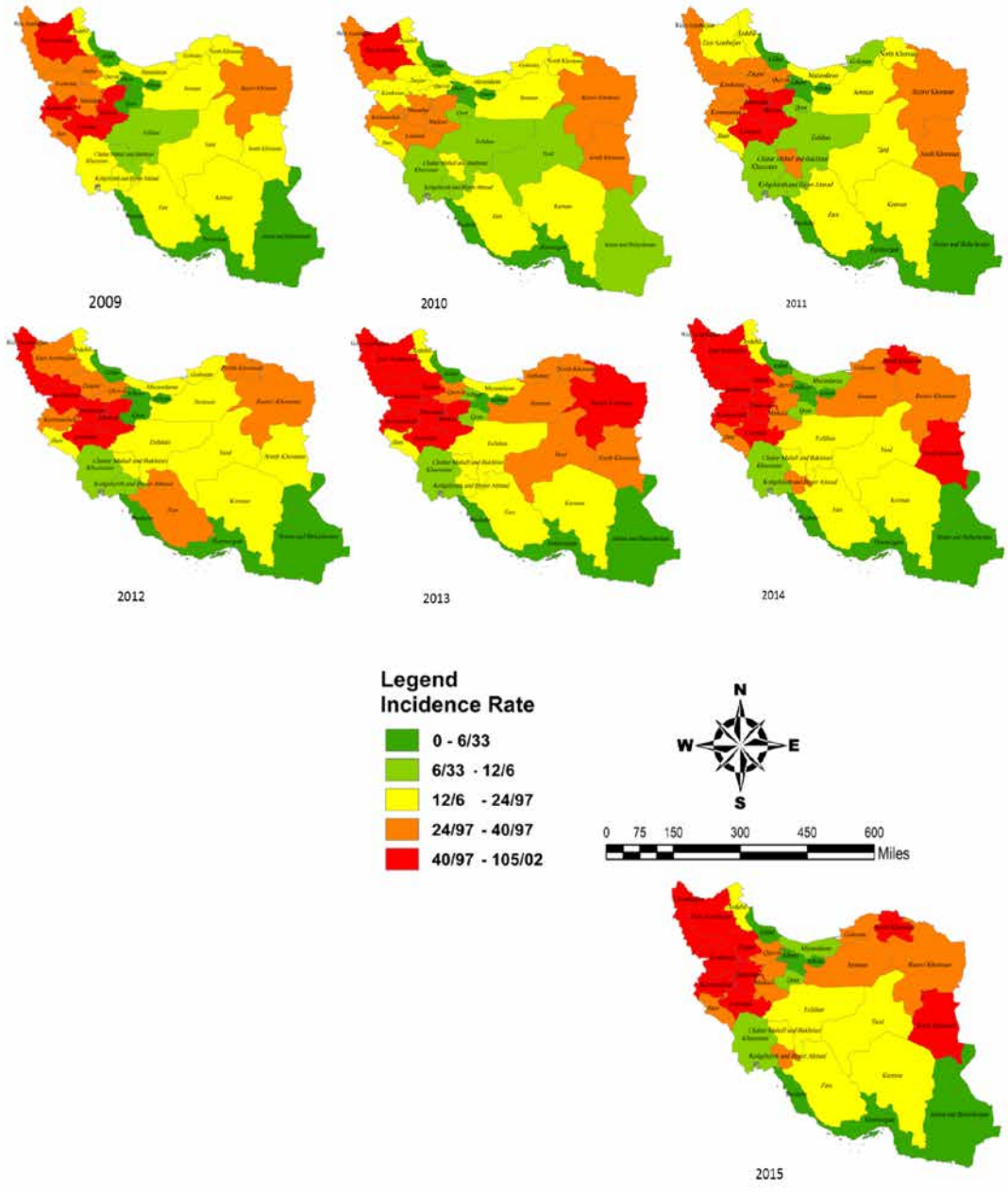


Fig. 2B. The incidence of brucellosis in 100,000 people over 2009-2015 period in each province.

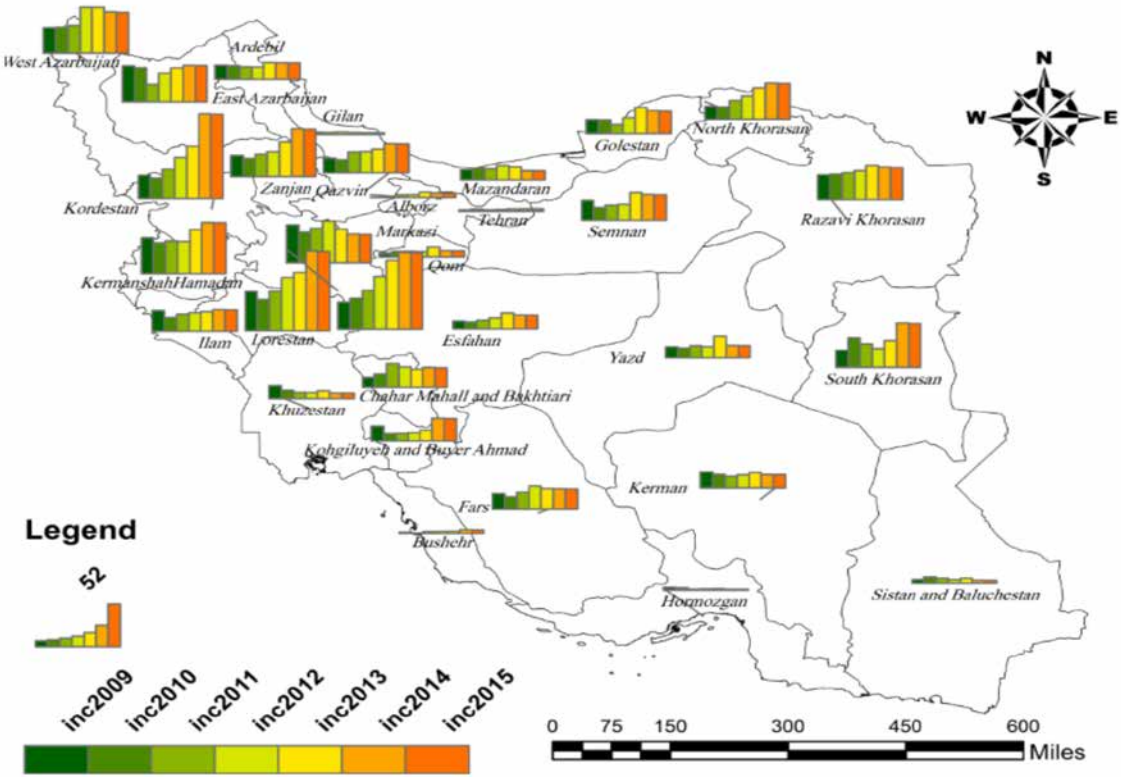


Fig. 3. Average incidence rate of brucellosis in Iran during 2009-2015.

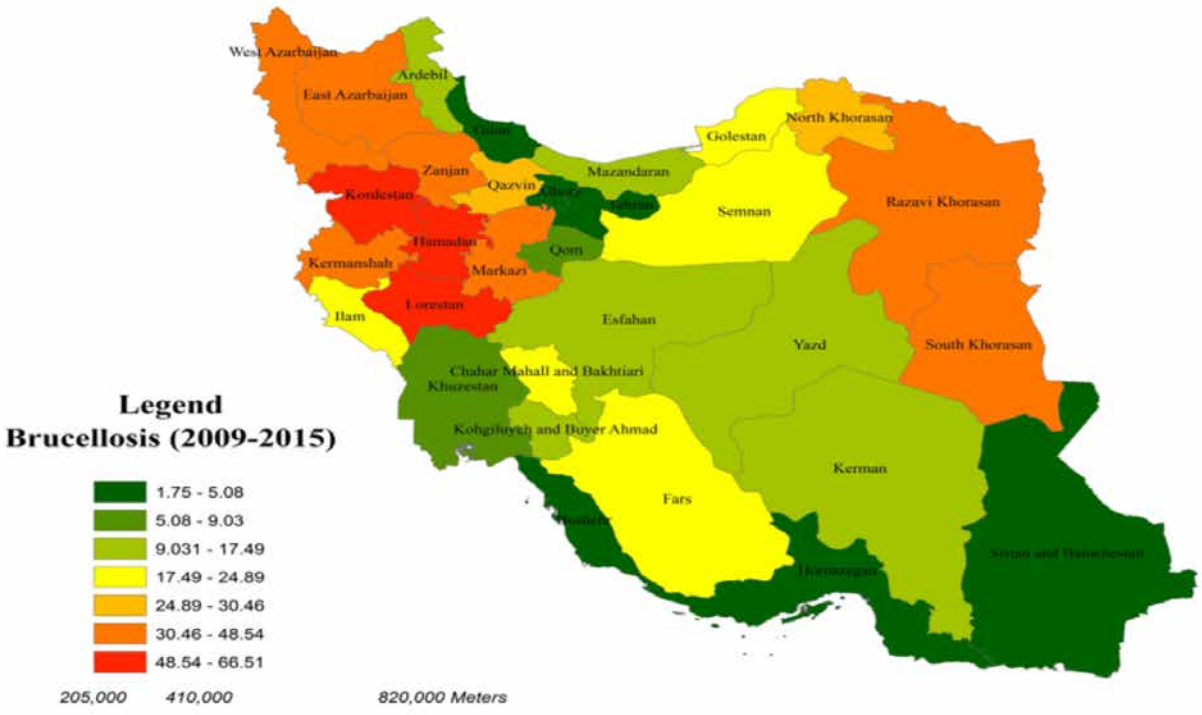


Figure 4. Prediction of brucellosis incidence rate in 100,000 people in Iran in 2021.

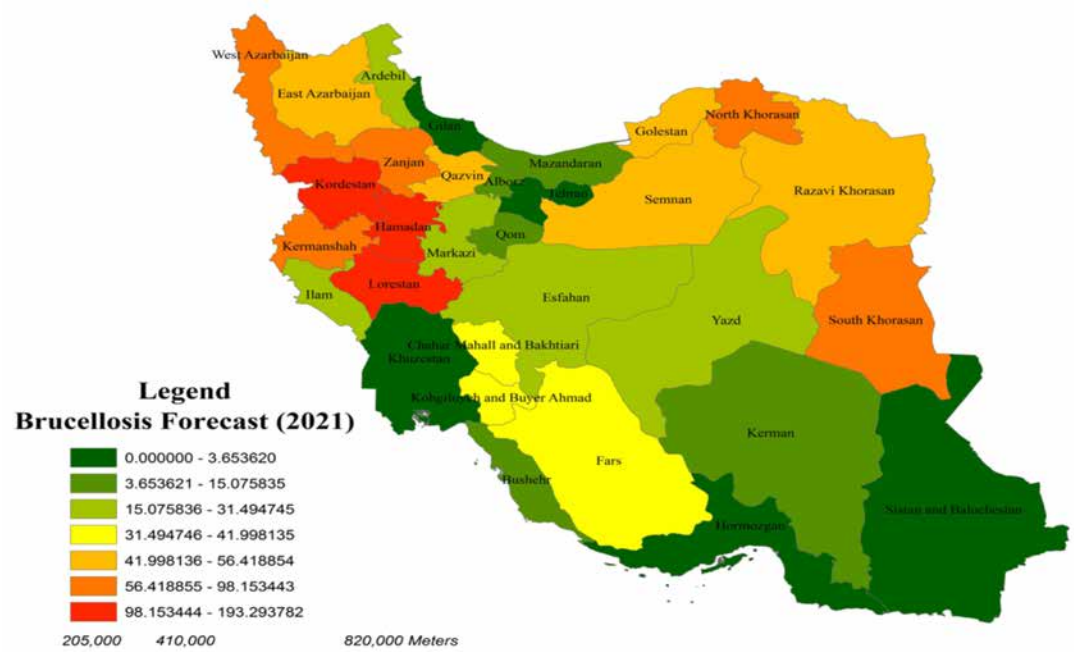
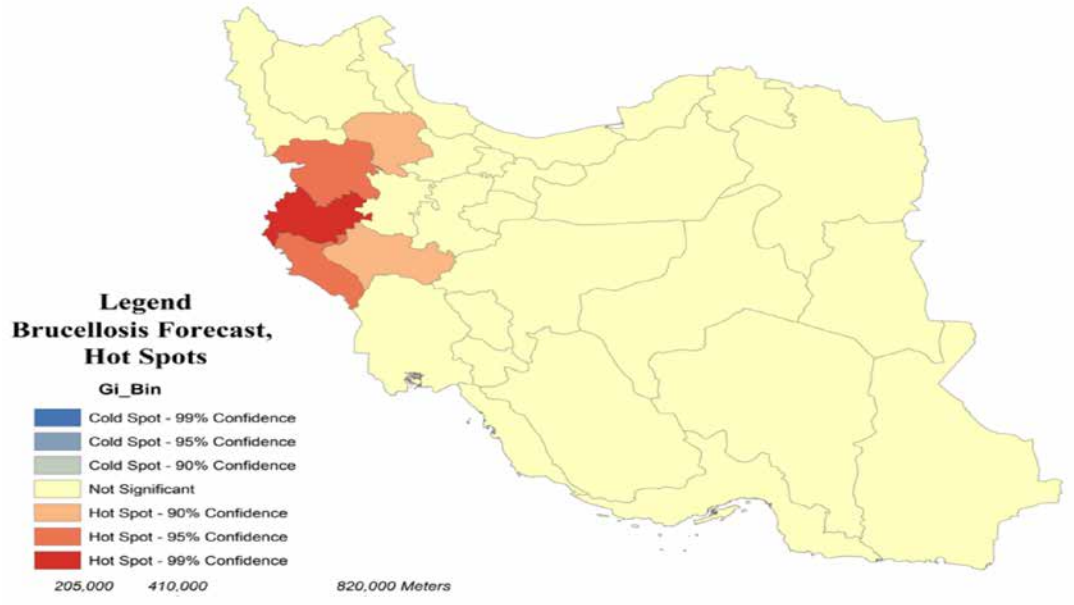


Fig. 5. The predicted hot and cold spots for the incidence rate of brucellosis in Iran in 2021.



According to the results of hot spot analysis in Figure 5, Kurdistan, Lorestan, Ilam, Zanjan and Kermanshah provinces may be among the hot spots in terms of incidence rate in 2021. The incidence rate of this disease in 2009-2015 period as well as the results of the hot spot analysis reveal that Lorestan and Kurdistan provinces face a grim prospect compared to other provinces and the incidence rate is expected to grow exponentially in future with the current increasing trend.

Discussion

The importance of brucellosis is not due to health-related complications of this disease but rather grave economic challenges posed by this disease, especially in developing countries [20, 21]. Iran is an endemic area for brucellosis and the incidence of this disease represents a serious national public health issue [21].

There are substantial variations in the frequency of

brucellosis in different regions of Iran. The incidence varies from 98 to 130 cases per 100,000 people, with the southern regions of Iran reporting the lowest rate of infection [22]. The highest incidence rate in Iran, 130 per 100 000 population, has been reported from Hamedan province in the west of the country [23].

According to the results of our study, the highest incidence of brucellosis during 2009-2015 was in Lorestan, Hamedan and Kurdistan, Markazi, Kermanshah, East and West Azerbaijan and North Khorasan, South Khorasan and Razavi Khorasan provinces. The results illustrate that the incidence of brucellosis in Iran dropped from 2009 to 2011 but it assumed an increasing trend from 2011 to 2014. Based on the results of modeling in Iran, Hamedan, Lorestan, West Kurdistan and East Azerbaijan provinces with 100%, 99.3%, 98.66%, 98.2% and 97.1% of their area, respectively, are at a higher risk of brucellosis breakout in the coming years.

Comparing the incidence of brucellosis in Iran to other countries shows its significantly higher incidence rate in Iran compared to developed countries such as the US and most European countries [24, 25]. The incidence rate in Iran closely resembles to eastern Mediterranean countries such as Saudi Arabia. Saudi Arabia [26], the United Arab Emirates [27], Turkey and Iraq [28].

Given that this disease is endemic in the Middle East region, its uneven distribution in different countries can be attributed to the low socioeconomic status and underdevelopment in the agricultural and livestock industry [7].

The results of this study reflect a rise in the incidence of brucellosis in Iran from 2011 to 2014 and a decline in 2015 compared to 2014. This rising trend may be due to improved statistical system and data recording in Disease Registration System of Iran over the years and its decline in 2015 could be attributed to enhanced livestock health and vaccination [29]. The study of Zhang et al. (2014) in China showed that the total incidence of brucellosis in humans was 0.92 per 100,000 people in 2004, increasing to 2.6 per 100,000 people in 2010 [30]. In Turkey, the incidence rose to more than 25.6 [31].

According to the World Health Organization's report, the prevalence of brucellosis varies widely (from 0.01 to 200 per 100,000 populations), so that it is in the Native American regions, 1 in 100,000, in the UK, 0.3 in 1 million. Germany is 0.03 per 100,000 and in rural Greece 0.3 per 100,000 [32-36].

According to a study (2003), the average incidence of brucellosis in the Iranian population was 21 per 100,000, however the rate varied between 1.5 and 107.5 per 100,000 in different regions of the country [20].

In a systematic meta-analysis and review study conducted by Mirnejad et al. on the incidence of brucellosis over an 18-year period, from 1996 to 2014, across the country, results from 34 articles showed tha the incidence of brucellosis was varied in different provinces, with the lowest reported incidence from Qom at 7 per 100,000 and the highest incidence from Kermanshah province with 276.42 per 100,000 (38).

Thus, the growing incidence of the disease in the community is a wake-up call that this disease is turning into a public health problem in the community, which can inflict economic consequences to the community [37].

According to the results of our study, the highest incidence during 2006-2015 was in Lorestan, Hamedan and Kurdistan, Markazi, Kermanshah, East and West Azerbaijan and North Khorasan, South Khorasan and Razavi Khorasan provinces. The findings of the present study are aligned with those reported by other Iranian researchers [12, 13]. In the western provinces of Iran, due to proximity to the Zagros Mountains and the presence of dense oak forests and fertile soil, the main economic activities of the people are agriculture and animal husbandry. Also, due to the commute of nomadic tribes, these areas have a higher incidence of brucellosis than other parts of Iran [13, 38].

Based on the results of our study, the western provinces of the Iran including Hamedan, Lorestan, Kurdistan and West and East Azerbaijan may be high brucellosis risk areas in the coming years. High incidence rates in these provinces have been reported in other studies as well [12, 39].

Environmental or geographical factors, low and medium altitudes, humidity and vegetation, and climatic conditions in the west and northwest of the country have provided a fertile ground for the survival and spread of the disease. Therefore, the impact of geographical factors on the incidence of zoonotic diseases is undeniable [40]. Underdevelopment or absence of traditional health infrastructure and traditional lifestyle, low education and lower socioeconomic status in the western and northwestern parts of Iran can also be major factors in the transmission of this disease in these areas, which can turn them into high risk areas in the future [11, 37]. Evaluation and controlling the disease by identifying the center of the disease and assessing the incidence and prevalence of the disease at specific times and health-quarantine measures could lead to adopting appropriate plans for disease control and prevention.

Conclusion

In general, the results suggest significant variations in the distribution of brucellosis incidence in Iran in the present and future. In the western and northwestern provinces of Iran, this disease can pose a major health issue, giving rise to a plethora of problems for people living in these areas. This calls for greater attention of health decision makers to the high risk areas of the country in the coming years to control the incidence of diseases in these areas by developing appropriate health plans and interventions. Providing policy and selection of appropriate operational methods using the facilities of the national health networks for the prevention and control of brucellosis based on disease diagnosis, early diagnosis, appropriate treatment, increasing awareness of the ways of transmission and prevention of the disease and coordination between different parts of the relevant organizations in a way that throughout the country is

accessible and is practiced uniformly can be used as a practical target to combat this disease.

Financial support

Kurdistan University of Medical Sciences.

Acknowledgments

This paper is based on the results of a research project with the ethical of code IR.MUK.REC.1395.184 approved by Kurdistan University of Medical Sciences. We would like to express our gratitude for sincere cooperation of the Center for Communicable Diseases Management, Ministry of Health and Medical Education, distinguished deputies of Health Affairs of the Medical Sciences Universities, experts and specialists in the Department for Prevention and Treatment of Infectious Diseases, practitioners and medical staff working in the health centers and all of those who contributed to this project.

Conflict of interest

This authors have no conflict of interest to declare.

References

[1] Pappas G, Papadimitriou P, Akritidis N, Christou L, Tsianos EV. The new global map of human brucellosis. Lancet Infect Dis 2006;6:91-9. https://doi.org/10.1016/S1473-3099(06)70382-6

[2] Al-Majali AM, Al-Qudah KM, Al-Tarazi YH, Al-Rawashdeh OF. Risk factors associated with camel brucellosis in Jordan. Trop Anim Health Prod 2008;40:193-200. https://doi.org/10.1007/s11250-007-9080-7

[3] Durusoy R, Karababa AO. Completeness of hepatitis, brucellosis, syphilis, measles and HIV/AIDS surveillance in Izmir, Turkey. BMC Public Health 2010;10:71. https://doi.org/10.1186/1471-2458-10-71

[4] Saegerman C, Porter S, Humblet M-F. Risk assessment of the re-emergence of bovine brucellosis/tuberculosis. A Paper Presented to International Colloquium on Emerging Animal Diseases, From Science to Policy - 2008.

[5] Moreno E. Brucellosis in central America. Vet Microbiol. 2002;90:31-8. https://doi.org/10.1016/S0378-1135(02)00242-0

[6] Nicoletti P. Brucellosis: past, present and future. Prilozi 2010;31:21-32.

[7] Dean AS, Crump L, Greter H, Schelling E, Zinsstag J. Global burden of human brucellosis: a systematic review of disease frequency. PLoS Negl Trop Dis 2012;6:e1865. https://doi.org/10.1371/journal.pntd.0001865.

[8] Mantur B, Amarnath S, Shinde R. Review of clinical and laboratory features of human brucellosis. Indian J Med Microbiol 2007;25:188-202. https://doi.org/10.4103/0255-0857.34758

[9] Hotez PJ, Savioli L, Fenwick A. Neglected tropical diseases of the Middle East and North Africa: review of their prevalence, distribution, and opportunities for control. PLoS Negl Trop Dis 2012;6:e1475. https://doi.org/10.1371/journal.pntd.0001475

[10] Tapak L, Shirmohammadi-Khorram N, Hamidi O, Maryanaji Z. Predicting the frequency of human brucellosis using climatic indices by three data mining techniques of radial basis function, multilayer perceptron and nearest Neighbor: A comparative study. Iran J Epidemiology 2018;14:153-65. http://irje.tums.ac.ir/article-1-6038-en.html

[11] Eini P, Keramat F, Hasanzadehhoseinabadi M. Epidemiologic, clinical and laboratory findings of patients with brucellosis in Hamadan, west of Iran. J Res Health Sci 2012;12:105-8. http://umsha.ofis.ir/default.aspx?general&member=1469

[12] Mostafavi E, Asmand M. Trend of brucellosis in Iran from 1991 to 2008. Iran J Epidemiology 2012;8. http://journals.tums.ac.ir/upload_fil

[13] Pakzad R, Pakzad I, Safiri S, Shirzadi MR, Mohammadpour M, Behroozi A, Mark JM, Janati A. Spatiotemporal analysis of brucellosis incidence in Iran from 2011 to 2014 using GIS. Int J Infect Dis 2018;67:129-36. https://doi.org/10.1016/j.ijid.2017.10.017

[14] Mostafavi E, Haghdoost A, Khakifirouz S, Chinikar S. Spatial analysis of Crimean Congo hemorrhagic fever in Iran. Am J Trop Med Hyg 2013;89:1135-41. https://doi.org/10.4269/ajtmh.12-0509

[15] Gatrell A, Senior M. Health and health care applications. In: Geographical information systems: Principles techniques management and applications. New York: Wiley 1999.

[16] Boulos MK, Roudsari AV, Carson ER. Health geomatics: an enabling suite of technologies in health and healthcare. J Biomed Inform 2001;34:195-219. https://doi.org/10.1006/jbin.2001.1015

[17] Sipe NG, Dale P. Challenges in using geographic information systems (GIS) to understand and control malaria in Indonesia. Malar J 2003;2:36. https://doi.org/10.1186/1475-2875-2-36

[18] Setianto A, Setianto A, Triandini T, Triandini T. Comparison of kriging and inverse distance weighted (IDW) interpolation methods in lineament extraction and analysis. J Appl Geology 2013;5:21-9. https://repository.ugm.ac.id/id/eprint/136178

[19] Getis A, Ord JK. The analysis of Spatial Association by use of Distance Statistics. Geographic Analysis 1992;24:189-206. https://doi.org/10.1111/j.1538-4632.1992.tb00261.x

[20] Moradi G, Kanani S, Majidpour M, Ghaderi A. Epidemiological status survey of 3880 case of brucellosis in Kurdistan. Iranian Infect Dis Trop Med 2006;11:27-33

[21] Blasco JM, Molina-Flores B. Control and eradication of Brucella melitensis infection in sheep and goats. Vet Clin North Am Food Anim Pract 2011;27:95-104. https://doi.org/10.1016/j.cvfa.2010.10.003

[22] Shoraka HR, Hoseini S, Hejazi A. Epidemiological study of brucellosis in Maneh & Semelghan town, North Khorasan province, in 2008-2009. J North Khorasan Univ Med Sci 2010;2:65-72.

[23] Hashemi SH, Keramat F, Ranjbar M, Mamani M, Farzam A, Jamal-Omidi S. Osteoarticular complications of brucellosis in Hamedan, an endemic area in the west of Iran. Int J Infect Dis 2007;11:496-500. https://doi.org/10.1016/j.ijid.2007.01.008

[24] HW. Handistatus II: zoonoses (human cases): global cases of brucellosis in 2004. http://wwwoieint/hs2/gi_zoon_maldasp?c_cont=6&c_mald=172&annee=2004 (accessed July 2015).

[25] Peng D, Zhao D, Liu J, Wang X, Yang K, Xicheng H, Yang Li, Fubing Wang. Multipathogen infections in hospitalized children with acute respiratory infections. Virol J 2009;6:155. https://doi.org/10.1186/1743-422X-6-155

[26] Biesbroek G, Tsivtsivadze E, Sanders EA, Montijn R, Veenhoven RH, Keijser BJ, Debby B. Early respiratory microbiota composition determines bacterial succession patterns and respiratory health in children. Am J Respir Crit Care Med 2014;190:1283-92. https://doi.org/10.1164/rccm.201407-1240OC

[27] Antoni S, Ferlay J, Soerjomataram I, Znaor A, Jemal A, Bray F. Bladder cancer incidence and mortality: a global overview and recent trends. Eur Urol 2017;71:96-108. https://doi.org/10.1016/j.eururo.2016.06.010

[28] Adeloye D, Harhay MO, Ayepola OO, Dos Santos JP, David RA, Ogunlana OO, Gadanya M, Osamor V, Amuta, Iweala E,

Auta A, Rebbeck T. Estimate of the incidence of bladder cancer in Africa: A systematic review and Bayesian meta-analysis. Int J Urol 2019;26:102-12. https://doi.org/10.1111/iju.13824

[29] Hashtarkhani S, Akbari M, Jarahi L, Etminani K. Epidemiological characteristics and trend of incidence of human brucellosis in Razavi Khorasan province. Medical journal of Mashhad university of medical sciences 2015;58:531-8. http://eprints.mums.ac.ir/id/eprint/3955 10.22038/MJMS.2015.6516

[30] Zhang J, Yin F, Zhang T, Yang C, Zhang X, Feng Z, Li X. Spatial analysis on human brucellosis incidence in mainland China: 2004-2010. BMJ Open 2014;4:e004470. https://doi.org/10.1136/bmjopen-2013-004470

[31] Yumuk Z, O'Callaghan D. Brucellosis in Turkey–an overview. Int J Infect Dis 2012;16:e228-e35. https://doi.org/10.1016/j.ijid.2011.12.011

[32] Al Dahouk S, Neubauer H, Hensel A, Schöneberg I, Nöckler K, Alpers K, Merzenich H, Stark K, Jansen A. Changing epidemiology of human brucellosis, Germany, 1962–2005. Emerg Infect Dis 2007;13:1895. https://doi.org/10.3201/eid1312.070527

[33] Seleem MN, Boyle SM, Sriranganathan N. Brucellosis: a re-emerging zoonosis. Vet Microbiol 2010;140:392-8. https://doi.org/10.1016/j.vetmic.2009.06.021

[34] Boschiroli M-L, Foulongne V, O'Callaghan D. Brucellosis: a worldwide zoonosis. Curr Opin Microbiol 2001;4:58-64. https://doi.org/10.1016/S1369-5274(00)00165-X

[35] Jelastopulu E, Bikas C, Petropoulos C, Leotsinidis M. Incidence of human brucellosis in a rural area in Western Greece after the implementation of a vaccination programme against animal brucellosis. BMC Public health 2008;8:241. https://doi.org/10.1186/1471-2458-8-241

[36] Skalsky K, Yahav D, Bishara J, Pitlik S, Leibovici L, Paul M. Treatment of human brucellosis: systematic review and meta-analysis of randomised controlled trials. BMJ 2008;336:701-4. doi: https://doi.org/10.1136/bmj.39497.500903.25 (

[37] Mirnejad R, Jazi FM, Mostafaei S, Sedighi M. Epidemiology of brucellosis in Iran: A comprehensive systematic review and meta-analysis study. Microb Pathog 2017;109:239-47. https://doi.org/10.1016/j.micpath.2017.06.005

[38] Khazaei S, Shojaeian M, Zamani R, Mansori K, Mohammadian-Hafshejani A, Rezaeian-Langroodi R, Ayubi E, Khazaei Z. Epidemiology and risk factors of childhood brucellosis in West of Iran. Int J Pediatr. 2016;4:2099-104. https://doi.org/10.22038/ijp.2016.6966

[39] Zeinali M, Shirzadi M, Sharifian J. National guideline for Brucellosis control. Tehran: J Fac Vet Med Univ Tehran 2009;6:7-10. [In Persian].

[40] Kassiri H, Amani H, Lotfi M. Epidemiological, laboratory, diagnostic and public health aspects of human brucellosis in western Iran. Asian Pac J Trop Biomed 2013;3:589-94. https://doi.org/10.1016/S2221-1691(13)60121-5

Received on July 24, 2020. Accepted on May 17, 2021.

Correspondence: Zaher Khazaei (MSc), Department of Public Health, School of Medicine, Dezful University of Medical Sciences, Dezful, Iran - Email: zaherkhazaei@yahoo.com

How to cite this article: Shirzadi MR, Mohammadi P, Moradi G, Goodarzi E, Khazaei S, Moayed L, Khazaei Z. The Incidence and Geographical Distribution of Brucellosis in Iran Using Geographic Information System and Prediction of its Incidence in 2021 J Prev Med Hyg 2021;62:E635-E643. https://doi.org/10.15167/2421-4248/jpmh2021.62.3.1699

RESEARCH ARTICLE

Trends in influenza coverage rates in five consecutive immunisation seasons in the Local Health Unit of Ferrara (North Italy)

SILVIA LUPI[1], ARMANDO STEFANATI[1], ANNALISA CALIFANO[2], ALDO DE TOGNI[2], GIUSEPPE COSENZA[2], GIOVANNI GABUTTI[1]
[1] University of Ferrara, Department of Medical Sciences, Italy; [2] Local Health Unit of Ferrara, Public Health Department, Italy

Keywords

Immunisation • Influenza • Coverage rate • Immunisation season • General practitioner

Summary

Seasonal influenza epidemics yearly affects 5-15% of the world's population, resulting in 3-5 million serious cases and up to 650,000 deaths. Elderly, pregnant women and individuals with underlying conditions are at increased risk of complications. According to the Italian National Immunisation Prevention Plan 2017-2019, these categories benefit from free vaccination but coverage rate in Italy are below desirable levels. The study considered the coverage rate in five consecutive influenza seasons (2010/2011-2014/2015) in Local Health Unit (LHU) of Ferrara (Italy). The amount of delivered vaccinations was not constant, with a decreasing trend. Coverage rose with increasing age, but the 75% target of over-65 years old individuals immunised was never achieved. In addition to age, coverage rates varied also according to District (the area of residence within the LHU). The District with the lowest vaccination coverage was the Western District. Higher levels of immunisation were observed in South-Eastern District in the pediatric age and in North-Central District in adult age group with a statistically significant difference. In the considered timespan, the percentage of immunisations delivered by the General Practitioners (GPs) increased. The trend in the LHU of Ferrara was similar to regional and national data, conditioned in the 2014/2015 season by the spreading of worrying news, although unfounded, on the safety of the vaccine. The GPs were essential in ensuring vaccine uptake, growing the percentage of delivered doses and achieving as much as possible effective elderly immunisation.

Introduction

Influenza is a common, highly contagious respiratory virus, which infects all age groups. Every year about 5% to 15% of worldwide population experience seasonal influenza, with 3-5 millions severe cases and more than 500,000 deaths [1]. During 2018/2019 influenza season, the cumulative population rate of hospitalization in the United States was 65.3 per 100,000 inhabitants. The majority of hospitalizations observed in over 65 years old people. Similarly to the past, the 93% of adults and 55% of children hospitalized for influenza had underlying medical conditions, and about one third of women of child-bearing age hospitalized for influenza were pregnant [2]. Among infectious diseases, influenza had higher population burden, incidence and mortality in Europe [3]. Influenza accounted for 81.8 DALYs per 100,000 population (95% uncertainty interval: 76.9-86.5) corresponding to the 30% of European total burden of infectious diseases. In the period 2009-2013, the estimated incidence was 5,887 cases per 100,000 population (95% uncertainty interval: 5,544-6,223) and the estimated mortality was 5.89 per 100,000 population (95% uncertainty interval: 5.54-6.22) [3]. On average, the Influenza Like Illnesses (ILI) affected the 9% of Italian population yearly, with a minimum of 4% observed in season 2005/2006 and a peak recorded in season 2017/2018 [4]. High virus circulation and elevated incidence characterized the 2018/2019 influenza season [5] with about 8,150,000 cases and 812 severe confirmed cases, 205 of them died. Complications are more common in the elderly, specifically in those with chronic underlying conditions, which are at increased risk for hospitalization [6]. The most effective measure to prevent the infection, reduce its morbidity and avoid the complications, including death, is the yearly vaccination [7]. According to the World Health Organization (WHO), the influenza vaccination of the elderly and other people at high risk should reach the 75 % coverage rate [8]. Despite the availability of a safe and effective vaccine and even though the greater part of countries recommended vaccination of the elderly population, immunisation coverage for this group is still low worldwide, also in European countries [9].

The area of the LHU of Ferrara corresponds to the entire territory of the Province of Ferrara (353,481 inhabitants at the 2011 census survey, 23.7% were over 65), located in the east of the Region Emilia-Romagna, North-East of Italy. The area of Local Health Unit of Ferrara is organized in three Districts. About 50% of the population resided in the Center-North District, where the main city Ferrara (132,545 inhabitants at 2011 census survey, about 27.4% were over 65) is located. The Center-North District is the most populated with public hygiene clinics and pediatrics clinics dedicated to immunisations and the University Hospital; the Western District has the smallest area; the South-Eastern

https://doi.org/10.15167/2421-4248/jpmh2021.62.3.1657

District is the largest and has the lowest population density [10].The District with the lowest number of inhabitants is the Western District. Healthcare services are supplied by three hospitals and one University hospital, six "Case della salute" and about 250 General Practitioners (GPs). In Italy, influenza immunisation can be obtained in clinics of public National Health System: General Practitioner (GP) or Pediatrician, according to age, in Public Health services or in hospital (mainly for healthcare workers).
We assessed the coverage rates for influenza immunisation in five consecutive immunisation seasons from 2010/2011 to 2014/2015 in the area of the LHU of Ferrara in order to evaluate the trend in vaccine uptake, highlight possible conditions of lower immunisation and obtain useful information for the estimation of vaccination campaign compliance.

Methods

Ethical aspect

The research was approved by Ethics Committee of the Area Vasta Emilia Centro (AVEC) in June 2018.

Study population

This is an observational study. All subjects residing on the territory of the Local Health Unit (LHU) of Ferrara that corresponds with the in the Province of Ferrara, North-East of Italy, in the time span 2010-2015 were considered. Data about residing population according to age, gender and Municipality were obtained from GeoDemo website of Italian Institute of Statistics (ISTAT) [11]. As immunisation season usually lasts from the final months of a year to the first months of the following one, the population resident on the 1st January 2011 for the 2010/2011 immunisation season was evaluated, and as consequence the population resident on the 1st January 2012 for the immunisation season 2011/2012, the population resident on the 1st January 2013 for the immunisation season 2012/2013, the population resident on the 1st January 2014 for the immunisation season 2013/2014, the population resident on the 1st January 2015 for the immunisation season 2014/2015. There were no exclusion criteria. No informed consent was needed as data were processed on a pseudonymised basis.

Data retrieval

Data on delivered immunisations were obtained from electronic Registry of Immunisation Service of Public Health Department of Local Health Unit of Ferrara (Italy). Data on resident population were obtained from GeoDemo.

Data on influenza immunisation

Data about influenza immunisation for five consecutive seasons (from 2011/2012 to 2014/2015) were obtained from the electronic Registry of Immunisation Service of Public Health Department of Local Health Unit of Ferrara. The database included for each administered vaccine doses personal data of the recipient, including age, gender, Municipality and District of residence, place where the vaccination was carried out (Public Health clinic, Community Pediatrics clinic, General Practitioner or Pediatrician's clinic, Hospital clinic, other services). In the LHU of Ferrara, immunisations of at risks children from zero to fourteen years of age were administered in Community Pediatrics or Pediatrician's clinic; from fifteen years of age, the vaccination were administered by the General Practitioner or in Public Health clinic. The healthcare workers (HCW) could obtain the influenza immunisation also in the workplace (Hospital clinic, other services). Data about vaccine uptake were considered in relation to belonging to one of the categories for which vaccination is recommended (over 65 years old or younger with chronic conditions, healthcare workers) according to national and regional guidelines [12].

Statistical analysis

Coverage rates according to resident population were calculated. The Chi square test was applied to compare coverage rates for influenza immunisation according to gender, age group and District of residence (Western District, Center-North District, South-Eastern District). Statistical analysis was performed with Stata 13.0, the significance was set at 0.05.

Results

The number of influenza vaccinations administered in the LHU of Ferrara in the timespan 2010/2011 to 2014-2015 season showed an irregular trend. In the 2010/2011 immunisation season (Tab. I), 71,166 vaccinations were delivered. The following year, the highest number (88,696) of distributed vaccinations was recorded, afterward the number of delivered immunisations decreased and then increased again. In the 2014/2015 season, the lowest number (68,496) of vaccinations was observed. In all

Tab. I. Number and percentage of doses of influenza vaccine delivered in the Local Health Unit of Ferrara in immunisation seasons from 2010/2011 to 2014/2015.

Immunisation season	2010/2011		2011/2012		2012/2013		2013/2014		2014/2015	
	N	%	N	%	N	%	N	%	N	%
Males	31.025	43.6	39.251	44.3	32.234	44.4	34.102	44.5	30.675	44.8
Females	40.123	56.4	49.431	55.7	40.298	55.6	42.587	55.5	37.821	55.2
n.d.	18	0.03	14	0.02						
Total	71.166		88.696		72.532		76.689		68.496	

considered immunisation seasons, the majority of doses (over 55%) was delivered to females.
As reported in Figure 1A, for females, and in Figure 1B, for males, a minor number of vaccinations, less than a thousand units, has been administered to subjects up to 14 years of age. In the childhood, males were predominantly immunised but the overall trend was decreasing. In adults (15-64 years old) and in the elderly (over 65 years old), the most relevant part of vaccinations was given to female subjects. Most of the doses were administered to individuals aged 65 or over. As the area of Local Health Unit of Ferrara is organized in three Districts, the percentage of doses distributed according to District of residence was evaluated (Fig. 2). The highest number of vaccinations (over 50%), in all the considered vaccination seasons, was obtained by individuals residing in the Center-North District. About a third of the immunisations was administered to subjects residing in the South-Eastern District and just less than 20% in the Western District.
In all the vaccination seasons considered (Fig. 3), over 95% of the immunisations were carried out at the General Practitioner's clinic. The percentage of vaccinations delivered by GPs showed an increasing trend over the years up to almost 97% in the 2014/2015 vaccination season. About 2-3% of the vaccinations were administered at the clinics of the Hygiene and Public Health Service of the Prevention Department of Ferrara's LHU. A decreasing percentage (from 1.2% in the 2010/2011 season to 0.5% in the 2013/2014 and 2014/2015 seasons) of vaccinations were administered in the outpatient departments of the Community Pediatric Service of the Maternal and Child Department of Ferrara's LHU. A very limited portion of doses was delivered in hospital.
The main motivation for the administration of the vaccine was being older than 64 years, in proportions ranging from 69.7% in the 2010/2011 immunisation season, increasing up to 75.3% in the 2014/2015 season (Tab. II). Other risk conditions were suffering from a chronic disease (respiratory diseases; chronic heart diseases; diabetes and other metabolic diseases, including obesity; malignancies). Only about 5% of influenza immunisations were delivered to healthcare workers. Coverage rates progressively increased with increasing age (Fig. 4) and

Fig. 1. Doses of influenza vaccine delivered in Local Health Unit of Ferrara in immunisation seasons 2010/2011 - 2014/2015 according to gender and age group. Local Health of Unit of Ferrara according to District of residence.

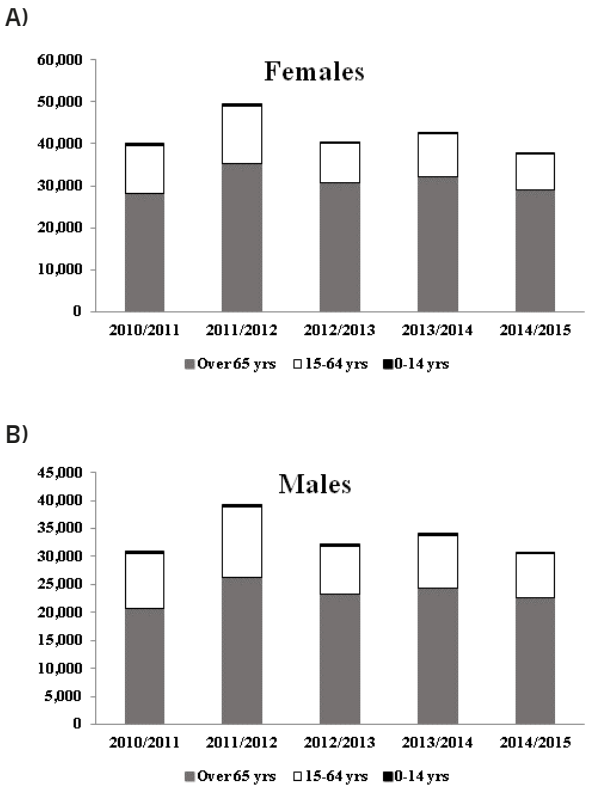


Fig. 2. Percentage of subjects vaccinated against influenza in Local Health of Unit of Ferrara according to District of residence.

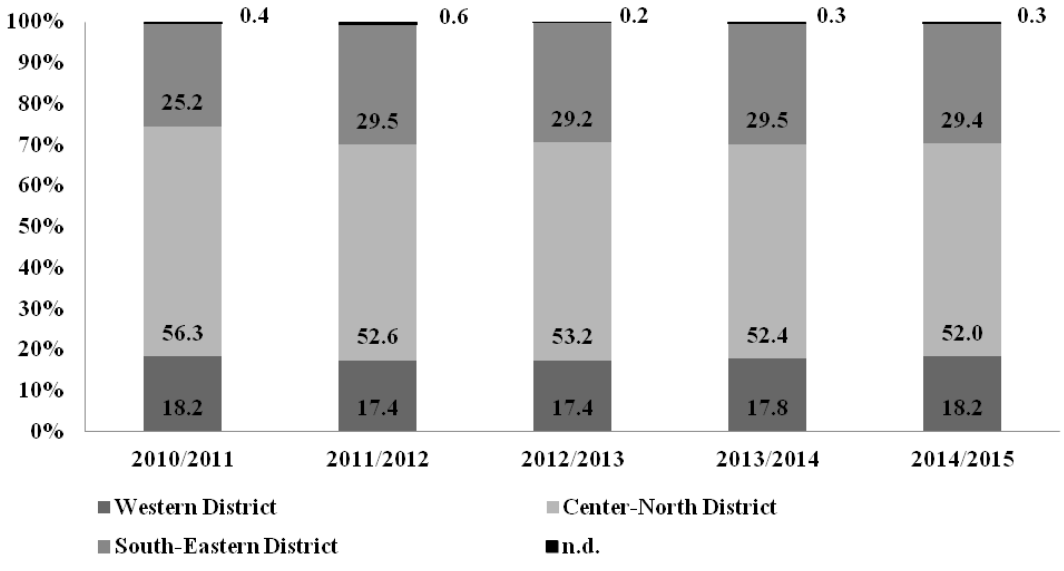
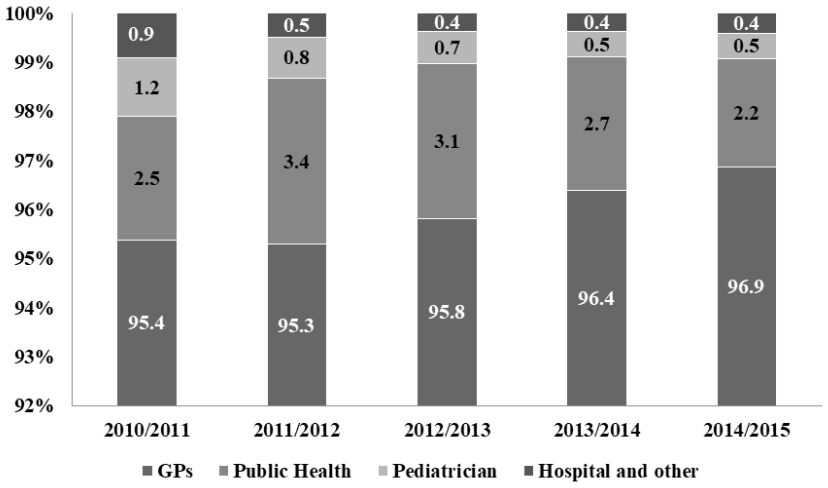


Fig. 3. Percentage of subjects vaccinated against influenza in Local Health of Unit of Ferrara according to place where vaccine was delivered.



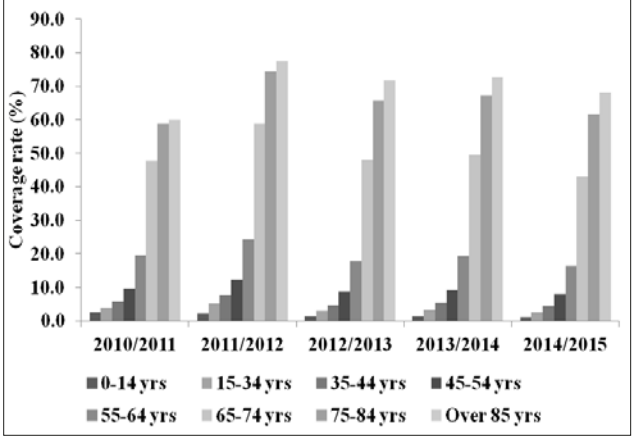
Tab. II. Number and percentage of doses of influenza vaccine delivered in the Local Health Unit of Ferrara in immunisation seasons from 2010/2011 to 2014/2015 according to risk condition.

Immunisation season	2010/2011		2011/2012		2012/2013		2013/2014		2014/2015	
	N	%	N	%	N	%	N	%	N	%
Over 65 yrs	49588	69.7	62605	70.6	54113	74.6	56627	73.8	51600	75.3
Lung diseases	4944	22.9	6572	25.2	4348	23.6	4664	23.2	4208	24.9
Heart diseases	4205	19.5	4791	18.4	3503	19.0	3628	18.1	3079	18.2
Diabetes	2808	13.0	3443	13.2	2622	14.2	2698	13.4	2304	13.6
Malignancies	1452	6.7	1447	5.5	1165	6.3	1443	7.2	1083	6.4
Other risk conditions	1727	8.0	2377	9.1	1877	10.2	2072	10.3	1748	10.3
HCWs	1161	5.4	1301	5.0	888	4.8	918	4.6	802	4.7
Family member and contacts	2066	9.6	2617	10.0	1690	9.2	1958	9.8	1620	9.6
Blood donors and public service workers	1985	9.2	3102	11.9	1896	10.3	2153	10.7	1643	9.7
Pay for vaccine	1230	5.7	441	1.7	430	2.3	528	2.6	409	2.4

HCWs: healthcare workers.

were almost doubled in over 65 compared to adults aged 55-64 years old. Compliance to the influenza vaccination showed a further growing trend in the elderly, reaching the highest values in over 85 subjects. Despite this tendency, the recommended coverage value of 75% was achieved only in subjects aged 85 and only in the 2011/2012 immunisation season.

Fig. 4. Coverage rates for influenza vaccination in Local Health of Unit of Ferrara according to age.



When considering coverage rates for influenza vaccine according to gender and age (Fig. 5), the target of 75% was never accomplished.

In all immunisation seasons, the coverage rates in over 65 years males were higher than in the females, with an average rate in the period of 59.9% in males and 57.5% in females, with a statistically significant difference ($p < 0.0001$). In 15-64 years age group, the vaccination coverage in females was higher than in the males showing a statistically significant differences ($p < 0.0001$) in all immunisation seasons. The average rate was 9.5% in females and 8.8% in males. In the pediatric age group, male subjects again depicted higher immunisation rates than females with a statistically significant difference ($p < 0.007$). The average rate over the period was 1.9% in males and 1.5% in females.

In Figure 6, coverage rates according the District of residence in different age groups are reported. In all examined immunisation seasons, the higher coverage

rates in pediatric age group were observed in the South-Eastern District, with statistically significant differences compared to the Western District ($p < 0.0001$) and to the Center-North District ($p < 0.014$). In the South-Eastern District coverage rates gradually decreased from 2.9% in the 2010/2011 season to 1.2% in the 2014/2015 immunisation season but the other Districts depicted a similar trend. The lower coverage rates were observed in the residents of Western District (from 2.0% in the 2010/2011 season to 0.8% in the 2014/2015 season), while the Center-North District had intermediate values. The differences between the Western District and the Center-North District were statistically significant only in the 2012/2013 immunisation season: the Center-North District recorded higher vaccination coverage than the Western District (1.4 *vs* 1.0%; $p = 0.002$). In the other immunisation seasons, the differences were not statistically significant.

In adults (15-64 years old), the highest levels of coverage rates were recorded in Center-North District (Fig. 6B) in all immunisation seasons. The trend of vaccination rates was inconstant in all districts. The residents in Western District had the lower coverage rates ranging from 9.2% in the 2011/2012 season to 5.8% in the

Fig. 5. Coverage rates for influenza vaccination in Local Health of Unit of Ferrara according to gender and age group.

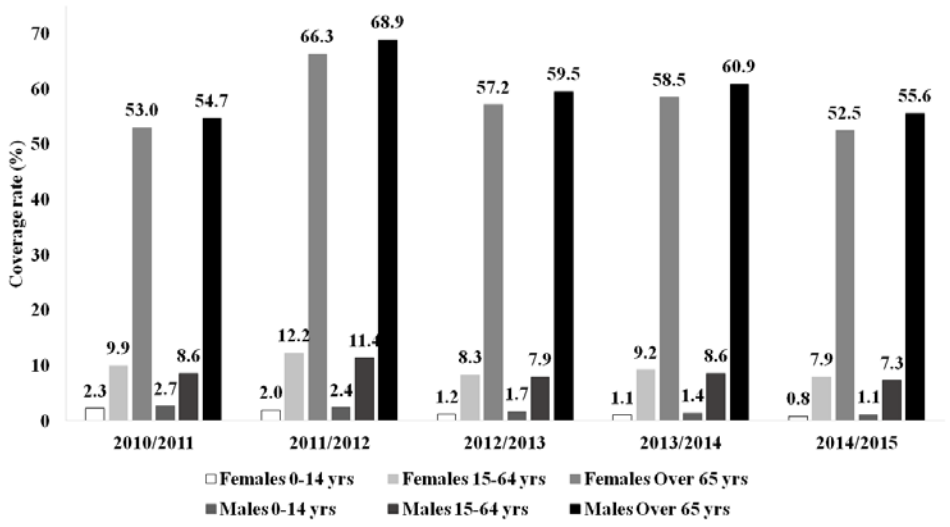
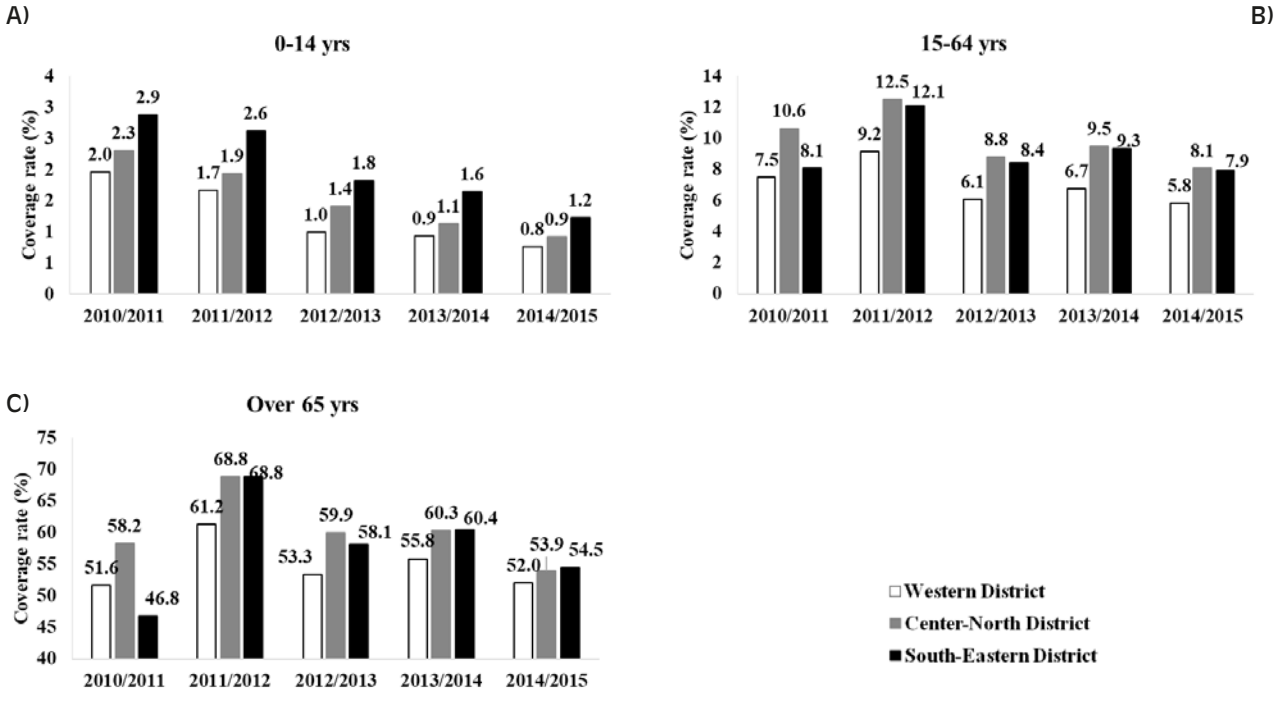


Fig. 6. Coverage rates for influenza vaccination in Local Health of Unit of Ferrara according to age group and District of residence.



2014/2015 season, while in the South-Eastern District values were very similar to those of the residents in the Center-North District, albeit lower and with statistically significant differences only in the first three immunisation seasons (10.6% in the Center-North District vs 8.1% in the South-Eastern District, $p < 0.0001$ in the 2010/2011 season; 12.5% in the Center-North District vs 12.1% in the South-Eastern District, $p = 0.009$ in the 2011/2012 season; 8.8% in the Center-North District vs 8.4% in the South-Eastern District, $p = 0.005$ in the 2012/20113 season). The differences between the Western District and the other two Districts were statistically significant in all immunisation seasons ($p < 0.0001$). The target of 75% of over 65 immunised against influenza was never achieved (Fig. 6C). In 2011/2012 immunisation season the 68.8% of the elderly residing in Center-North District and the South-Eastern District were immunised. In the Western District, coverage rates remained almost unchanged with values slightly above 50%, with the exception of the 2011/2012 season (maximum value of 61.2%). In the vaccination seasons from 2010/2011 to 2012/2013, the coverage rates of residents in the Center-North District were higher than those of residents in the South-Eastern District, while starting from the 2013/2014 season the highest coverage were observed in the residents of the South-Eastern District (60.4% in the 2013/2014 season and 54.5% in the 2014/2015 season). However, the differences between the Center-North and South-Eastern District were statistically significant only in the 2010/2011 season (58.2% in the Center-North District vs 46.8% in the South-Eastern District, $p < 0.0001$) and in the 2012/2013 season (59.9% in the Center-North District vs 58.1% in the South-Eastern District, $p < 0.0001$). The differences between the Western District and the other two Districts were statistically significant in all immunisation seasons ($p < 0.0001$).

Discussion

The study evaluated coverage rates for influenza in the population residing in the area of LHU of Ferrara (Italy) in the immunisation seasons from 2010/2011 to 2014/2015. The percentage of people receiving the flu shot was fluctuant over years, a trend reported also in a meta-analysis on Chinese population [13]. As expected, the influenza vaccination rates showed an increasing trend with increasing age, with a sudden rise from the age of sixty-five. Our results however confirm that despite national and international recommendations for seasonal influenza vaccination for elderly, healthcare workers and those with medical risk conditions, the rates for these groups did not reach the target. Despite data about the prevalence of a chronic condition in people younger than 65 were not available, on the whole it was possible to describe a greater compliance to immunisation in males, in pediatric age, and, in females, in the age group 15-64 years.

In 2009 the Council of the European Union set a target of 75% coverage for annual influenza vaccination among all defined target groups by 2014/15 [14]. Namely, as indicated by the World Health Organization, pregnant women (at any stage of pregnancy), children aged between 6 to 59 months, elderly individuals (aged > 65 years), individuals with chronic medical conditions and healthcare professionals [15]. At present, there is consensus among European countries regarding the routine seasonal influenza vaccination of elderly, however, for children few countries (Austria, Estonia, Finland, Latvia, Malta, Poland, Slovakia, Slovenia and the United Kingdom) have introduced the recommendation of routine influenza vaccination at different age groups and with different reimbursement methods [16]. In the United States, the Advisory Committee on Immunization Practices has recommended the vaccination of all people aged ≥ 6 months without contraindications [17]. Recently, also the Chinese Centre for Disease Prevention and Control published technical guidelines about influenza vaccination to recommend priority populations, which included children (up to 5 years), elderly, pregnant women, and healthcare workers [13]. The Italian National Immunization Prevention Plan 2017-2019 recommendations align with international guidelines [11].

In Europe, the vaccine coverage data referring to the 2014/2015 season showed an average of 45.5% (range from 1.0 to 76.3%) in the elderly, 24% (from 5 to 54.9%) in health care workers, 49.8% (from 21 to 71.8%) in patients with chronic medical conditions, and 23.6% (from 0.3 to 56.1%) in pregnant women. [16]. In our study desirable vaccination coverage levels were obtained only in the most advanced age groups, in particular after the age of eighty-five. Percentages in elderly were very similar to coverage rates reported where compliance in immunisation is higher in Europe (The Netherlands, England and Scotland) in a comparable timespan [18]. Despite the free and active offer of the influenza vaccine, endorsed on the territory by the General Practitioners, among the elderly living in the area of the LHU of Ferrara a decline in coverage rate, comparable to regional [19] and national data [20], was observed. The coverage rates decrease was mainly attributable to a communication crisis on supposed safety issues, later proved to be unfounded. The 2014/2015 immunisation season was marked by a sharp decrease in the coverage rates for influenza vaccination, following the so-called "Fluad case". About a month after the start of the vaccination campaign, two cases of suspected adverse reactions with fatal outcome were reported in Italy after the administration of the Fluad adjuvanted influenza vaccine. Both reports, coming from the same Local Health Unit, occurred on the day of the vaccination, but with different lots. Later a case of meningitis with a fatal outcome and a case of encephalitis occurred with one of the lots already undergoing verification. According to the specific guidelines for vaccines of the European Medicines Agency, the two lots were suspended and investigated. The death events presented various elements of bias; especially advanced age, the presence of co-morbidities and previous therapies able

to explain the adverse reaction but no anomalies able to justify a causal relationship between the reported events and the administration of the vaccine were detected. Unfortunately, the media impact had more serious public health outcomes: a reduction in the number of vaccinated people was observed, with an overall 25-30% decrease in compliance in 2014/2015 immunisation season [21]. The subsequent trend in registered influenza cases may be attributable to the approximately 3 million vaccinations not administered. In all immunisation seasons considered, over 95% of the vaccinations were administered in the clinic of a General Practitioner, with a growing tendency of delivered doses that increased from 95.4% of the 2010/2011 immunisation season to 96.9% in the 2014/2015 immunisation season, despite the general decrease in the compliance to the vaccination proposal. One of the factors favouring the influenza vaccination uptake could be the widespread distribution throughout the territory of General Practitioners. The area of the LHU is composed by three Districts and corresponds with the Province: the most populated Center-North District with public hygiene clinics and pediatrics clinics dedicated to immunisations and the University Hospital; the Western District with the smallest area; the South-Eastern District is the largest and has the lowest population density [10]. Public health and pediatric clinics and one hospital (Cento and Lagosanto respectively) are also located in the Western District and in the South-Eastern District. The inclusion of many Municipalities of the river Po delta area, the shortage of public means of transport would suggest a greater difficulty in achieving good results of vaccination coverage against influenza, in particular in the elderly population, in residents in the South-Eastern District. On the contrary, residents of the South-Eastern District showed levels of vaccination coverage statistically significantly higher than the other Districts, in children in all immunisation seasons and, in the over sixty-five years, in the last two immunisation seasons considered, even in those which showed a general decline in the compliance to the vaccine proposal. The excellent results obtained in the South-Eastern District could suggest that General Practitioners have a crucial role in promoting vaccination compliance in the elderly population, that could face greater difficulties in accessing health services. Italian Healthcare System provides for universal and free influenza immunisation of subjects considered at risk to experience the complication of the infection. In addition, GPs receive a financial incentive for each administered influenza vaccine. The public funding for at-risk groups was shown to be effective in obtaining higher coverage rates [22]. However, the coverage of costs for the older population alone did not seem to be completely successful. Several studies showed that the likelihood of being vaccinated increased significantly with the increasing number of GP visits in the past 12 months [23, 24]. The motivation and the proactive behaviour of the GP remain the main factors able to improve immunisation rates [25-27]. A recent meta-analysis reported among interventions able to improve influenza immunisation in elderly the health risk appraisal plus an offer of influenza vaccination, the offer of free influenza vaccination, the payment of the GP per vaccination with significant positive effects [28]. These findings suggest that GPs promote the influenza vaccination and that particularly in those patients who frequently visit the GP as they are more likely to receive information; persuading people that they are susceptible to influenza; increase belief that vaccination is effective; and appropriately decrease concern about side effects.

Conclusions

Although not considered by general population a severe disease, influenza is, among infectious diseases, one with the greatest social impact, causing annually millions of cases and thousands of deaths worldwide. In addition to the serious health consequences, influenza has a heavy economic burden, both in terms of loss of productivity due to work absences, and in health costs due to the treatment and hospitalization of those affected by complications. The influenza vaccination, recommended to over 65 and other groups at risk, represents one of the safest and most cost-effective public health interventions. Despite this, immunisation coverage rates are below the minimum optimal threshold of 75%, both in the elderly population and in subjects with chronic diseases. The research on LHU of Ferrara population showed that the levels of immunisation against influenza increased with increasing age. However, the goal of vaccinating at least 75% of people over 65 was not achieved in any of the considered immunisation seasons. The best results were recorded in the 2011/2012 immunisation season, but the target vaccination coverage was only achieved in the over eighty-five-year-old subjects. A possible barrier to influenza immunisation compliance could be represented by the poor perception of the harm of the disease, moreover, the spread of unfounded news on the supposed safety issues of the vaccine in the 2014/2015 immunisation season led to a significant decrease in coverage which is, in following years, gradually and with difficulty recovering. A decline in influenza vaccine uptake was similarly found in the population of LHU of Ferrara, which depicted the same trend observed at regional and national level. As the number of delivered doses and vaccination coverage decreased, a steady increase in the percentage of vaccinations administered by General Practitioners (about 97% of total doses in the 2014/2015 immunisation season) was observed. The gap with respect to the target coverage targets shows the need to take actions aimed at increasing the perception of the safety and efficacy of the influenza vaccination in the general population in order to reach previous coverage levels and further increase the compliance up to the minimum threshold of 75%. The GP's endorsement could be successful in encouraging elderly to be vaccinated.

Acknowledgements

Funding sources: GG received grants from GlaxoSmithKline Biologicals SA, Sanofi Pasteur MSD, Novartis, Crucell/Janssen, Seqirus, Sanofi Pasteur, Merck Italy, Pfizer and PaxVax for being consultant or taking part in advisory board, expert meetings, being a speaker or an organizer of congresses/conferences and acting as investigator in clinical trials.

Conflict of interest statement

SL, AS, AC, ADT. GC declare no conflict of interest.

Authors' contributions

GG, SL and AS conceptualised and designed the study. AC, ADT, GC provided the data. SL and AS analysed and interpreted the data. AS and SL drafted the manuscript. GG, AC, ADT and GC revised it critically. All authors read and approved the final manuscript.

References

[1] World Health Organization (WHO). Influenza (2019). Available at: www.who.int/influenza/surveillance_monitoring/bod/en (accessed on 03/09/2019).

[2] World Health Organization (WHO). Review of the 2018–2019 influenza season in the northern hemisphere. Wkly Epidemiol Rec. 2019;94:345-64.

[3] Cassini A, Colzani E, Pini A, Mangen MJ, Plass D, McDonald SA, Maringhini G, van Lier A, Haagsma JA, Havelaar AH, Kramarz P, Kretzschmar ME, on behalf of the BCoDE Consortium. Impact of infectious diseases on population health using incidence-based disability-adjusted life years (DALYs): results from the Burden of Communicable Diseases in Europe study, European Union and European Economic Area countries, 2009 to 2013. Euro Surveill 2018;23:pii=17-00454. https://doi.org/10.2807/1560-7917.ES.2018.23.16.17-00454E

[4] Epicentro. Epidemiologia dell'influenza (2019). Available at: https://www.epicentro.iss.it/influenza/epidemiologia-italia. (accessed on 25/09/2019).

[5] Bella A, Castrucci MR. La sorveglianza integrata dell'influenza in Italia: i risultati della stagione 2018-19. Bollettino Epidemiologico Nazionale 2019; luglio-agosto. Available at: https://www.epicentro.iss.it/ben/2019/luglio-agosto/sorveglianza-integrata-influenza-2018-19?utm_source=newsletter&utm_medium=email&utm_campaign=26settembre2019 (accessed on 30/09/2019).

[6] Mertz D, Kim TH, Johnstone J, Lam -P-P, Science M, Kuster SP, Fadel SA, Tran D, Fernandez E, Bhatnagar N, Loeb M. Populations at risk for severe or complicated influenza illness: systematic review and meta-analysis. BMJ 2013;347:f5061. https://doi.org/10.1136/bmj.f5061

[7] Demicheli V, Jefferson T, Di Pietrantonj C, Ferroni E, Thorning S, Thomas RE, Rivetti A. Vaccines for preventing influenza in the elderly. Cochrane Database Syst Rev 2018;2:CD004876. https://doi.org/10.1002/14651858.CD004876.pub4

[8] World Health Organization (WHO). Vaccines against influenza WHO position paper - November 2012. Wkly Epidemiol Rec. 2012;87:461-76.

[9] World Health Organization (WHO). Influenza. Available at: www.euro.who.int/en/health-topics/communicable-diseases/influenza/vaccination/seasonal-vaccination-policies-and-coverage-in-the-european-region (accessed on 19/11/2019).

[10] Azienda USL di Ferrara. Profilo di salute della comunità ferrarese. Dicembre 2016. Available at: http://www.ausl.fe.it/azienda/dipartimenti/sanita-pubblica/Profilo_di_salute_della_comunit_ferrarese_2016.pdf (accessed on 19/11/2019).

[11] ISTAT. GeoDemo. Available at: demo.istat.it (accessed on 03/09/2019).

[12] 2017-2019 National Immunisation Plan. Gazzetta Ufficiale della Repubblica Italiana. GU Serie Generale n. 41 del 18 febbraio 2017. Available at: www.salute.gov.it/imgs/C_17_pubblicazioni_2571_allegato.pdf (accessed on 19/11/2019).

[13] Wang Q, Yue N, Zheng M, Wang D, Duan C, Yu X, Zhang X, Bao C, Jin H. Influenza vaccination coverage of population and the factors influencing influenza vaccination in mainland China: a meta-analysis. Vaccine 2018;36:7262-69. https://doi.org/10.1016/j.vaccine.2018.10.045

[14] Council of the European Union. Council Recommendation of 22 December 2009 on seasonal influenza vaccination (2009/1019/EU). 2009. Available at: http://eur-lex. europa.eu/LexUriServ/LexUriServ.do?uriDOJ:L:2009:348:0071:0072: EN:PDF (accessed on 21/06/2021).

[15] World Health Organisation. Influenza (seasonal): fact sheet, November 2018. Available at: http://www.who.int/mediacentre/fact sheets/fs211/en (accessed on 04/06/2021).

[16] European Centre for Disease Prevention and Control. Seasonal influenza vaccination and antiviral use in Europe - Overview of vaccination recommendations and coverage rates in the EU Member States for the 2013-14 and 2014-15 influenza seasons. Stockholm: ECDC 2016.

[17] Grohskopf LA, Sokolow LZ, Broder KR, Walter Eb, Fry AM, Jernigan DB. Prevention and Control of Seasonal Influenza with Vaccines: Recommendations of the Advisory Committee on Immunization Practices – United States, 2018-19 Influenza Season. MMWR Recomm Rep 2018;67:1-20. https://doi.org/10.15585/mmwr.rr6703a1

[18] Blank PR, van Essen GA, Ortiz de Lejarazu R, Kyncl J, Nitsch-Osuch A, Kuchar EP, Falup-Pecurariu O, Maltezou HC, Zavadska D, Kristufkova Z, Kassianos G. Impact of European vaccination policies on seasonal influenza vaccination coverage rates: an update seven years later. Hum Vaccin Immunother. 2018;14:2706-14. https://doi.org/10.1080/21645515.2018.1489948

[19] Emilia Romagna Region. Epidemiological report, season 2017/2018. Available at: http://www.quotidianosanita.it/allegati/allegato2729096.pdf (accessed on 19/11/2019).

[20] Ministero della Salute. Dati di copertura della vaccinazione antinfluenzale (2019). Available at: http://www.salute.gov.it/portale/influenza/dettaglioContenutiInfluenza.jsp?lingua=italiano&id=679&area=influenza&menu=vuoto (accessed on 24/09/2019).

[21] Signorelli C, Odone A, Conversano M, Bonanni P. Deaths after Fluad flu vaccine and the epidemic of panic in Italy. BMJ 2015;350:h116. https://doi.org/10.1136/bmj.h116

[22] Mereckiene J, Cotter S Nicoll A , et al. Seasonal influenza immunisation in Europe. Overview of recommendations and vaccination coverage for three seasons: pre-pandemic (2008/09), pandemic (2009/10) and post-pandemic (2010/11). Euro Surveill 2014;19:20780.

[23] Prior L, Evans MR Prout H . Talking about colds and flu: the lay diagnosis of two common illnesses among older British people. Soc Sci Med 2011;73:922-8.

[24] Hoffmann K, Paget J, Wojczewski S, Katic M, Maier M, Soldo D. Influenza vaccination prevalence and demographic factors of patients and GPs in primary care in Austria and Croatia: a cross-sectional comparative study in the framework of the APRES project. Eur J Public Health 2016;26:395-401. https://doi.org/10.1093/eurpub/ckw006

[25] Gignon M, Idris H, Manaouil C, Ganry O. The waiting room: vector for health education? The general practitioner's point of view. BMC Res Notes 2012;5:511.e.

[26] Rolland MA, Gignon M. Immunization educational game in general practice waiting rooms. A comparative study. Santé Publique 2015;27:159-65.

[27] Berkhout C, Willefert-Bouche A, Chazard E, Zgorska-Maynard-Moussa S, Favre J, Peremans L, Ficheur G, Van Royen P. Randomized controlled trial on promoting influenza vaccination in general practice waiting rooms. PLoS One 2018;13:e0192155. https://doi.org/10.1371/journal.pone.0192155

[28] Thomas RE, Lorenzetti DL. Interventions to increase influenza vaccination rates of those 60 years and older in the community. Cochrane Database Syst Rev. 2018;5:CD005188. https://doi.org/10.1002/14651858.CD005188.pub4

Received on July 2, 2020. Accepted on June 29, 2021.

Correspondence: Armando Stefanati, University of Ferrara, Department of Medical Sciences, via Fossato di Mortara 64b, 44121 Ferrara, Italy - Tel.: +39 00 0532-455569 - Fax: +39 00 0532-205066 - E-mail: armando.stefanati@unife.it

How to cite this article: Lupi S, Stefanati A, Califano A, De Togni A, Cosenza G, Gabutti G. Trends in influenza coverage rates in five consecutive immunisation seasons in the Local Health Unit of Ferrara (North Italy). J Prev Med Hyg 2021;62:E644-E652. https://doi.org/10.15167/2421-4248/jpmh2021.62.3.1657

Research article

Prevalence of anemia and associated risk factors among pregnant women in an urban community at the North of Saudi Arabia

MAHA AWADH ALRESHIDI[1], HASSAN KASIM HARIDI[2]
[1] Family & Community Medicine Joint Program, Hail, Saudi Arabia; [2] Research Department, Health Affairs, Hail Region, Saudi Arabia

Keywords

Anemia • Risk factors • Pregnant • Women

Summary

Background. *Anemia in pregnancy is common public health problem with poor outcome for both mother and child. This study, aimed to determine the prevalence of anemia and its associated factors among pregnant women in an urban community at the north of Saudi Arabia.*
Materials and methods. *A cross-sectional study was carried out among 390 pregnant attending for antenatal care in one of eight Primary Health Care (PHC) centers in Hail city, Saudi Arabia.*
Results. *Among participants, 133 (34.1%) were anemic (hemoglobin level < 11 g/dl). Out of which, 24.9% were mildly anemic, 9.2% were moderately anemic and none of the participant was found to be severely anemic. The prevalence of anemia increased significantly with low income (p = 0.026), bigger family size (p = 0.020), higher parity (p = 0.023), longer menstrual cycle > 5 days (p = 0.042), bleeding during pregnancy (p = 0.028), infrequent intake of meat (p = 0.020), the habit of drinking tea just after meals (p = 0.019), past history of anemia (p < 0.001), clinical anemia (pallor) (p < 0.001). On the other hand, increased BMI (p = 0.002) and frequent intake of food from restaurants (p = 0.008) were found to be negatively associated with anemia among pregnant women.*
Conclusion. *"In urban Hail region, Saudi Arabia, anemia among pregnant women was a moderate public health problem. Low income, bigger family size, higher parity, longer menstrual cycle > 5 days, bleeding during pregnancy, infrequent intake of meat, the habit of drinking tea just after meals, past history of anemia, and the sign of clinical anemia (pallor), were found to be significantly associated with anemia. These findings give insight to healthcare providers about the importance of early detection and management of anemia in early pregnancy. Further research utilizing prospective cohort design to study risk factors of anemia including rural areas, should be considered to support and extend the present study findings".*

Introduction

Anemia is a condition in which the number of red blood cells and consequently their oxygen-carrying capacity is insufficient to meet the body's physiologic needs. It is an indicator of both poor nutrition and poor health [1]. While some degree of dilutional anemia is very frequent and can be considered part of the normal physiology of pregnancy, iron deficiency anemia is likewise common during pregnancy but can have serious adverse health consequences for the mother and child [2].
Anemia in pregnancy is a worldwide health and social problem associated with mortality and morbidity in the mother and baby, including risk of miscarriages, stillbirths, prematurity, low birth weight, and severe neonatal complications needs admission to intensive care units [3-9].
World Health Organization (WHO), reported in 2015 that 38% of pregnant women have anemia globally, corresponding to 32 million pregnant women for the year 2011 [1]. Reducing anemia is recognized as an important component of the health of women and children, and the second global nutrition target for 2025 calls for a 50% reduction of anemia in women of reproductive age [3].
WHO, classified anemia among pregnant women in Saudi Arabia as severe public health problem with 40.0% prevalence at the national level [1].
A notable variation in anemia prevalence among pregnant women appears in studies carried out in different regions in Saudi Arabia [10-13]. This variation, implies the significance of carrying out a standardized regular national and local surveys to highlight temporal and spatial distribution of the problem, identify significant local risk factors and to evaluate the progress of prevention and control strategies. Hence, we aimed in this research to assess the prevalence of anemia among pregnant women in urban Hail region, the north of Saudi Arabia and to identify important risk factors associated with, in order to provide insights to policy-makers and administration to deal with the problem.

Methods

Setting

A cross-sectional study was carried out among pregnant women attending one of eight governmental Primary Health Care (PHC) centers in Hail city, at the north of Saudi Arabia during the period November 3, 2019 to June 25, 2020. PHC centers were selected at random

between 24 centers covering all neighborhoods of Hail city. Among other services provided by PHC centers, antenatal care is a main service provided free of charge.

Participants

The sample was selected using a two-stage sampling method. In the first stage; from the list of 24 PHC centers, one third of centers (eight centers) were selected systematically with the first one at random. In the second stage, women, who visited the selected PHC centers attending for antenatal care, were systematically randomly selected and invited to undergo an interview. Pregnant women were eligible if they were aged 18 years or over, with a singleton pregnancy, and no hematological disease.

Sample size

We assumed 50% prevalence of anemia among pregnant women (to maximize sample size), since we found a large variation in the prevalence of anemia among studies carried out in different regions in Saudi Arabia [10-13], then we assigned a 95% confidence level, and a 5% margin of error. Therefore, the sample size was calculated using Cochran's Sample Size Formula [14] to comprise 384 pregnant women.

Data collection

Preparing for conducting the study, the authors visited the assigned PHC centers and met directors of those centers, introduced to the study objectives, showed the official letters of the regional health authority to facilitate the study conduction and the letter of ethical approval. All centers approached agreed to participate. Data were collected through face-to-face interviews with the eligible pregnant women during the study period with cautions against committing any selection or information bias during recruiting and interviewing eligible participants in the study. Other data, including anthropometric measurement and laboratory investigations, past medical history were taken from the booking file of the pregnant woman in the PHC center. One female researcher carried out all interviews with pregnant women who agreed to participate in the study and gave their consent. The interviews were carried out privately and taken about 15 minutes.

Data collection tool

Each participant was interviewed to complete the structured questionnaire which had been developed by the researchers based relevant literature to meet the objectives of the research [7, 10-13, 15, 16].

The questionnaire consisted of 4 sections. Sociodemographic aspect of the participants included in the 1st section.

In the second section, dietary and nutritional information relating to their intakes of iron-rich foods, iron absorption-inhibiting foods and eating habits were collected utilizing the Food Frequency Questionnaire (FFQ) format. Participants women were asked about their usual food consumption by querying the frequency at which the food items are usually consumed. There were four options in the category for frequency of intake, which were: (a) "at least once per day"; (b) "at least once per week"; (c) "at least once per month"; and (d) "rarely or never taken". Alongside with every option the number of times the food item usually consumed was asked for. Intake of supplements (iron, folic acid and B12) were also asked about as (Yes/No).

The 3rd section included obstetric, gynecological and medical history: menstrual history, parity, birth intervals, current or past diagnoses of medical conditions.

The last section, collected data from the pregnant woman booking file, including clinical examination, anthropometric measurements, laboratory hematological investigations in order to evaluate the anemic status of the pregnant woman.

A pilot study was done on 20 eligible pregnant women (not included in the final sample) was carried out before beginning of the study, consequently, the questionnaire was revised and modified to its final form. Face and content validity of the questionnaire were assessed by a panel of 4 experts in concern with anemia in pregnancy (obstetrician, nutritionist, family medicine and public health). The reliability was relatively high for the total items of the questionnaire (Cronbach's Alfa = 0.745) and for the subset of items describing the frequency food intake habits (Cronbach's Alfa = 0.699).

Data management and analysis

Data was entered, cleaned and analyzed using Epi info version 7 and SPSS version 23. Data was summarized using proportions for categorical data and mean and standard deviation for continuous data. The relationship was determined using chi square for categorical variables and T test or Anova test for continuous variables or nonparametric tests as applicable if the data were not normally distributed.

The hemoglobin level of < 11 g/dL was considered anemia. Anemia severity was considered according to WHO criteria for mild (10.0-10.9), moderate (7.0-9.9) and severe (< 7) [1].

Univariate and multivariable analysis was carried out using logistic regression analysis to find out factors that were associated with anemia in pregnancy. Pregnant women with proven anemia based on the hemoglobin level < 11 g/l (no = 0; yes = 1) were tested against predictor variables assumed to be associated with anemia as categorized in 4 domains, namely: (i) sociodemographic factors; (ii) dietary and nutrition factors; (iii) obstetric and menstrual factors; and (iv) medical factors found on clinical examination, anthropometric measurements, laboratory hematological investigations and personal history of anemia and important relevant medical conditions. Four adjusted multivariate logistic regression models were approached to capture predictor variables independently associated with anemia in pregnant women in each domain. An overall model combining the four models was also carried out. Variables of the final models were determined using a stepwise

backwards removal method, deleting variables with a p value above 0.25 in order to exclude the non-important variables from the model until the minimum adequate model was reached. Odds ratios (ORs) as well as their 95% confidence intervals (CIs) were calculated for the predictor variables in the analyses. All statistical tests were two-tailed and differences were considered to be statistically significant at a p-value ≤ 0.05.

Ethics

The study protocol was approved by the Bioethical Committee of the General Directorate of Health Affairs, Hail region, Saudi Arabia, with ethical approval number is: 2019-21. Agreed participants signed the study consent form.

Results

Sociodemographic and economic characteristics

Out of 400 pregnant women approached, 390 agreed to participate in the study and completed the interview, with a response rate (97.5%). Non-response was mainly due to the time factor.

The mean age ± (standard deviation) of the participants was 29.9 ± (7.56) years, less than half of them 171 (43.8%) were in the age range of 25-34 years. A considerable number of the participants 153 (39.2%) were university educated, living in medium size families 2-5 members 232 (59.5%). The majority 288 (73.9%) reported having family income < 10.000 SR (2,666 US $) (Tab. I).

Tab.I. Background characteristics of participant pregnant women (n = 390).

Variable	N or mean (SD)	%
Sociodemographic aspect		
Woman age (years)		
< 25	109	27.9
25-34	171	43.8
≥ 35	110	28.2
Mean (SD)	29.9 (7.56)	
Median (range)	29 (18-49)	
Woman education		
No formal education	14	3.6
Primary/middle	34	8.7
High school	150	38.5
University/higher	192	49.2
Woman occupation		
House wife	304	77.9
Employed	86	22.1
Husband education		
No formal education	18	4.6
Primary/middle	40	10.3
High school	179	45.9
University/higher	153	39.2
Family income (SR)		
< 5,000	47	12.1
5,000-10,000	241	61.8
10,000-15,000	85	21.8
> 15,000	17	4.4
Family type		
Nuclear	381	97.7
Extended	9	2.3
Family size		
2-3	126	32.3
4-5	106	27.2
6-7	84	21.5
≥ 8	74	19.0
Obstetric and menstrual history		
Gravida		
1-2	122	31.3
3-4	107	27.4
≥ 5	161	41.3
Parity		
0	70	17.9
1-2	109	27.9
3-4	101	25.9
≥ 5	110	28.2
Mean (SD)	3.1 (2.47)	
Median (range)	3 (0-10)	

▶

Tab.I. Background characteristics of participant pregnant women (n = 390).

Variable	N or mean (SD)	%
Obstetric and menstrual history		
Number of children under 5 years		
0	103	26.4
1	152	39.0
≥ 2	135	34.6
Mean (SD)	1.1 (0.83)	
Median (range)	1 (0-4)	
Inter pregnancy space (years)		
Not applicable (primigravida)	127	32.6
< 2	161	41.3
≥ 2	102	26.2
Mean (SD)	(1.04)	
Median (range)	1 (0-6)	
Menstrual cycle duration (days)		
≤ 5	95	24.4
> 5	295	75.6
Mean (SD)	5.8 (0.75)	
Median (range)	6 (3-8)	
Menstrual cycles usually regular		
Yes	380	97.4
No	10	2.6
Menstrual cycles usually heavy		
Yes	20	5.10
No	370	94.9
Duration of pregnancy (trimester)		
First	124	31.8
Second	132	33.8
Third	134	34.4
Antenatal visits		
< 3	233	59.7
≥ 3	157	40.3
First antenatal visit		
During 1st trimester	274	70.3
During 2nd trimester	103	26.4
During 3rd trimester	13	3.3
Bleeding during pregnancy		
Yes	23	5.9
No	367	94.1
The pregnancy was planned for		
Yes	49	12.6
No	341	87.4
Medical history		
Chronic medical illness		
Yes	20	5.1
No	370	94.9
Any chronic bleeding condition		
Yes	32	8.2
No	358	91.8
Past history of anemia		
Yes	148	38.0
No	241	62.0
Dietary practice and supplements intake		
Iron supplement		
Yes	262	67.2
No	128	32.8
Folic acid supplement		
Yes	335	85.9
No	55	14.1
Meat intake		
Once or more weekly	73	18.7
Less than 4 times per month	303	77.7
Never/rare	14	3.6

Tab.I. Background characteristics of participant pregnant women (n = 390).

Variable	N or mean (SD)	%
Dietary practice and supplements intake		
Green leafy vegetables intake (per day)		
Infrequent	134	34.4
Once or more per day	256	65.6
Fresh fruits intake (per day)		
Infrequent	332	85.1
Once or more per day	14.9	14.9
Number of meals per day		
< 3	29	7.4
3	311	79.7
≥ 4	50	12.8
Habit of drinking tea immediately after meal		
Yes	212	54.4
No	178	45.6
Consuming food from restaurants		
Not consuming	10	2.6
Once per week	191	49.0
Tow times or more	189	48.5
Clinical examination/Laboratory workup		
BMI (kg/m²)		
< 25	107	27.5
25 - < 30	148	38.0
≥ 30	134	34.4
Clinical anemia		
Yes	109	27.9
No	281	72.1
Blood hemoglobin level (g/l)		
< 7.0	0	0.0
7.0-9.9	36	9.2
10.0-10.99	97	24.9
≥ 11	257	65.9
Mean (SD)		
Median (range)		
Laboratory anemia (WHO classification)		
Anemic (Hb < 11 g/dl)	133	34.1
Non-anemic (Hb ≥ 11 g/dl)	257	65.9

Obstetric and menstrual and medical history

Study participants have a mean parity (SD) of 3.1 (2.47), of them 110 (28.2%) were grand multipara (≥ 5 deliveries) and 70 (17.9%) were primigaravida. Menstrual cycles were usually regular among 380 (97.4%) with mean duration 4.8 (0.75) days. Participants described their menses as usually heavy were 20 (5.0%).

Nearly, equal proportions were in their first, second or third trimester (124; 31.8%, 132; 33.8% and 134; 34.4%) respectively. Among participants 23 (5.9%) reported having bleeding in their current pregnancy and only 49 (12.6%) reported that the current pregnancy was planned for.

Participants reported having a chronic medical illness were 20 (5.1%) and 32 (8.2%) reported having chronic bleeding conditions like hemorrhoids, while a considerable number 148 (38.0%) reported past history of anemia (Tab. I).

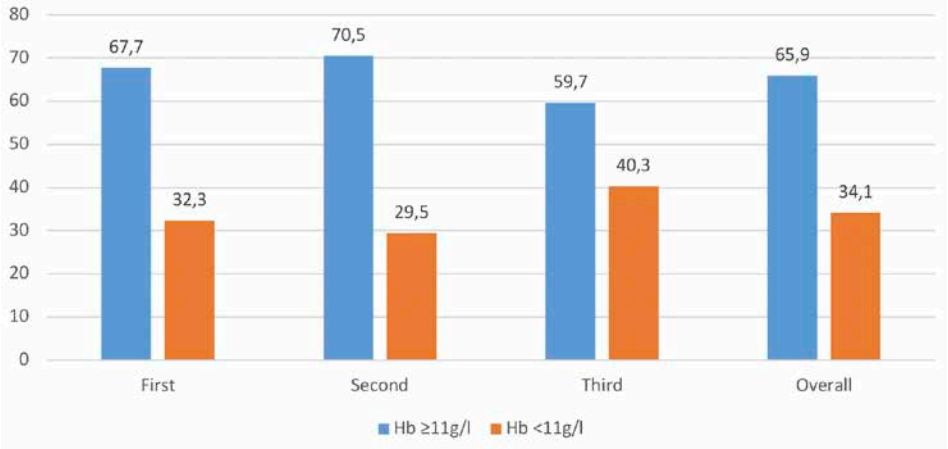
Dietary practice and supplements intake

While around two third of the participants 262 (67.2%) of the pregnant women take iron supplements, yet, most of them 335 (85.9%) take folic acid. Infrequent red meat consumption was reported; only 73 (18.7%) were consuming red meat weekly, while 303 (77.7%) take meat sometimes per month and 14 (3.6%) rarely or never consuming meat. Moreover, less than two third of the participants (256; 65.6%) reported consuming leafy green vegetables at least once daily, while few participants (58; 14.9%) reported consuming fresh fruits daily. More than half 212 (54.4%) of the participants reported the habit of taking tea immediately after meal. Most participants 311 (79.7%) were taking 3 meals per day, while 50 (12.8%) were taken 4 meals or more per day and few of them (29; 7.4%) who reported taking less than 3 meals. About half (191; 49.0%) of the participants reported having one main meal from restaurant per week, 189 (48.5%) taking two or more main meals from restaurants per week, while only very few participants 10 (2.6%) who did not consume restaurant food (Tab. I).

Prevalence and severity of anemia

The prevalence of anemia among the pregnant women in our study was 34.1% (95% CI: 29.5-39.1%). Among the anemic participants, 97 (72.9%) had mild anemia and 36

Fig. 1. Prevalence of anemia among pregnant women according to the pregnancy trimester.



(27.1%) had moderate anemia. None of the participants had severe anemia. The mean (±) SD hemoglobin concentration among the study participants was 11.6 ± (1.20). The prevalence of anemia with respect to the trimesters was 40 (32.3%), 39 (29.5%) and 54 (40.3%) for the 1st, 2nd and 3rd trimesters respectively (Fig. 1).

Factors associated with anemia

We carried out univariate (Tab. II) and multivariate (Tab. III) logistic regression analysis to determine factors associated with anemia among participants' pregnant women. We built 4 separate multivariate models predicting association of anemia with: (i) socio-demographic factors; (ii) dietary practice and supplement intake; (iii) obstetric and menstrual factors; and (iv) medical history and clinical examination variables. Subsequently, we built out an overall predicting model adjusting for all variables.

In model (i) lower family income < 10,000 SR (aOR = 1.81, 95% CI: 1.08-3.03, p = 0.026), and big family size > 7 members compared to small families < 4 members (aOR = 2.05, 95% CI: 1.12-3.74, p = 0.020), were

Tab. II. Univariate association between anemia in pregnant women and covariates according to sociodemographic, nutrition, reproductive and medical aspects (n = 390).

Term	Anemia*	Odds ratio	95% CI	P-value
Sociodemographic aspect				
Age in years				
< 25	34 (31.2)	1		
25-34	58 (33.9)	1.13	0.68-1.89	0.636
≥ 35	41 (37.3)	1.31	0.75-2.30	0.344
Woman education				
No formal education	4 (28.6)	1		
Elementary education	16 (47.1)	2.22	0.58-8.49	0.243
High school	48 (32.0)	1.18	0.35-3.94	0.792
University/higher	65 (33.9)	1.28	0.39-4.24	0.687
Occupation				
House wife	112 (36.8)	1	0.32-0.96	0.033
Employed	21 (24.4)	0.55		
Husband education				
No formal education	8 (44.4)	1		
Elemental (primary & middle school)	12 (30.0)	0.54	0.17-1.69	0.287
High school	59 (33.0)	0.62	0.23-1.64	0.331
University/higher	54 (35.3)	0.68	0.25-1.83	0.447
Family income (SR)				
< 10,000 SR	107 (37.2)	1.73	1.04-2.86	0.034
≥ 10,000	26 (25.5)	1		
Family size				
2-3	37 (29.4)	1		
4-5	36 (34.0)	1.24	0.7-2.16	0.453
6-7	27 (32.1)	1.14	0.63-2.07	0.668
> 7	33 (44.6)	1.94	1.07-3.52	0.030

Tab. II. Univariate association between anemia in pregnant women and covariates according to sociodemographic, nutrition, reproductive and medical aspects (n = 390).

Term	Anemia*	Odds ratio	95% CI	P-value
Dietary practice and supplements intake				
Iron supplementation				
Yes	92 (35.1)	0.87	0.56-1.37	0.547
No	41 (32.0)	1		
Folic acid supplementation				
Yes	116 (34.6)	0.85	0.46-1.56	0.590
No	17 (30.9)	1		
Frequency of taking meat				
At least once per week	15 (20.5)	1		
Less than 4 times per month	112 (37.0)	2.27	1.23-4.19	0.009
Rare/never	6 (42.9)	2.90	0.87-9.64	0.082
Vegetable intake (per day)				
Once or more per day	92 (35.4)	1		
Infrequent	41 (31.5)	0.84	0.54-1.32	0.450
Fresh fruits intake (per day)				
Once or more per day	16 (27.6)	1		
Infrequent	117 (35.2)	1.43	0.77-2.65	0.258
Frequency of intake of food from restaurants per week (number)	Range (0-5)	0.7028	0.55-0.90	0.005
Reproductive health variables(obstetric and menstrual history)				
Number of pregnancies (gravida)				
1-2	36 (29.5)	1		
3-4	38 (35.5)	1.32	0.76-2.29	0.333
≥ 5	59 (36.6)	1.38	0.83-2.29	0.209
Number of deliveries (parity)				
1-2	35 (32.1)	1		
3-4	30 (29.7)	0.89	0.50-1.61	0.706
≥ 5	45 40.9)	1.46	0.84-2.55	0.177
Inter pregnancy interval				
Not applicable (primigravida)	43 (33.9)	1		
< 2 years	47 (29.2)	0.81	0.49-1.33	0.397
≥ 2 years	43 (42.2)	1.42	0.83-2.44	0.198
Menstrual cycle length (days)				
≤ 5	26 (27.4)	1		
> 5	107 (36.3)	1.51	0.91-2.51	0.113
Menstrual cycle usually regular				
Yes	132 (34.7)	1		
No	1 (10.0)	0.21	0.03-1.66	0.139
Menstrual cycle usually heavy				
Yes	10 (50.0)	1		
No	123 (33.2)	0.50	0.20-1.23	0.130
Trimester of pregnancy				
1st	40 (32.3)	1		
2nd	39 (29.5)	0.89	0.52-1.50	0.639
3rd	54 (40.3)	1.42	0.85-2.36	0.181
Antenatal care visits				
1-2 visits	76 (32.6)	1		
≥ 3	57 (36.3)	1.18	0.77-1.80	0.451
Month of the first antenatal care visit	Range (1-8)	1.12	1.00-1.26	0.050
Medical history/clinical examination/laboratory workup				
Chronic Illness				
Yes	10 (50.0)	1		
No	123 (33.2)	0.50	0.20-1.23	0.130
Hemorrhoid				
Yes	16 (50.0)	2.06	1.00-4.26	0.050
No	1			
BMI (kg/m²)				
< 25	45 (42.1)	1		
25-29.99	53 (35.8)	0.77	0.46-1.28	0.312
≥ 30	35 (26.1)	0.49	0.28-0.84	0.010
Clinical pallor				
Yes	104 (95.4)	1		
No	29 (10.3)	0.006	0.00-0.02	< 0.001

* Hemoglobin < 11 g/dl.

Tab. III. Models of Logistic Multivariate Analysis Predicting associations between anemia in pregnant women and covariates in sociodemographic, nutrition, reproductive, medical and overall domains (n = 390).

Characteristics	Anemia* n (%)	Adjusted OR (95% CI)	P-value
Model 1: Sociodemographic Domain **Final -2*Log-Likelihood: 490.40; Likelihood Ratio = 10.13; p = 0.038**			
Family income (SR)			
< 10,000	107 (37.2)	1.81 (1.08-3.03)	0.026
≥ 10,000	26 (25.5)	1	
Family size			
2-3	37 (29.2)	1	
4-5	36 (34.0)	1.32 (0.75-2.32)	0.331
6-7	27 (32.1)	1.32 (0.71-2.44)	0.376
> 7	33 (44.6)	2.05 (1.12-3.74)	0.020
Model 2: Dietary practice and supplements intake Domain **Final -2*Log-Likelihood: 478.83; Likelihood Ratio = 21.71; p < 0.001**			
Number of meals per day (number)	Range (1-4)	0.69 (0.45-1.05)	0.081
Drinking tea after meals			
Yes	81 (38.2)	1.91 (1.21-3.03)	0.019
No	52 (29.2)	1	
Intake of meat per week			
At least once	15 (20.2)	1	
Infrequent/rare/never	118 (37.2)	2.09 (1.13-3.90)	0.020
Meals from restaurants per week (number)	Range (0-5)	0.71 (0.55-0.92)	0.008
Model 3: Reproductive profile Domain (obstetric and menstrual history) **Final -2*Log-Likelihood: 486.46; Likelihood Ratio = 14.08; p = 0.007**			
Parity (number)	Range (0-10)	1.10 (1.1.01-1.98)	0.023
Menstrual cycle duration (days)			
≤ 5	26 (27.4)	1	
> 5	107 (36.3)	1.78 (1.02-3.12)	0.042
Menstrual cycle heavy			
Yes	10 (50.0)	2.34 (0.93-5.91)	0.071
No	123 (33.2)	1	
Bleeding during pregnancy			
Yes	11 (47.8)	2.43 (0.97-6.09)	0.058
No	122 (33.2)	1	
Model 4: Medical history and clinical examination Domain **Final -2*Log-Likelihood: 199.26; Likelihood Ratio = 300.44; p < 0.001**			
Past history of anemia			
Yes	70 (47.3)	4.10 (1.91-8.81)	< 0.001
No	63 (26.1)	1	
Clinical anemia (pallor)			
Yes	104 (95.4)	207.36 (73.38-585.96)	< 0.001
No	29 (10.3)		
BMI (kg/m²)	Range (17.73-42.15)	0.90 (0.84-0.96)	0.002
Model 5: Overall Model **Final -2*Log-Likelihood: 199.26; Likelihood Ratio = 300.44; p < 0.001**			
Family income (SR)			
< 10,000	107 (37.2)	2.33 (0.89-6.09)	0.084
≥ 10,000	26 (25.5)	1	
Parity (number)	Range (0-10)	1.13 (0.96-1.34)	0.152
Past history of anemia			
Yes	70 (47.3)	3.32 (1.48-7.44)	0.004
No	63 (26.1)	1	
Bleeding during pregnancy			
Yes	11 (47.8)	4.25 (1.17-15.47)	0.028
No	122 (33.2)	1	
Clinical anemia (pallor)			
- Yes	104 (95.4)	216.32 (75.54-619.48)	< 0.001
- No	29 (10.3)	1	
BMI (kg/m²)	Range (17.73-42.15)	0.90 (0.83-0.96)	0.002

* Hemoglobin < 11 g/dl.

independently predicted anemia among pregnant women.
In model (ii) infrequent intake of meat (aOR = 2.09, 95% CI: 1.13-3.90, p = 0.020) and the habit of drinking tea immediately after meals (aOR = 1.91, 95% CI: 1.21-3.03, p = 0.019), were independently associated with anemia, whereas, intake of restaurant meals (aOR = 0.71, 95% CI: 0.55-0.91, p = 0.008) possessed a protective effect.
In bivariate analysis we found that the intake of restaurant food was found to be associated with socio-economic factors as, women's higher education (p < 0.001), employment (p = 0.001) and higher family income (p = 0.002) (not included in Tables).
In model (iii), higher parity (aOR = 1.10, 95% CI: 1.01-1.98, p = 0.023), menstrual cycle > 5 days (aOR = 1.78, 95% CI: 1.02-3.12, p = 0.042) were independently associated with anemia.
In model (iv) past history of anemia (aOR = 4.10, 95% CI: 1.91-8.81, p < 0.001), clinical anemia manifested by pallor (aOR = 207, 95% CI: 73.38-585.96, p < 0.001) was independently associated with anemia, while increasing BMI (kg/m^2) was a protective independent factor (aOR = 0.90, 95% CI: 0.84-0.96, p = 0.002). In bivariate analysis BMI was found to be associated with women's employment (p = 0.008), lower education less than high school (p = 0.013), but not associated with income (p = 0.105) (not included in Tables).
The overall model (v) revealed a significant independent positive association of anemia among pregnant women with the past history of anemia (aOR = 3.32, 95% CI: 1.48-7.44, p = 0.004), the reported bleeding during pregnancy (aOR = 4.25, 95% CI: 1.17-15.47, p = 0.28) and pallor on clinical examination (aOR = 216.32, 95% CI: 75.54-619.48, p < 0.001). In linear regression analysis, clinical pallor explained 50% of the variance of laboratory anemia in terms of hemoglobin < 11 g/dl (r^2 = 0.50; F statistic = 391.44, p < 0.001)
On the other hand, increased BMI (kg/m^2) significantly appeared as a protective factor for anemia development in pregnancy with lower likelihood of association (aOR = 0.9, 95% CI: 0.83-0.96, p = 0.002).

Discussion

Despite, anemia in pregnant women at the national level in Saudi Arabia (40.0% prevalence) is classified by WHO as severe public health problem [1], yet, the estimated prevalence in our study (34.1%) indicates that the problem in urban Hail is of moderate public health importance based on the same WHO classification [1]. This prevalence is also lower than the global prevalence (38.2%) and of Eastern Mediterranean countries (38.9%) [1].
Compared to the prevalence reported in other regions in Saudi Arabia, the estimate for urban Hail is slightly higher than the prevalence reported in Asir region (31.9%) [12], but lower than the prevalence reported in Makkah (39.0%) [10], Al-Khobar (41.3%) [13] and much lower than the prevalence reported from Al-Ahsa (73.3%) [11].
In our analysis, most of the identified significant risk factors of anemia among pregnant women in urban Hail, were similar to risk factors reported in many national, regional and worldwide studies. Some socio-demographic and economic characteristics were found to be significant risk factors having an independent association with anemia in pregnancy, in particular lower family income and bigger family size. Pregnant women with lower family incomes (< 10,000 SR) were about two folds more likely to be anemic compared to those with higher income. Furthermore, family size was steadily and independently associated with anemia in pregnancy. The pregnant woman who lives in a family with 7 members or more, were more than two folds likely have the risk to be anemic. This association between anemia in pregnancy and low family income and living in beg sized families was documented in previous studies [7, 15-18], which might indicate a less food security and low dietary diversity.
Our study highlighted the importance of nutritional factors as important risk factors associated with in anemia in pregnancy. Consumption of meat was a factor which showed significant association with anemia in pregnancy. Pregnant women with the habit of eating meat less than once per week were 2.1 times at higher risk of developing anemia than pregnant mothers who ate meat one or more times per week. This finding is consistent with other studies in which pregnant women who frequently eat red meat had higher hemoglobin concentrations [15, 16, 19, 20]. Red meat is an important dietary source of heme iron [21].
Consistent with other studies [15, 19], the habit of drinking tea just after meal in our study was independently associated with increased risk of anemia in pregnancy. Phenolic compounds found in tea, coffee, and other beverages are a main inhibitor of non-heme iron absorption [21].
Interestingly, results in our study revealed a protective effect of frequent intake of food from restaurants, a habit many Saudi families do. For every one meal taken per week, there was a decrease by 29% likelihood of developing anemia among pregnant woman. A possible explanation is the dietary diversity with meat and other animal proteins are a usual main component of this meal, which is a good source of iron and proteins [21].
In our study, increased parity was independently associated with anemia in pregnant women. Women with higher parity pregnancies had a higher risk of anemia in pregnancy compared to those who had had fewer pregnancies A 10% more increase in anemia prevalence for every increase in parity by one (OR = 1.10, 95% CI: 1.1.01-1.98). Other research indicated that frequent pregnancies are associated with anemia in pregnancy [15, 20, 22, 23] giving no chance to restore the depleted iron stores [18, 22, 24, 25].
Consistent with other studies [26, 27], participants in our study with pre-pregnancy longer menstrual cycles (> 5 days), were more likely to have anemia in pregnancy compared to women with less cycles duration (OR = 1.73; 95% CI: 1.02-3.12).
Bleeding during pregnancy was also another predictive factor for anemia in pregnancy in our study. Participants who reported antepartum bleeding were four times more

likely to be anemic (OR = 4.25; 95% CI: 1.17-15.47). A logically explained when a considerable blood loss occurs. This finding was also reported in previous studies. Participants who reported past history of anemia before pregnancy were four times more likely to be anemic during pregnancy, which is consistent with other studies [28].

In our study, the odds of anemia, decreased with obesity. This finding is consistent with the results of other studies [29-31]. A systematic review carried out in 2011 revealed that obese women tend to have a higher hemoglobin and ferritin concentrations [22].

Pallor on clinical examination as a sign of anemia was highly indicative of anemia (aOR = 216.32, 95% CI: 75.54-619.48, $p < 0.001$). In linear regression analysis, clinical pallor explained 50% of the variance of laboratory anemia in terms of hemoglobin < 11 g/dl ($r^2 = 0.5$; F statistic = 391.44, $p < 0.001$). Pallor documented in other studies [9, 32, 33] as a sensitive indicator of anemia in pregnant women.

Limitations

Our study encountered some limitation: (i) measurements were taken from booking files of the pregnant women in the PHC centers, so that we cannot ensure a standardized measurement of hemoglobin and anthropometric measurements. However, all laboratory testing machines and scales are the same in all PHC centers and regularly calibrated by the same quality control staff; (ii) the cross-sectional nature of the study cannot determine the direction of cause and effect relationship; (iii) social desirability and recall bias are major concerns in any interview survey as participants were requested to give dietary information and monthly income and past events.

Conclusions

"In urban Hail region, Saudi Arabia, anemia among pregnant women was a moderate public health problem. Low income, bigger family size, higher parity, longer menstrual cycle > 5 days, bleeding during pregnancy, infrequent intake of meat, the habit of drinking tea just after meals, past history of anemia, and the sign of clinical anemia (pallor), were found to be significantly associated with anemia. These findings give insight to healthcare providers about the importance of early detection and management of anemia in early pregnancy. Further research utilizing prospective cohort design to study risk factors of anemia including rural areas, should be considered to support and extend the present study findings".

Ethics approval and consent to participate

The protocol of the study was reviewed and approved by the Regional Bioethics Committee of the General Directorate of Health Affairs, Hail region, with the approval number 2019/21 dated October 6, 2019. Agreed participants signed the study consent form. Participants were guaranteed anonymity confidentiality of the responses and voluntary participation and they can withdraw for any reason and any time, without any implications.

Availability of data and materials

Available from the corresponding author on reasonable request.

Acknowledgements

Funding sources: this research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

We thank directors and healthcare staff in PHC centers, Hail City, Saudi Arabia for facilitating the study. We also thank the participant pregnant women for their agreement, patience and allowing the time to carry out the interview with them.

Conflict of interest statement

The authors declare no conflict of interest.

Authors' contributions

MA conceived the study idea, participated in development of the data collection tool, carried out all interviews and participated in interpretation of the study results.

HH adapted the study idea, designed the data collection tool, carried out data analysis & interpretation of results and wrote the manuscript.

References

[1] World Health Organization. The Global Prevalence of Anaemia in 2011. Geneva, Switzerland: World Health Organization 2015. Available at: https://apps.who.int/iris/handle/10665/177094

[2] Al-Khaffaf A, Frattini F, Gaiardoni R, Mimiola E, Sissa C, Franchini M. Diagnosis of anemia in pregnancy. J Lab Precis Med 2020;5:9. http://dx.doi.org/10.21037/jlpm.2019.12.03

[3] Global nutrition targets 2025: anaemia policy brief. Geneva: World Health Organization 2014. WHO/NMH/NHD/14.4; http://apps.who.int/iris/bitstream/10665/148556/1/WHO_NMH_ NHD_14.4_eng.pdf?ua=1 (accessed 4/8/2020).

[4] Figueiredo ACMG, Gomes-Filho IS, Batista JET, et al. Maternal anemia and birth weight: a prospective cohort study. PLoS One 2019;14:e0212817. https://doi.org/10.1371/journal.pone.0212817

[5] Kozuki N, Lee AC, Katz J; Child Health Epidemiology Reference Group. Moderate to severe, but not mild, maternal anemia is associated with increased risk of small for-gestational-age outcomes. J Nutr 2012;142:358-62. https://doi.org/10.3945/jn.111.149237

[6] Allen LH. Anemia and iron deficiency: effects on pregnancy outcome. Am J Clin Nutr 2000;71(5 Suppl):1280S-4S. https://doi.org/10.1093/ajcn/71.5.1280s

[7] Lin L, Wei Y, Zhu W, Wang C, Su R, Feng H, Yang H. Gesta-

tional diabetes mellitus Prevalence Survey (GPS) study Group. Prevalence, risk factors and associated adverse pregnancy outcomes of anaemia in Chinese pregnant women: a multicentre retrospective study. BMC Pregnancy Childbirth 2018;18:111. https://doi.org/10.1186/s12884-018-1739-8.

[8] Tunkyi K, Moodley J. Anemia and pregnancy outcomes: a longitudinal study. J Matern Fetal Neonatal Med 2018;31:2594-8. https://doi.org/10.1080/14767058.2017.1349746

[9] Meda N, Dao Y, Touré B, Yameogo B, Cousens S, Graham W. [Assessing severe maternal anemia and its consequences: the value of a simple examination of the coloration of palpebral conjunctiva]. Sante 1999;9:12-7.

[10] Abdelhafez AM, El-Soadaa SS. Prevalence and risk factors of anemia among a sample of pregnant females attending primary health care centers in Makkah, Saudi Arabia. Pak J Nutr 2012;11:1113-20. https://doi.org/10.3923/pjn.2012.1113.1120

[11] Taha A, Azhar S, Lone T, Murtaza G, Khan SA, Mumtaz A, Asad MH, Kousar R, Karim S, Tariq I, Ul Hassan SS, Hussain I. Iron deficiency anaemia in reproductive age women attending obstetrics and gynecology outpatient of university health centre in Al-Ahsa, Saudi Arabia. Afr J Tradit Complement Altern Med 2014;11:339-42. https://doi.org/10.4314/ajtcam.v11i2.19

[12] Mahfouz AA, el-Said MM, Alakija W, Badawi IA, al-Erian RA, Moneim MA. Anemia among pregnant women in the Asir region, Saudi Arabia: an epidemiologic study. Southeast Asian J Trop Med Public Health 1994;25:84-7.

[13] Rasheed P, Koura MR, Al-Dabal BK, Makki SM. Anemia in pregnancy: a study among attendees of primary health care centers. Ann Saudi Med 2008;28:449-52. https://doi.org/10.5144/0256-4947.2008.449

[14] Cochran WG. Sampling techniques. 2nd Ed. New York: John Wiley and Sons, Inc. 1963.

[15] Tan S, Li H, Gao X, Xiang S, He Q, Zhang L, Huang L, Xiong C, Yan Q, Yan Y. [Influential factors for anemia in pregnancy based on a nested case-control study in Changsha]. Zhong Nan Da Xue Xue Bao Yi Xue Ban 2016;41:619-25. https://doi.org/10.11817/j.issn.1672-7347.2016.06.011

[16] Fan CL, Luo JY, Gong WJ, Liu XQ, Zhou SJ, Zhang FF, Zeng J, Li HX, Feng N. [Nested case-control study on associated factors for anemia during pregnancy]. Zhonghua Liu Xing Bing Xue Za Zhi 2017;38:1269-1273. https://doi.org/10.3760/cma.j.issn.0254-6450.2017.09.025

[17] Melku M, Addis Z, Alem M, Enawgaw B. Prevalence and predictors of maternal anemia during pregnancy in Gondar, Northwest Ethiopia: an institutional based cross-sectional study. Anemia 2014;2014:108593. https://doi.org/10.1155/2014/108593

[18] Karaoglu L, Pehlivan E, Egri M, Deprem C, Gunes G, Genc MF, Temel I. The prevalence of nutritional anemia in pregnancy in an east Anatolian province, Turkey. BMC Public Health 2010;10:329. https://doi.org/10.1186/1471-2458-10-329

[19] Baig-Ansari N, Badruddin SH, Karmaliani R, Harris H, Jehan I, Pasha O, Moss N, McClure EM, Goldenberg RL. Anemia prevalence and risk factors in pregnant women in an urban area of Pakistan. Food Nutr Bull 2008;29:132-9. https://doi.org/10.1177/156482650802900207

[20] Abriha A, Yesuf ME, Wassie MM. Prevalence and associated factors of anemia among pregnant women of Mekelle town: a cross sectional study. BMC Res Notes 2014;7:888. https://doi.org/10.1186/1756-0500-7-888

[21] Geissler C, Singh M. Iron, meat and health. Nutrients 2011;3:283-316. https://doi.org/10.3390/nu3030283

[22] Cheng HL, Bryant C, Cook R, O'Connor H, Rooney K, Steinbeck K. The relationship between obesity and hypoferraemia in adults: a systematic review. Obes Rev 2012;13:150-61. https://doi.org/ 10.1111/j.1467-789X.2011.00938.x

[23] Al-Farsi YM, Brooks DR, Werler MM, Cabral HJ, Al-Shafei MA, Wallenburg HC. Effect of high parity on occurrence of anemia in pregnancy: a cohort study. BMC Pregnancy Childbirth 2011;11:7. https://doi.org/10.1186/1471-2393-11-7

[24] King JC. The risk of maternal nutritional depletion and poor outcomes increases in early or closely spaced pregnancies. J Nutr 2003;133(5 Suppl 2):1732S-6S. https://doi.org/10.1093/jn/133.5.1732S

[25] Dewey KG, Cohen RJ. Does birth spacing affect maternal or child nutritional status? A systematic literature review. Matern Child Nutr 2007;3:151-73. https://doi.org/10.1111/j.1740-8709.2007.00092.x

[26] Akase T, Hihara E, Uematsu K, Kodaka M, Akase T, Tashiro S. [Single center survey of the relationship between pregnancy anemia and prepregnancy lifestyle]. Yakugaku Zasshi 2008;1281081-6. https://doi.org/10.1248/yakushi.128.1081

[27] Pala K, Dundar N. Prevalence & risk factors of anaemia among women of reproductive age in Bursa, Turkey. Indian J Med Res 2008;128:282-6.

[28] Wright S, Earland D, Sakhuja S, Junkins A, Franklin S, Padilla L, Aung M, Jolly PE. Anemia in pregnancy in Western Jamaica. Int J Womens Health 2017;9:431-9. https://doi.org/10.2147/IJWH.S129567

[29] Chang JS, Chen YC, Owaga E, Palupi KC, Pan WH, Bai CH. Interactive effects of dietary fat/carbohydrate ratio and body mass index on iron deficiency anemia among Taiwanese women. Nutrients 2014;6:3929-41. https://doi.org/10.3390/nu6093929

[30] Kordas K, Centeno ZY, Pachón H, Soto AZ. Being overweight or obese is associated with lower prevalence of anemia among Colombian women of reproductive age. J Nutr 2013;143:175-81. https://doi.org/10.3945/jn.112.167767

[31] Qin Y, Melse-Boonstra A, Pan X, Yuan B, Dai Y, Zhao J, Zimmermann MB, Kok FJ, Zhou M, Shi Z. Anemia in relation to body mass index and waist circumference among Chinese women. Nutr J 2013;12:10. https://doi.org/ 10.1186/1475-2891-12-10

[32] Stoltzfus RJ, Edward-Raj A, Dreyfuss ML, Albonico M, Montresor A, Dhoj Thapa M, West KP Jr, Chwaya HM, Savioli L, Tielsch J. Clinical pallor is useful to detect severe anemia in populations where anemia is prevalent and severe. J Nutr 1999;129:1675-81. https://doi.org/10.1093/jn/129.9.1675

[33] Chowdhury ME, Chongsuvivatwong V, Geater AF, Akhter HH, Winn T. Taking a medical history and using a colour scale during clinical examination of pallor improves detection of anaemia. Trop Med Int Health 2002;7:133-9. https://doi.org/10.1046/j.1365-3156.2002.00837.x

Received on January 17, 2021. Accepted on March 8, 2021.

Correspondence: Hassan Kasim Haridi, Academic Affairs & Postgraduate Studies, General Directorate of Health Affairs, Najran region King Saud Bin Abdel Aziz Road, Najran City, Saudi Arabia - Tel.: +966507114741 - E-mail: hassankasim@hotmail.com

How to cite this article: Alreshidi MA, Haridi HK. Prevalence of anemia and associated risk factors among pregnant women in an urban community at the North of Saudi Arabia. J Prev Med Hyg 2021;62:E653-E663. https://doi.org/10.15167/2421-4248/jpmh2021.62.3.1880

RESEARCH ARTICLE

Profile and predictors of adolescent tobacco use in Ghana: evidence from the 2017 Global Youth Tobacco Survey (GYTS)

DIVINE D. LOGO[1,3], FELIX B. OPPONG[2], ARTI SINGH[3], SEIDU AMENYAGLO[3], KENNETH WIRU[4], SAMPSON T. ANKRAH[3], LABRAM M. MUSAH[5], SARDICK KYEI-FARIED[6], JOANA ANSONG[7], ELLIS OWUSU-DABO[3]
[1] Research and Development Division, Ghana Health Service, Accra, Ghana; [2] Global Statistical Institute, Techiman, Ghana; [3] Department of Global and International Health, School of Public Health, College of Health Sciences, Kwame Nkrumah University of Science and Technology, Kumasi, Ghana; [4] Kintampo Health Research Centre, Ghana Health Service, Kintampo, Ghana; [5] Vision for Alternative Development, Accra, Ghana; [6] Disease Control and Prevention Division, Ghana Health Service, Accra, Ghana; [7] World Health Organization Ghana Country Office, Accra, Ghana

Keywords

Adolescence • Predictors • Profile • Second-hand smoke • Tobacco use • Waterpipe tobacco

Summary

Background. *Understanding the predictive factors for tobacco use, and initiation among the youth is critical for effective intervention and prevention. We, therefore, aimed to determine the profile, associated factors, the regional disparities in the use of tobacco products among the youth in Ghana.*
Method. *The study used the 2017 Ghana Global Youth Tobacco Survey (GYTS) to obtain tobacco-related information among the youth in Junior High Schools across the country. The survey used a two-stage cluster randomized sampling technique to obtain nationally representative data. Weighted univariate and multivariate logistic regression analyses were used to assess the association of participant's characteristics and use of tobacco.*
Results. *Out of the 6039 targeted respondents, 5,664 (93.8%) participated, 2,707 males, 2,929 females, and 28 of the participants had missing gender data. The use of any tobacco product (cigarette, smokeless tobacco, electronic cigarette, or waterpipe tobacco) was 28.3, 7.0, and 4.8% in the Savanna/northern zone, middle/forest zone, and Coastal zone respectively. From the univariate analysis, age ($p = 0.005$), pocket money ($p < 0.001$), and exposure to secondhand smoke (SHS) at home ($p < 0.001$) were significantly associated with tobacco use. In the multivariate analysis, age ($p = 0.002$), pocket money ($p < 0.001$), exposure to SHS at home ($p < 0.001$), and being taught about the dangers of tobacco use ($p = 0.043$) were significantly associated with tobacco use.*
Conclusion. *Multiple factors including age, pocket money, exposure to SHS were identified to be associated with tobacco use among the youth in Ghana. Promoting anti-smoking campaigns in early adolescence, as well as programmes targeting early tobacco use can guard the youth against initiating tobacco use.*

Background

The tobacco epidemic is a prime public health challenge facing the world and killing over 8 million people every year [1]. Among these deaths, over 7 million are because of direct tobacco use whiles the rest are non-smokers being exposed to SHS. It is also the single most preventable cause of disease and disability globally.
The tobacco menace does not affect only adults, but persons of all ages of life including children and adolescents. Tobacco smoke exposure in the form of SHS exposure among children is also high. Close to half of children regularly breathe air polluted by tobacco smoke in their homes and other public places, resulting in over 65000 deaths each year from illnesses because of SHS [2] and sudden infant death syndrome globally [3]. Also, over 25 million and 13 million boys and girls aged 13-15 years in school are currently using cigarette or smokeless tobacco respectively across the world [4]. Among developed countries, we have observed a significant decrease compared to developing countries where reports show higher prevalence. Despite the drop in cigarette smoking among the youth in developed countries, the overall tobacco use especially among adolescent girls continues to surge globally [4, 5].
In sub-Saharan Africa (SSA), tobacco consumption among the youth varies, ranging from a prevalence of 1.4% in Zimbabwe, 1.5% in Nigeria, to as high as 34.4% in South Africa. This has been attributed to income growth and increasing cigarette affordability, non-adherence to restrictions and bans, as well as the tobacco industry's aggressive marketing strategies in some countries in SSA [6, 8]. In Ghana, close to 9% (boys = 8.9% ; girls = 8.2%) are currently using some form of tobacco products [7]. The recent shift from conventional cigarettes to the use of other tobacco often promoted by the tobacco industry as a safe alternative to smoking among the youth populations is of particular concern because of the rise in nicotine dependence and tobacco use persistence into adulthood [8]. The decline in the cigarette is due to the sustained and highly effective regulation, public health, and clinical efforts informed by extensive scientific data [9]. Regrettably, the decline in cigarette use among the youth has led to the surge

https://doi.org/10.15167/2421-4248/jpmh2021.62.3.2035

in new, non-cigarette tobacco and nicotine-delivery products, commonly referred to as alternative tobacco products (ATPs). These include Shisha (hookah), cigars, smokeless tobacco, and electronic cigarettes [9]. The use of ATPs among the youth has been attributed to the increased availability; perception of safety; lack of or non-implemented regulations surrounding their use; reduced cost and easy availability and accessibility; attractive smell and taste [9]. ATPs also, affect smoking cessation rates negatively and expands the nicotine market by attracting the youth [10]. For instance, in Ghana, the recent GYTS findings align with this global trend, showing decreasing trends for cigarette smoking, from 3.6% in the year 2000 [11] to 2.8% in 2017, whiles higher rates of other tobacco products such as smokeless tobacco use (3.6%), shisha use (1.5%), and electronic cigarette use (4.9%) [7] have been reported for the first time among the youth. The use of ATPs among the youth and young adults is of concern due to their increased vulnerability to nicotine dependence. Studies on predictors of early tobacco use among Hispanic adolescence include family separation, school failure, and association to deviant peers [12, 13]. A study among Norwegian youth also indicated family control factors and peer pressure [14], as a powerful predictor of smoking initiation and also reported among the youth in the Middle East (Iran) [15], and as well as Whites, Blacks, and Hispanic adolescents in Europe [16].

Studies on predictors of tobacco use among the youth in Africa are lacking. To prevent future growth in tobacco use mainly as a result of the shifting attention of the tobacco industry and the increased vulnerability of the youth population in Africa, there is the need to document the key predictors of tobacco initiation among the youth. The study aims to determine the profile of tobacco use and to assess the factors associated with tobacco use among adolescents in Ghana using data from the 2017 GYTS

Methods

The study used the 2017 Ghana Global Youth Tobacco Survey (GYTS) to obtain tobacco-related information among adolescents in Junior High School across the country. They sampled participants from the three main ecological/epidemiological zones of Ghana, namely the savanna or the northern zone, the middle of the forest zone, and the coastal zone. The savannah/northern zone covers the current five northern regions (Northern, Savannah, North East, Upper East, and Upper West regions). The middle/forest zone comprises the current Ashanti, Bono, Bono East, Ahafo, Eastern, Volta, and Oti regions, and the coastal zone covers the current Greater Accra, Central, Western, and Western North regions. Students from seventy-seven (n = 77) schools across the country were included in the survey. The Ghana GYTS is a standard school-based survey designed to collect information on cigarette and non-cigarette tobacco products and on five determinants of tobacco use – access/availability and price, SHS exposure, cessation, media messages, and tobacco advertising sponsorship and promotion. The survey design and methodology have been described in earlier studies [7, 17]. In brief, the study used a two-stage cluster sampling to obtain representative data of Ghanaian youth in school. In the first stage, we selected schools proportional to their enrollment size, followed by a random selection of classes within these schools in the second stage. Inclusion and exclusion criteria for selection were; all registered schools, both public and private, and grades or classes that represent the student population of boys and girls of 13-15 years of age enrolled in schools. The authors included all schools with an enrolment size of 80 and above in the sample frame unless the schools did not comprise grades/classes that represent students aged 13-15 years. All students in selected classes were eligible to participate in the survey. Parental consent and assent from students were sought before data collection and participation. Students were also informed that participation was voluntary and therefore they could discontinue when they wished, or decide not to respond to a question that they were not comfortable with.

Study measures

This study used four primary outcome measures to assess tobacco use among the youth in Ghana. These were the use of cigarettes, smokeless tobacco, electronic cigarette, and waterpipe tobacco (shisha) (Tab. I). We determined these by the participant's response to the questions: ''During the past 30 days, on how many days did you smoke cigarettes?'', During the past 30 days, did you use any form of smoked tobacco products other than cigarettes (e.g., cigars, waterpipes, cigarillos, little cigars, pipes)?'', "During the past 30 days, on how many days did you smoke waterpipe tobacco (shisha)? ''During the past 30 days, did you use any form of smokeless tobacco products (e.g., chewing tobacco, snuff, dip)?'', "During the past 30 days, on how many days did you use electronic cigarettes?" In total, on how many days have you used an electronic cigarette or e-cigarette in your entire life?", We classified those who smoked one or more days during the past 30 days as current cigarette smokers. Among the ever-users of any tobacco products we determined their status by a positive response to any of the following questions: "Have you ever tried or experimented with any form of smokeless tobacco products (such as snuff, "Bonto", chewing tobacco)?", ''Have you ever tried or experimented with waterpipe tobacco (shisha) smoking, even one or two puffs?" respectively.

We constructed predictors from selected questions that could hypothetically and in theory be associated with tobacco use among adolescents in Ghana, including exposure to SHS inside the home (public place), exposure to smoking or anti-smoking media messages, age, and gender.

Ethical approval for the study was obtained from the Ghana Health Service Ethics Review Committee. Approval was also obtained from the Ministry of

Tab. I. Description of variables used in the study.

Variable	Description/definition
Age	Participants age at the time of the survey (11-12 years, 13-15 years, and 16-17 years)
Grade	The participants' grade in Junior High School (1st year of Junior High School (JHS1), 2nd year of Junior High School (JHS2), 3rd year of Junior High School (JHS3)
Current cigarette smokers	Participants who currently smoke cigarettes 1 or more days in the past 30 days
Ever cigarette smokers	Participants who ever smoked cigarettes or who tried or experimented with cigarette smoking, even one or two puffs
Current smokeless tobacco users	Participants who currently use smokeless tobacco products in the past 30 days
Exposure to secondhand smoke at home	Participants who were exposed to tobacco smoke at home in the past 7 days or who reported that smoking occurred in their presence inside their home on 1 or more days in the past 7 days
Taught about the dangers of tobacco use at school	Participants were taught about the dangers of tobacco use in class during the past 12 months
Exposure to anti-tobacco messages in the media	Participants who saw or heard any anti-tobacco messages in the media (e.g., television, radio, internet, billboards, posters, newspapers, magazines, or movies) in the past 30 days
Current electronic cigarette users	Participants who used electronic cigarettes during the past 30 days
Current waterpipe (shisha) users	Participants who used waterpipe (shisha) during the past 30 days
Pocket money	The amount of pocket money that participants spend on themselves on the average per week (No pocket money, Less than 2 cedis, 2-5 cedis, 6-10 cedis, 11-20 cedis, 21 cedis, or more)

Education/Ghana Education Service and the heads of the selected schools. We obtained parental consent and written assent from children after a detailed explanation of the study objectives, procedures, risks, and benefits had been presented to them.

Statistical analysis

Data were weighted by taking into account the design characteristics of the survey. The following weighting formula was used:

$$W = W1 \times W2 \times f1 \times f2 \times f3 \times f4$$

W1 is the inverse of the probability of selecting the school; W2 is the inverse of the probability of selecting the class within the school; f1 is a school-level nonresponse adjustment factor calculated by school size category (small, medium, large); f2 is a class adjustment factor calculated by school; f3 is a student-level nonresponse adjustment factor calculated by class; f4 is a post-stratification adjustment factor calculated by gender and grade.

The background characteristics of the study participants were presented as unweighted frequencies and weighted percentages. The prevalence of tobacco use was mapped to show regional disparities in the use of cigarettes, smokeless tobacco, electronic cigarette, and waterpipe tobacco (shisha). Tobacco use was also presented by background characteristics of the respondents, stratified by gender. Chi-squared tests were used to assess the association between participant's characteristics and the use of any tobacco product. The use of any tobacco product implies the use of cigarettes, smokeless tobacco, electronic cigarette, or waterpipe tobacco.

Weighted univariate and multivariate logistic regression analyses were used to obtain estimates of the association between the following – gender, age, grade/form, amount of pocket money, exposure to SHS at home, exposure to antismoking media message, and being taught about the danger of tobacco use during the past 12 months and use of any tobacco product. Given the interest in these selected variables, they were all included in the multivariate analysis irrespective of their statistical significance in the univariate analysis. All test results were considered to be statistically significant at a default alpha of 5%. STATA version 15 (StataCorp, Texas) was used for the statistical analysis.

Results

Characteristics of study respondents

Out of the 6,039 targeted respondents, 5,664 (93.8%) participated in the survey 2,707 males, 2,929 females, and 28 with missing gender. As presented in Table II, about 90% (n = 5,116) of the students were within the 13-15 years age group. Regarding pocket money, close to 90% (n = 4,777) of the students reported having money to spend every week. About a quarter of the respondents (23.7%, n = 1,239) reported being exposed to SHS at home. Of all the respondents, 52.5% (n = 2804) said they were taught about the dangers of tobacco use in school. The tobacco products used among the Junior High Students in Ghana included cigarette: 3.0% (boys = 3.2%; girls = 2.7%), smokeless tobacco: 3.6% (boys = 3.2%; girls = 3.9), electronic cigarette: 5.8% (boys = 5.5%, girls 6.1%) and water pipe (Shisha): 1.7% (boys = 0.9%; girls 2.1%) (Tab. II).

Tab. II. Background and smoking characteristics of study participants-GYTS Ghana, 2017.

Characteristics	Overall (n = 5,664)		Males[β] (n = 2,707)		Females[β] (n = 2,929)	
	Unweighted frequency	Weighted percentage	Unweighted frequency	Weighted percentage	Unweighted frequency	Weighted percentage
Age*						
11 to 12 years	137	2.7	63	2.8	70	2.6
13 to 15 years	5,116	90.9	2,412	89.9	2,681	91.9
16 to 17 years	402	6.4	228	7.3	173	5.6
Grade#						
JHS1	2,104	37.5	1,016	37.5	1,085	37.8
JHS2	2873	34.1	1,351	33.9	1,508	34.3
JHS3	662	28.4	329	28.6	328	27.9
Pocket money[$]						
No pocket money	874	10.9	431	10.0	436	11.8
Less than 2 cedis	1,206	19.2	572	19.7	627	18.4
2-5 cedis	1,455	28.1	701	29.5	746	26.6
6-10 cedis	826	17.0	382	16.3	443	18.0
11-20 cedis	627	13.1	292	12.8	333	13.5
21 cedis or more	663	11.7	323	11.7	337	11.7
Exposure to SHS at home[¥]						
Yes	1,239	23.7	608	25.7	617	21.6
No	4,410	76.3	2,092	74.3	2,304	78.4
Exposure to antismoking media message[£]						
Yes	2,694	48.8	1,274	47.6	1,403	49.6
No	2,825	51.2	1359	52.4	1,457	50.4
Taught about the danger of tobacco use during the past 12 months[€]						
Yes	2,804	52.5	1,336	52.7	1455	52.5
No	1,743	29.8	838	28.2	898	31.1
Don't know	1,092	17.8	521	19.2	565	16.4
Region						
Savanna/Northern	1,862	17.5	899	17.6	951	17.1
Middle/forest	1,804	47.5	846	48.2	952	47.2
Coastal	1,998	35.0	962	34.3	1,026	35.8
Current cigarette use[®]						
Yes	162	3.0	92	3.2	66	2.7
No	5,053	97.0	2383	96.8	2651	97.3
Current use of smokeless tobacco[©]						
Yes	211	3.6	104	3.2	105	3.9
No	5,146	96.4	2,451	96.8	2,675	96.1
Current use of electronic cigarette™						
Yes	349	5.8	148	5.5	198	6.1
No	5,081	94.2	2,440	94.5	2618	93.9
Current use of waterpipe[@]						
Yes	77	1.7	31	0.9	44	2.1
No	5,293	98.3	2,534	99.1	2,735	97.9

* 9 missing value; [#] 25 missing value; [$] 13 missing value; [¥] 15 missing value; [£] 145 missing value; [€] 25 missing value; [®] 449 missing value; [©] 307 missing value; ™ 234 missing value; [@] 294 missing value, [β] 28 respondents had missing gender.

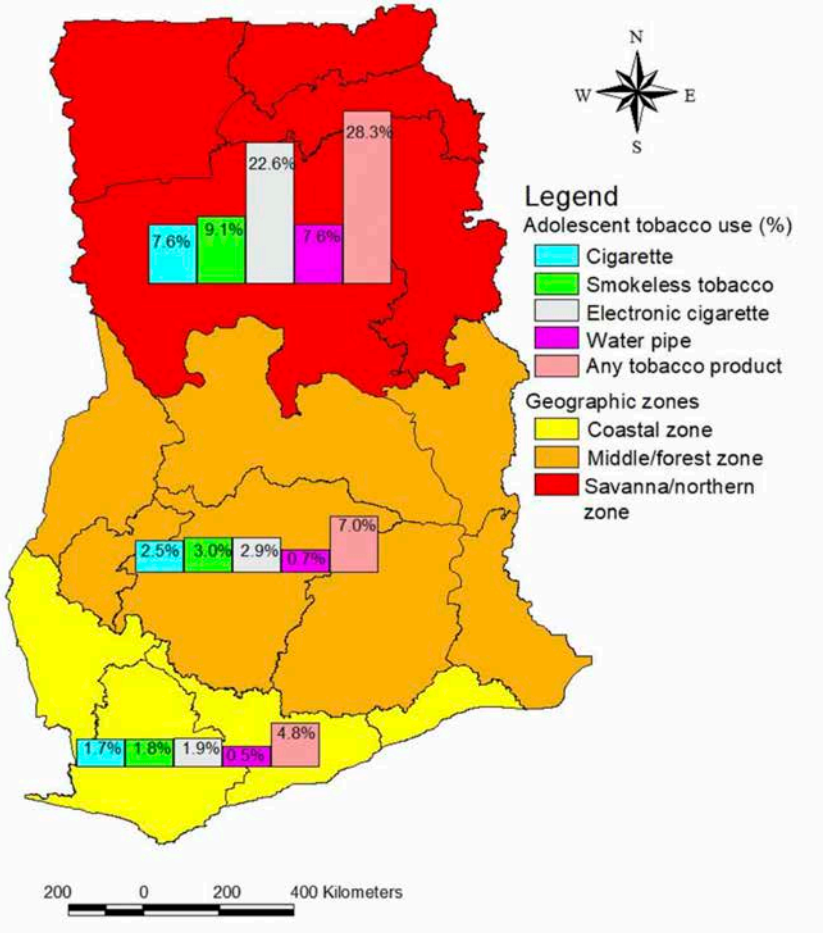
Regional disparities in tobacco use

In Figure 1, a map of Ghana has been used to present the regional disparities in the use of cigarettes, smokeless tobacco, electronic cigarette, and waterpipe tobacco (shisha). Compared to the other regions, tobacco use was higher in the Savanna/northern zone. In particular, the use of any tobacco product (cigarette, smokeless tobacco, electronic cigarette, or waterpipe tobacco) was 28.3, 7.0, and 4.8% in the Savanna/northern zone, middle/forest zone, and Coastal zone respectively.

Use of tobacco by respondent's characteristics

Out of the 5,664 study participants, 99.9% (n = 5,659) responded to the questions on the use of cigarette, smokeless tobacco, electronic cigarette, or waterpipe tobacco. Among these 5,659 respondents, 2,706 were males, 2,926 were females and 27 students had missing gender. The results from the Chi-squared tests are presented in Table III. Overall, 9.9% (7.5-13.1%) of junior high school students in Ghana were using some

Fig. 1. Regional disparities in tobacco use among junior high school students in Ghana.



form of tobacco product (cigarette, smokeless tobacco, electronic cigarette, or waterpipe tobacco). Among all respondents, age (p = 0.001), amount of pocket money (p < 0.001), and exposure to SHS at home (p < 0.001) were significantly associated with tobacco use among Junior High students in Ghana. Gender (p = 0.779), grade (p = 0.050), exposure to antismoking media message (p = 0.111), and taught about the danger of tobacco use during the past 12 months (p = 0.063) were not significantly associated with tobacco use.

In males, age (p = 0.003) and exposure to SHS at home (p < 0.001) were significantly associated with tobacco use. Among females, age (p = 0.035), grade (p = 0.028), amount of pocket money (p < 0.001), exposure to SHS at home (p < 0.001), and taught about the dangers of tobacco use during the past 12 months (p = 0.021) were significantly associated with tobacco use.

Predictors of tobacco use

The results of the univariable and multivariable logistic regression analysis are presented in Table IV. From the univariate analysis, compared to students between 16 to 17 years, tobacco use was significantly lower among the 13 to 15 years group (OR: 0.55, 95% CI: 0.31-0.95, p = 0.005). Tobacco use was also significantly lower among those who receive 2 Ghana cedis (GH¢2) (0.35USD) or more pocket money compared to those who do not usually have pocket money (p < 0.001). Those exposed to SHS at home are also more likely to use tobacco compared to those who are not exposed (OR: 6.08, 95% CI: 4.08-9.05, p < 0.001).

In the multivariate analysis, age (p = 0.002), amount of pocket money (p < 0.001), exposure to SHS at home (p < 0.001), and being taught about the dangers of tobacco use during the past 12 months (p = 0.043) were significantly associated with tobacco use. The association is such that, tobacco use is significantly higher among those between 11-12 years compared to those between 16-17 years (OR: 2.27, 95% CI: 1.02-5.03), higher among those who receive GH¢ 2(0.35USD) or more pocket money compared to those who do not usually have pocket money, higher among those exposed to SHS at home (OR: 5.99, 95% CI: 4.04-8.89), and lower among those who have been taught about the dangers of tobacco use during the past 12 months (OR: 0.56, 95% CI: 0.35-0.88).

Discussion

This study used data from the Ghana 2017 GYTS to present nationally representative estimates of the profile

Tab. III. Profile of cigarette, smokeless tobacco, electronic tobacco, and/or waterpipe use.

	Overall (n = 5,659)			Males (n = 2,706)			Females (n = 2,926)		
Characteristics	**n/N ***	**% (95% CI)[g]**	**P-value[§]**	**n/N**	**% (95% CI)**	**P-value[§]**	**n/N**	**% (95% CI)**	**P-value[§]**
Overall	582/ 5,659	9.9 (7.5-13.1)							
Gender									
Males	288/ 2,706	9.9 (7.6-12.9)	0.779	-	-	-	-	-	-
Females	287/ 2,926	9.4 (6.2-14.0)		-	-		-	-	
Age									
11 to 12 years	32/136	28.1 (12.2-52.3)	**0.001**	17/63	25.3 (11.9-45.9)	**0.003**	15/70	32.0 (8.2-71.2)	**0.035**
13 to 15 years	472/5,112	9.0 (6.9-11.7)		223/2,411	8.9 (6.7-11.7)		242/2,678	8.5 (5.8-12.5)	
16 to 17 years	77/402	15.4 (9.3-24.3)		47/228	16.7 (10.5-25.6)		30/173	13.6 (5.2-31.1)	
Grade									
JHS1	263/2,102	8.5 (6.2-11.5)	0.050	135/1,016	10.0 (7.1-13.9)	0.790	127/1,083	6.9 (4.9-9.7)	**0.028**
JHS2	264/2,872	8.1 (6.3-10.3)		131/1,350	9.0 (6.7-12.0)		132/1,508	7.0 (5.2-9.4)	
JHS3	47/661	14.0 (8.2-22.9)		20/329	10.9 (5.6-20.0)		25/327	15.7 (7.3-30.7)	
Pocket money									
No pocket money	122/872	18.2 (10.7-29.1)	**< 0.001**	58/430	13.3 (9.7-18.0)	0.122	62/435	22.2 (10.5- 40.8)	**< 0.001**
Less than 2 cedis	162/1,204	15.6 (11.3-21.2)		74/572	13.0 (9.0-18.5)		86/626	16.3 (10.8-23.8)	
2-5 cedis	139/1,455	8.3 (5.5-12.3)		75/701	10.3 (6.0-17.2)		63/746	6.0 (3.6-9.7)	
6-10 cedis	56/825	5.4 (3.2-9.2)		29/382	5.8 (2.8-11.9)		26/442	5.0 (2.2-10.7)	
11-20 cedis	61/627	8.6 (5.5-13.3)		31/292	10.7 (5.3-20.3)		29/333	6.2 (3.9-9.9)	
21 cedis or more	37/663	4.0 (2.2-7.0)		19/323	4.5 (2.3-8.7)		18/337	3.5 (1.7-6.9)	
Exposure to SHS at home									
Yes	327/1,236	24.8 (17.9-33.2)	**< 0.001**	156/608	22.5 (15.9-30.8)	**< 0.001**	166/615	27.3 (17.5-39.9)	**< 0.001**
No	247/4,408	5.1 (4.0-6.6)		129/2,091	5.6 (4.0-7.7)		116/2,303	4.1 (3.0-5.7)	
Exposure to the antismoking media message									
Yes	299/2,690	11.0 (7.9-15.1)	0.111	145/1,273	9.8 (7.2-13.1)	0.781	149/1,400	11.1 (6.5-18.5)	0.117
No	245/2,824	8.3 (6.0-11.3)		120/1,359	9.3 (6.6-12.9)		125/1,457	7.2 (4.8-10.5)	
Taught about the danger of tobacco use during the past 12 months									
Yes	225/2,802	7.8 (5.7-10.6)	0.063	127/1,335	9.0 (6.3-12.8)	0.578	97/1,454	6.4 (4.0-10.3)	**0.021**
No	189/1,742	11.5 (7.8-16.6)		91/838	9.9 (6.6-14.6)		95/897	11.5 (6.6-19.3)	
Don't know	155/1,091	11.8 (8.2-16.8)		64/521	11.9 (7.3-18.9)		89/564	11.4 (7.8-16.5)	

* unweighted, N: total number of the respondent; n: number of respondents using some form of tobacco product (cigarette, smokeless tobacco, electronic cigarette, or waterpipe tobacco); [g] Weighted; [§] p-value based on Chi-squared test.

and predictors, and also to assess regional disparities in tobacco use among junior high school students in Ghana. About 3.0% of Junior High School students smoke cigarettes, close to 6% use electronic cigarettes, close to 2% use water-pipe tobacco (shisha), and close to 4% also, use smokeless tobacco. The current decline in cigarette smoking compared to the previous findings could be described as an improvement in disguise, because other tobacco products' use has emerged including smokeless tobacco use (3.6%), shisha use (1.5%), and electronic cigarette use (4.9%) [7, 17].

We also found that close to one-third of the participants were exposed to SHS at home, and had a six-fold likelihood of using tobacco compared to those who are not (OR: 6.08, 95% CI: 4.08-9.05, $p < 0.001$). Studies on adolescent tobacco use in SSA have reported a similar association of higher tobacco use among those exposed to SHS [17-20]. Mamudu et al. [19] in their study among adolescents in West Africa, indicated that exposure to SHS inside the homes ranged from 13.0 to 45.0%. The authors also associated parental or peer smoking behaviors with adolescent tobacco use in those countries, including Ghana [19]. Another study in West Africa (Nigeria) also indicates a similar finding [20]. The World Health Organization on Framework Convention on Tobacco Control (WHO FCTC) has emphasized that 100% smoke-free policies are the only proven way to effectively protect people from the harmful effects of SHS [21]. Other pressing issues cannot override the challenge of SHS exposure because tobacco alone kills more people than coronavirus pandemic (COVID-19) daily. Therefore, public education campaigns could inform parents of the dangers of SHS exposure for their wards and promote smoke-free households. Also, educating the youth about the health implications of SHS could make smoking socially offensive and prevent tobacco initiation and continue to use.

Tobacco use was lower among students who received education about the dangers of tobacco. This is consistent with other studies across SSA [22-24], even though other studies report conflicting findings [20, 25]. Certainly, school-based tobacco educational programmes have produced varying results in previous research with regards to their effectiveness in making a behavioural change among the youth who use tobacco and/or prevent initiation [26, 27]. Our findings together with other existing literature highlight the need for a comprehensive approach to youth tobacco prevention, such as strongly enforced smoke-free school policies, as well as engaging communities to include out-of-school youth in the

Tab. IV. Association between respondent's characteristic and use of any tobacco product.

	Univariate			Multivariate		
Characteristics	OR	95% CI	Overall p-value	OR	95% CI	Overall p-value
Gender						
Males	1		0.779	1		0.901
Females	0.94	0.62-1.43		0.98	0.67-1.42	
Age						
11 to 12 years	2.15	0.76-6.11	**0.005**	2.27	1.02-5.03	**0.002**
13 to 15 years	0.55	0.31-0.95		0.69	0.44-1.10	
16 to 17 years	1			1		
Grade						
JHS1	1		0.123	1		0.225
JHS2	0.95	0.63-1.43		0.95	0.66-1.37	
JHS3	1.75	0.96-3.18		1.50	0.86-2.63	
Pocket money						
No pocket money	1		**< 0.001**	1		**< 0.001**
Less than 2 cedis	0.83	0.47-1.48		0.87	0.47-1.61	
2-5 cedis	0.41	0.20-0.83		0.46	0.22-0.94	
6-10 cedis	0.26	0.12-0.56		0.30	0.14-0.67	
11-20 cedis	0.43	0.20-0.92		0.48	0.22-1.00	
21 cedis or more	0.19	0.08-0.42		0.28	0.12-0.62	
Exposure to SHS at home						
Yes	6.08	4.08-9.05	**< 0.001**	5.99	4.04-8.89	**< 0.001**
No	1			1		
Exposure to the antismoking media message						
Yes	1.37	0.93-2.03	0.112	1.17	0.85-1.62	0.321
No	1			1		
Taught about the danger of tobacco use during the past 12 months						
Yes	0.65	0.43-1.00	0.097	0.56	0.35-0.88	**0.043**
No	1			1		
Don't Know	1.04	0.64-1.68		0.95	0.58-1.54	

programmes which may be more effective than only concentrating efforts on the classroom educational methods.

Among the three main ecological/epidemiological zones in Ghana, the Savanna/Northern zone which is most deprived and the poorest had the highest prevalence of tobacco use among the youth compared to the southern zone which has a better economic livelihood. We have reported similar findings in other studies in Ghana [17, 28, 29]. This suggests that the socioeconomic environment where the school is located may influence the smoking behaviours of students through several mechanisms, including exposure to tobacco advertising, availability of tobacco products, and the development of social norms that may facilitate the uptake of tobacco products.

Our study finding also indicates that pocket money was a predictor of tobacco use among the respondents. Respondents who received GH¢ 2(0.35USD) or more as pocket money were less likely to use tobacco compared to those who received no pocket money. This is in contrast to other studies [30, 31] that report a strong association between higher tobacco use among adolescents and increase pocket money. In our setting, the finding of higher tobacco use among those without pocket money compared with those with pocket money can be interpreted in the context of socioeconomic status. This study, however, agrees with other studies from Ghana [17, 28], which showed the northern zone (the most deprived and the poorest) had the highest prevalence of tobacco use among the youth compared to the southern zone which has a better economic livelihood. We recommend targeted policies that will create awareness about the dangers of tobacco use, especially among the youth.

Age was significantly associated with tobacco use; tobacco use was higher among 11-12 years as compared to 16-17 years (OR: 2.27, 95% CI: 1.02-5.03). Our findings agreed with other studies [18, 19, 23]. We consider children to be vulnerable, hence their rights to a smoke-free environment become paramount in the discussions on tobacco control. Therefore, for a successful implementation of tobacco control policies, children must be the prime target, because approximately 90% of adult smokers today started the habit in their teens [32], and also the tobacco industry sees children as a replacement for smokers [33].

Children and adolescents are a vulnerable population, hence need full protection from tobacco use. Countries with WHO FCTC comprehensive smoke-free implementation sets the obvious examples for the rest of the world to mimic.

Strengths and limitations

The main strength of our study is the large sample size and robust sampling methodology which is nationally representative and with high response rates among schools and students. Limitations of our study include the use of self-administered questionnaires by students which may have led to under/over-reporting. However, some studies have reported high reliability of the results on self-administered youth smoking questionnaires [34,35]. Also, the survey was limited to school-going youth and this may not represent all youth in Ghana. We suggest further investigation on electronic cigarette use among the youth.

Conclusions

Multiple predictive factors influence youth smoking initiation and continuous use in Ghana. These findings call for the support and the adoption of multi-level comprehensive tobacco control strategies as proposed by the WHO-FCTC and other tobacco control bodies such as the Center for Disease Control's Best Practice for Comprehensive Tobacco Control (CDC-Georgia Atlanta). There is the need to have policies and interventions developed to prevent early smoking initiation among the youth especially targeting children with lower socioeconomic status. Also, the younger teenagers may be targeted with special anti-smoking programmes both in and out of school. Finally, culturally accepted refusal skills and sensitization about the dangers of tobacco should be developed by the Ministry of Health/Health Promotion Division targeting particularly the youth in the northern zone, for effective prevention and/or reduction in tobacco uptake.

Acknowledgements

Funding sources: this research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.
We are thankful to the Research and Development Division of the Ghana Health Service, Ministry of Health Ghana for allowing us to use the GYTS data. We are also grateful to the School of Public Health, Kwame Nkrumah University of Science and Technology for providing all the technical assistance for this study.

Conflict of interest statement

The authors declare no conflict of interest.

Authors' contributions

DDL, FBO, and EOD conceived the idea and conceptualized the study. DDL and FBO conducted the data analysis and wrote the first draft. SA, AS, STA contributed significantly to the statistical analyses. KW, LB, SKF, JA, and EOD provided critical contributions to the discussion of the findings of the study. All authors contributed to the study design and review of the manuscript.

References

[1] WHO. Tobacco - World Health Organization;tobacco fact sheet from WHO providing key facts and information on surveillance, second-hand smoke, quitting, picture warnings, ad bans. WHO Newsroom/Factsheet 2020. www.who.int/news-room/fact-sheets/detail/tobacco WHO 2020 (accessed Aug 30, 2020).

[2] WHO-FCTC- Safeguarding children's wellbeing through protection from tobacco smoke. WHO framework on Tobacco Control 2020. https://www.who.int/fctc/mediacentre/news/2019/childrens-wellbeing-through-protection-from-tobacco-smoke/en (accessed Nov 29, 2020).

[3] Office on Smoking and Health (US). The Health Consequences of Involuntary Exposure to Tobacco Smoke: A Report of the Surgeon General. Atlanta (GA): Centers for Disease Control and Prevention (US) 2006.

[4] Drope J, Schluger N, Cahn Z, Drope J, Hamill S, Islami F, Liber A, Nargis N. The Tobacco Atlas. Atlanta: 2018. Available: https://tobaccoatlas.org/topic/youth (Accessed: 20-Sep-2020).

[5] Jafari A, Rajabi A, Gholian-Aval M, Peyman N, Mahdizadeh M, Tehrani H. National, regional, and global prevalence of cigarette smoking among women/females in the general population: a systematic review and meta-analysis. Environ Health Prev Med 2021;26:5. https://doi.org/10.1186/s12199-020-00924-y

[6] Townsend L, Flisher AJ, Gilreath T, King G. A systematic review of tobacco use among sub-Saharan African youth. J Subst Use 2006;11:245-69. https://doi.org/10.1080/14659890500420004

[7] Ghana-GYTS; Centers for Disease Control and Prevention. Global Youth Tobacco Survey. Accra, Ghana: 2017. Available: https://nccd.cdc.gov/GTSSDataSurveyResources/Ancillary/DataReports.aspx?CAID=1 (accessed: 20-Sep-2020).

[8] Harrell PT, Naqvi SMH, Plunk AD, Ji M, Martins SS. Patterns of youth tobacco and polytobacco usage: the shift to alternative tobacco products. Am J Drug Alcohol Abuse 2017;43:694-702. https://doi.org/10.1080/00952990.2016.1225072

[9] Lauterstein D, Hoshino R, Gordon T, Watkins BX, Weitzman M, Zelikoff J. The changing face of tobacco use among United States youth. Curr Drug Abuse Rev 2014;7:29-43. https://doi.org/10.2174/1874473707666141015220110

[10] Glantz SA, BarehamDW. E-Cigarettes: use, effects on smoking, risks, and policy implications. Annu Rev Public Health 2018;39:215-35. https://doi.org/10.1146/annurev-publhealth-040617-013757

[11] Ghana-GYTS. Global Youth Tobacco Survey (GYTS), Ghana Fact Sheet. USA, Georgia Atlanta: 2009. Available: https://www.tobaccofreekids.org/assets/global/pdfs/en/Ghana_GYTS_2009_en.pdf (accessed: 20-Sep-2020).

[12] Lopez B, Wang W, Schwartz SJ, Prado G, Huang S, Hendricks Brown C, Pantin H, Szapocznik J. School, family, and peer factors and their association with substance use in Hispanic adolescents. J Prim Prev 2009;30:622-41. https://doi.org/10.1007/s10935-009-0197-5

[13] Van Ryzin MJ, Fosco GM, Dishion TJ. Family and peer predictors of substance use from early adolescence to early adulthood: an 11-year prospective analysis. Addict Behav 2012;37:1314-24. https://doi.org/10.1016/j.addbeh.2012.06.020

[14] Tjora T, Hetland J, Aarø LE, Øverland S. Distal and proximal family predictors of adolescents' smoking initiation and development: a longitudinal latent curve model analysis. BMC Public Health 2011;11:911. https://doi.org/10.1186/1471-2458-11-911

[15] Baheiraei A, Soltani F, Ebadi A, Cheraghi MA, Rahimi Foroushani A. Family and peer risk factors as predictors of lifetime tobacco use among Iranian adolescents: gender similarities and differences. Glob J Health Sci 2014;6:63-75. https://doi.org/10.5539/gjhs.v6n4p63

[16] Mahabee-Gittens EM, Xiao Y, Gordon JS, Khoury JC. Continued importance of family factors in youth smoking behavior. Nicotine Tob Res 2012;14:1458-66. https://doi.org/10.1093/ntr/nts078

[17] Logo DD, Kyei-Faried S, Oppong FB, Ae-Ngibise KA, Ansong J, Amenyaglo S, Ankrah ST, Singh A, Owusu-Dabo E. Waterpipe use among the youth in Ghana: lessons from the Global Youth Tobacco Survey (GYTS) 2017. Tob Induc Dis 2020;18:47. https://doi.org/10.18332/tid/120937

[18] Jallow IK, Britton J, Langley T. Prevalence and determinants of tobacco use among young people in The Gambia. BMJ Glob Health 2017;2:e000482. https://doi.org/10.1136/bmjgh-2017-000482

[19] Mamudu HM, Veeranki SP, John RM, Kioko DM, Ogwell Ouma AE. Secondhand smoke exposure among nonsmoking adolescents in West Africa. Am J Public Health 2015;105:1823-30. https://doi.org/10.2105/AJPH.2015.302661

[20] Itanyi IU, Onwasigwe CN, Ossip D, Uzochukwu BSC, McIntosh S, Aguwa EN, Wang S, Onoka CA, Ezeanolue EE. Predictors of current tobacco smoking by adolescents in Nigeria: interaction between school location and socioeconomic status. Tob Induc Dis 2020;18:13. https://doi.org/10.18332/tid/117959

[21] WHO-FCTC. Who framework convention on tobacco control. Geneva, Switzerland: 2005. Available: https://www.who.int/tobacco/framework/WHO_FCTC_english.pdf?ua=1 (accessed: 20-Jun-2020).

[22] Talley B, Masyn K, Chandora R, Vivolo-Kantor A. Multilevel analysis of school anti-smoking education and current cigarette use among South African students. Pan Afr Med J 2017;26:37. https://doi.org/10.11604/pamj.2017.26.37.7880

[23] Kapito-TemboA, Muula AS, Rudatsikira E, Siziya S. Smoking among in-school adolescents in Dar Es Salam, Tanzania: results from the Global Youth Tobacco Survey. Tanzan J Health Res 2011;13.196-204. https://doi.org/10.4314/thrb.v13i3.64138

[24] Mamudu HM, Veeranki SP, John RM. Tobacco use among school-going adolescents (11-17 years) in Ghana. Nicotine Tob Res 2013;15:1355-64. https://doi.org/10.1093/ntr/nts269

[25] Siziya S, Rudatsikira E, Muula AS. Antismoking messages and current cigarette smoking status in Somaliland: results from the Global Youth Tobacco Survey 2004. Confl Health 2008;2:6. https://doi.org/10.1186/1752-1505-2-6

[26] Thomas RE, McLellan J, Perera R. School-based programmes for preventing smoking. Cochrane Database Syst Rev 2013;2013:CD001293. https://doi.org/10.1002/14651858.CD001293.pub3

[27] Peterson AV Jr, Kealey KA, Mann SL, Marek PM, Sarason IG. Hutchinson Smoking Prevention Project: long-term randomized trial in school-based tobacco use prevention results on smoking. J Natl Cancer Inst 2000;92:1979-91. https://doi.org/10.1093/jnci/92.24.1979

[28] Debrah E. Alleviating poverty in Ghana: the case of Livelihood Empowerment against Poverty (LEAP). Afr Today 2013;59:41-67. https://doi.org/10.2979/africatoday.59.4.41

[29] Ghana. Covid-19 & Tobacco. The Unuversity of Edinburgh, Usher Institute, UK: 2020. https://www.ed.ac.uk/files/atoms/files/covid19_and_tobacco_briefing_-_ghana.pdf (accessed Feb 06, 2021).

[30] Rachiotis G, Barbouni A, Basagiannis A, Katsioulis A, Kostikas K, Mouchtouri V, Merakou K, Kremastinou J, Hadjichristodoulou CS. Prevalence and determinants of current cigarette smoking and secondhand smoking among Greek adolescents: the Global Youth Tobacco Survey (GYTS) 2013 study. BMJ Open 2020;10:e034760. https://doi.org/10.1136/bmjopen-2019-034760

[31] Asare S, Stoklosa M, Drope J, Larsen A. Effects of prices on youth cigarette smoking and tobacco use initiation in Ghana and Nigeria. Int J Environ Res Public Health 2019;16:3114. https://doi.org/10.3390/ijerph16173114

[32] US Surgeon General; US Department of Health and Human Services. The health consequences of smoking – 50 years of progress: a report of the surgeon general. Atlanta, GA: US Department of Health and Human Services, Centers for Disease Control and Prevention, National Center 2014.

[33] Perry CL. The tobacco industry and underage youth smoking: tobacco industry documents from the Minnesota litigation. Arch Pediatr Adolesc Med 1999;153:935-41. https://doi.org/10.1001/archpedi.153.9.935

[34] Brener ND, Kann L, McManus T, Kinchen SA, Sundberg EC, Ross JG. Reliability of the 1999 youth risk behavior survey questionnaire. J Adolesc Health 2002;31:336-42. https://doi.org/10.1016/s1054-139x(02)00339-7

[35] Brener ND, Mcmanus T, Galuska DA, Lowry R, Wechsler H. Reliability and validity of self-reported height and weight among high school students. J Adolesc Health 2003;32:281-7. https://doi.org/10.1016/s1054-139x(02)00708-5

Received on February 22, 2021. Accepted on April 9, 2021.

Correspondence: Ellis Owusu-Dabo, Kwame Nkrumah University of Science and Technology, Kumasi, Ghana - Tel.: +233-3220-65280 / +233-20-1964425 - E-mail address: owusudabo@yahoo.com

How to cite this article: Logo DD, Oppong FB, Singh A, Amenyaglo S, Wiru K, Ankrah ST, Musah LM, Kyei-Faried S, Ansong J, Owusu-Dabo E. Profile and predictors of adolescent tobacco use in Ghana: evidence from the 2017 Global Youth Tobacco Survey (GYTS). J Prev Med Hyg 2021;62:E664-E672. https://doi.org/10.15167/2421-4248/jpmh2021.62.3.2035

Research article

Teachers' knowledge about type 1 diabetes in public female elementary schools in Northern Saudi Arabia

FAWZH MUZIL ALSHAMMARI[1], HASSAN KASIM HARIDI[2]
[1] Family & Community Medicine Joint Program, Hail, Saudi Arabia; [2] Health Affairs, Hail Region, Saudi Arabia

Keywords

Type 1 diabetes • Students • Schools • Teachers • Saudi Arabia

Summary

Background. *Saudi Arabia ranks the 4th country in the world in incidence rate of Type 1 Diabetes (T1D), which is usually diagnosed in children and teens. Managing T1D at school is important for children's short- and long-term health. Little is known about how much teachers are compatible to support students with diabetes in schools in northern Saudi Arabia. The aim of this study was to assess factual knowledge about T1D among teachers in public female elementary schools.*

Materials and methods. *This was a cross-sectional survey conducted in 18 elementary schools in Hail region, during October 16, 2019 to January 23, 2020. A structured self- administered questionnaire approached all school teachers and other school staff caring students (n = 600).*

Results. *A total of 504 questionnaires received completed (84.0% response rate). Overall, 220 (43.7%) teachers reported having had or currently having a student/s with T1D. Only a small percentage (10.8%) who stated that they had received training to support students with T1D. Participant attained an overall fair knowledge score (13.20 ± 3.81 on 20-point scale; 66.0%), however, only 27.3% who attained good score (≥ 80%) compatible with being an effective support person for students with diabetes. The multivariate logistic regression model, revealed that: (1) received training [adjusted Odds Ratio (aOR: 3.38; p < 0.001); (2) have/ever had diabetic student/s (aOR: 2.02; p = 0.002); (3) teacher himself is diabetic or have a near contact diabetic person (aOR: 2.35; p = 0.001); (4) family history of diabetes (aOR: 1.84; p = 0.015); and (5) teacher's capacity to inject insulin (aOR: 1; p = 0.003), were factors that predicted teacher's good knowledge.*

Conclusion. *Teachers in female elementary schools in our region need to improve their knowledge about diabetes in children, especially recognizing and management of diabetic emergencies. Training programs are crucially needed to empower teachers with knowledge and self-confidence in helping students with diabetes.*

Introduction

Type 1 diabetes mellitus (T1D), (previously known as insulin-dependent, juvenile or childhood-onset) is a chronic illness characterized by the body's inability to produce insulin due to the autoimmune destruction of the beta cells in the pancreas. Although onset frequently occurs in childhood, the disease can also develop in adults. Neither the cause of T1D nor the means to prevent it are known [1, 2].

The classic symptoms of T1D are, polyuria, polydipsia, polyphagia and unexplained weight loss. Other symptoms may include fatigue, nausea, and blurred vision. The onset of symptomatic disease may be sudden. It is not unusual for patients with type 1 diabetes to present with diabetic ketoacidosis [1].

T1D is quite prevalent in the world, with a proportion of 1 in every 300 persons and steadily rising frequency of incidence of about 3% every year. As per the Diabetes Atlas (8th edition), 35,000 children and adolescents in Saudi Arabia suffer from T1D, which makes Saudi Arabia rank the 8th in terms of numbers of TID patients and 4th country in the world in terms of the incidence rate (33.5 per 100,000 individuals) of TID [3].

Students with T1D spend most of the day in school, that make them at an increased risk of suffering from diabetic emergencies during the school time, so that it is essential that all aspects of T1D management can take place there, in which they needs the care of teachers and other school personnel [4-8]. Knowledgeable, trained school personnel are essential to the student's safety and physical well-being when dealing with immediate health risks of high or low blood-glucose level, however several studies worldwide demonstrated knowledge gab about T1D and inadequate specific training among teachers and other school staff [9-14].

Still there is limited data on knowledge and compatibility of teachers to support diabetic students in schools in northern Saudi Arabia, so that we aimed in this study to assess factual knowledge about type 1 diabetes among teachers and other school staff in public elementary female schools in Hail region, Saudi Arabia.

Methods

Study design and location

A cross-sectional study was carried out in public elementary (primary and intermediate) female schools

in Hail region, Saudi Arabia. The region is located at the north, in nine governorates with an area of 103,887 km^2 and an estimated population of 684,619 (2016) [15].

Being a conserving society, schools in the Saudi Arabian education system are unisex, with separate education male and female sector administration within Ministry of Education. Due to logistic limitation, having easy access and decrease administrative efforts, female schools were chosen to be the target setting of the study.

Participants

Classroom teachers and other school personnel in female elementary (primary and middle) schools, in Hail Governorate, were the target population of the study. Primary schools in Saudi Arabia enroll children at the age 6-11 years, while middle schools enroll age groups 12-14 years. All teachers and other school staff in direct contact with students at the time of the survey (n = 600) were approached.

Sampling

Among the nine governorates in Hail region, Saudi Arabia, Hail governorate was chosen to be the study setting, since it encompasses 60.7% of population [15]. To ensure representation, a list of all public female elementary schools in Hail gonernorate (n = 177), were obtained from the Education Authority in the region, and arranged according to school education level (primary-intermediate) and location (urban-rural). From the list 10% of schools (n = 18) were assigned systematically, taking in consideration the (urban-rural and primary-intermediate) school category weights [16].

Data collection tool

An anonymous, structured, pre-coded self-administered questionnaire was used to assess factual knowledge about type 1 diabetes needed for school staff to know. The content of the questionnaire was developed based on review of literature and related surveys [3, 7, 17]. Data collection tool included three sections. The first section involved eight items to characterize socio-demographic, professional and school aspects. The second section included twenty questions to assess teachers' knowledge about Type 1 diabetes, based on the tool "Test of Diabetes Knowledge for Teachers (TDKT)" [7] and other relevant sources [3, 7]. The last section, included six questions about personal experience, self-efficacy in dealing with a diabetic child, training received, and sources of information.

A pilot test for the data collection tool was carried out on 20 teachers, equally divided between primary and middle schools. Face and content validity of the data collection tool was established based on input of four experts in the field of pediatrics, endocrinology, public health and education with experience in students' school health. The data collection tool indicated high internal consistency (Cronbach's alpha = 0.797) for the subset of knowledge questions included the 20 point scale to ascertain teachers' knowledge about type 1 diabetes.

Questionnaire administration

The data collection took place during October 16, 2019 to January 23, 2020. After taking permission from the regional education authority in Hail region, our female researcher, contacted all schools involved in the study and met directors of the assigned schools, introduced to the aim of the study, presented the official letters of the regional education authority to facilitate the study conduction and the letter of ethical approval. All schools approached agreed to participate. An assigned coordinator in every school given full details about the study and asked to distribute the questionnaires to all teachers and other school staff in direct contact with students at the time of the survey, emphasizing voluntary participation. Participants were asked not to disclose their identity to assure them that this survey was only for academic purposes. Questionnaires were collected from each school after 2 days of distribution.

Statistical analysis

Data was analyzed using the Statistical Package for the Social Sciences (SPSS) software, version 23.0 (SPSS, Chicago, IL, USA). Frequencies and percentages, means, and standard deviations were used to summarize data. A scoring system was assigned to summarize participants' correct responses to the twenty questions exploring participants' knowledge about type 1 diabetes. Correct responses scored 1, while non-correct and don't know responses were scored 0, with maximum knowledge score of twenty points. Achieving 16 point (80%) or more was considered an indication of good knowledge of the participant compatible with being an effective support person for students with diabetes in school [9, 17].

Multivariate logistic regression analysis was carried out to predict factors associated with respondents ' good knowledge. Respondants attained good knowledge scores ($\geq$ 80% = 1; $<$ 80% = 0) were tested against independent variables assumed to have an influence on the participants' knowledge level and other possible confounders. Variables retained in the final model were determined using a stepwise backwards removal method, deleting variables with p-value above 0.25 in order to exclude the non-important variables from the model until the minimum adequate model was reached. Odds ratios (ORs) as well as their 95% confidence intervals (CIs) were calculated for the predictor variables in the analyses. All statistical tests were two-tailed and differences were considered to be statistically significant at a p-value $\leq$ 0.05.

Ethics

The study protocol was approved by the Bioethics Committee of the General Directorate of Health Affairs, Hail region, Saudi Arabia, with ethical

approval number: 2019-19. Agreed participants signed the study consent form.

Results

Out of 600 questionnaires distributed, 504 were returned completed from 18 public female elementary schools with a response rate 84.0%.

Table I describes the personal characteristics of the study population. Participants had 39.2 ± 6.81 mean age, and 13.7 ± 8.73 mean experience. Two hundred forty-six (48.8%) came from primary schools, while 258 (51.2%) came from intermediate schools. Among all, 423 (85.7%) were classroom teachers, Others (72; 14.3%), were school staff with direct contact with students (Counselors, Supervisors and Administrators).

Table II, describe diabetes related characteristics of the participants. Among all participants, 220 (43.7%) reported ever having a student/s with T1D in their classrooms, 313 (62.0%) were either diabetic themselves or have a near relation with somebody having diabetes and 299 (59.3%) had a family history of diabetes. Less than one third (32.5%) reported that their schools conducted training programs regard type 1 diabetes, while only 10.8% who reported they attended a training in this field. Participants' who acknowledged attending a training program about type 1 diabetes were 55.7% and almost all of them (95.6%) appreciate a presence of a school nurse. A low proportion (24.6%) of the participants reported self-efficacy in recognizing signals of hypoglycemia in the diabetic student and only 40.1% who reported they can inject insulin if needed to their diabetic student.

Table III, includes the factual knowledge questions, the proportion of teachers who gave correct answers and the total mean knowledge score. The survey respondents obtained a mean score of 13.2 ± 3.81 points on the diabetes knowledge scale (66.0% of the total score). Among all, 132 (25.9%) did not have enough knowledge (score of < 60%), 238 (46.8%) had basic knowledge (score of 60 - < 80%) and only 39 (27.3%)

Tab. I. Characteristics of teachers participating in the study and school setting (n = 504).

	N	%*
Age (years)		
< 30	47	9.3
30-39	197	39.1
≥ 40	260	51.6
Mean ± SD (range)	39.2 ± 6.81 (23-60)	
Work experience (years)		
< 5	101	20.0
5-9	75	14.9
10-19	183	36.3
≥ 20	145	28.8
Mean ± SD (range)	13.7 ± 8.73 (1-36)	
Education		
Diploma	82	16.3
Bachelor	408	81.1
Postgraduate higher education	13	2.6
Teacher role		
Classroom teacher	432	85.7
Others (counsellers, supervision and adminstration)	72	14.3
Teaching subject		
Science subjects	216	42.9
Other subjects (language, realign, social sience, etc.)	288	57.1
School level		
Primary	246	48.8
Middle	258	51.2
School setting		
Urban (hail city)	436	86.50%
Semiurban/rural (outside hail city)	68	13.50%

* The percentages were calculated excluding the missing values.

Tab. II. Diabetes related characteristics of the participants (n = 504).

Question	No	%*
Are you diabetic or somebody intimate to you have diabetes?		
Yes	312	62.0
No	191	38.0
Family History of diabetes		
Yes	299	59.3
No	205	40.7
Have you ever have a diabetic student in your classroom?		
Yes	220	43.7
No	284	56.3
Do your school has conducted training in dealing with students with type 1 diabetes?		
Yes	163	32.5
No	339	67.5
Do you attended any training about type 1 diabetes?		
Yes	54	10.8
No	448	89.2
Do you want to attended a training about type 1 diabetes?		
Yes	280	55.7
No	111	22.1
Not decided	112	22.3
Agree for presence of school nurse		
Agree	482	95.6
Uncertain	17	3.4
Disagree	5	1.0
Can you recognize signals of hypoglycemia in your diabetic student?		
Yes	125	24.6
No	379	75.4
Can you inject insulin, if needed to your diabetic student?		
Can	202	40.1
Can't	302	59.9

* The percentages were calculated excluding the missing values.

Tab. III. Factual knowledge questions and proportion of teachers giving correct* answers (n = 504).

Question	Correct n (%)	Incorrect n (%)	Don't know n (%)
1. If not controlled, diabetes leads to frequent urination? (yes)	471 (93.5%)	4 (0.8%)	29 (5.8%)
2. If not controlled, diabetes leads to increased thirst? (yes)	461 (91.5%)	8 (1.6%)	35 (6.9%)
3. Diabetes leads to fatigue and lack of focus for the student. (yes)	430 (85.3%)	15 (3.0%)	59 (11.7%)
4. Diabetes leads to weight loss for the student? (yes)	357 (70.8%)	45 (8.9%)	102 (20.2%)
5. Paleness, shakiness, sweating, difficulty concentrating, confusion, weakness or fainting mean low blood sugar? (yes)	379 (75.3%)	5 (1.0%)	119 (23.7%)
6. Type 1 diabetes is usually diagnosed in children, teens, and young adults? (yes)	204 (40.6%)	26 (5.2%)	273 (54.3%)
7. The child develops type 1 diabetes as a result of excessive sugar intake and lack of physical activity? (no)	49 (9.7%)	316 (62.7%)	139 (27.6%)
8. Type 1 diabetes can be contagious? (no)	404 (80.2%)	23 (4.6%)	77 (15.3%)
9. Type 1 diabetes is treated with insulin? (yes)	290 (57.8%)	50 (10.0%)	162 (32.3%)
10. There is no cure for type 1 diabetes, but it can only be controlled? (yes)	233 (46.2%)	61 (12.1%)	210 (41.7%)
11. A low sugar coma is more dangerous than a high sugar coma? (yes)	361 (72.1%)	17 (3.4%)	123 (24.6%)
12. The diabetic student must eat her meals or snacks at the required times regularly and take her time until it ends? (yes)	437 (87.2%)	10 (2.0%)	54 (10.8%)
13. A student with diabetes may need to eat some snacks outside break? (yes)	408 (81.1%)	16 (3.2%)	79 (15.7%)
14. A diabetic student can fully participate in sport activities like all of her classmates? (yes)	372 (74.0%)	43 (8.5%)	88 (17.5%)
15. The diabetic student must eat sweets or juices before the physical activity class? (yes)	232 (46.0%)	71 (14.1%)	201 (39.9%)
16. In the event of low blood sugar, the diabetic student should take the sweetened juice? (yes)	414 (82.1%)	18 (3.6%)	72 (14.3%)
17. When symptoms of low blood sugar are noticed, the child needs to quickly and properly intervene? (yes)	453 (89.9%)	6 (1.2%)	45 (8.9%)
18. In a coma, a small amount of jam or honey can be placed in the mouth of the diabetic student? (yes)	288 (57.1%)	34 (6.7%)	182 (36.1%)
19. A diabetic student may need to take an insulin dose during the school day? (yes)	329 (65.3%)	17 (3.4%)	158 (31.3%)
20. Do you know the difference between type 1 and type 2 diabetes? (participants' who respond yes, considered right answer)	140 (27.8%)	254 (50.4%)	110 (21.8%)
Total knowledge score (**maximum score 20 points) • Mean (SD) • Attained score/full score (%)	 13.2 (3.81) 66.0%		
Knowledge level: n (%) • < 60% knowledge score • 60 - < 80% knowledge score • ≥ 80% knowledge score	 132 (25.9) 238 (46.8) 139 (27.3)		

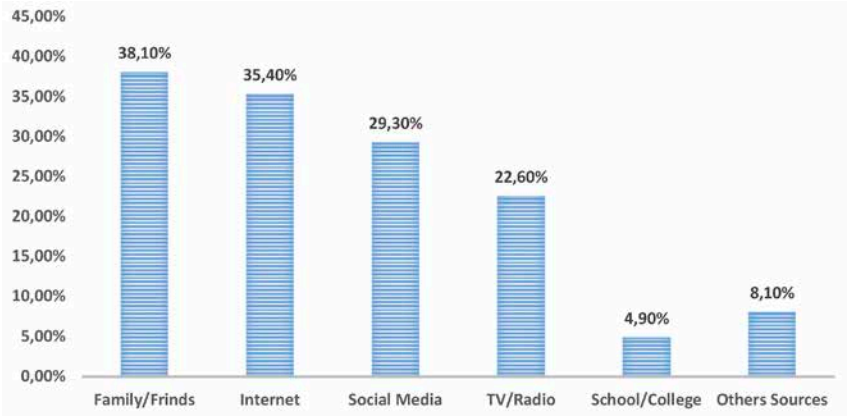
* Correct answer in parenthesis. Percentage were calculated excluding missing values.

who obtained good score (≥ 80%) compatible with being an effective support person for students with diabetes in school [9, 17].

Respondent answers revealed knowledge gap in some important aspects of TID; a small percentage (27.8%) who can differentiate between type 1 and type 2 diabetes, 40.6% who recognized that type 1 diabetes is usually diagnosed in children, teens and young adults, 90.3% incorrectly thought that type 1 diabetes develops as a result of excessive sugar intake and lack of physical activity and 19.8% beliefs that the disease is contagious. Furthermore, only 46.2% who correctly thought that there is no cure for type 1 diabetes, but can only be controlled, and just 57.8% who recognized that type 1 diabetes is treated with insulin, 65.3% recognized that the diabetic student may need to take an insulin dose during the school day and only 46.0% who acknowledged that a diabetic student must eat sweets or juices before the physical activity class.

However, the participants answers indicated adequate T1D knowledge in other areas. Majority of the participants, were aware about the classic symptoms of uncontrolled T1D as: frequent urination (93.5%), increased thirst (91.5%), fatigue and lack of focus (85.3%) and weight loss (70.8%). With regard knowledge about the disease control, 87.2% of the participants recognized that diabetic student must eat her meals or snacks at the required times regularly and take her time until it ends and 81.1% recognized that she need to eat some snacks outside break. Likewise, participants' expressed good knowledge about acute complication of type 1 diabetes; 75.3% correctly recognized common symptoms of hypoglycaemia such as paleness, shakiness, sweating, difficulty concentrating, confusion, weakness or fainting, and 89.9% correctly thought that in event of low blood sugar the child needs to quickly and properly intervene and 82.1% of them recognized that diabetic student should take the sweetened juice and 89.9% in this

Fig. 1. Participants' main sources of information about type 1 diabetes.



Tab. IV. Multivariate Logistic regression model* capturing independent predictors of good knowledge about type 1 diabetes among teachers.

Variables	aOR	95% CI	P-value
The teacher Can recognize hypoglycemia (Yes/no)	1.45	0.89-2.36	0.135
The teacher can inject insulin (Can/Cannot)	1.98	1.27-3.10	0.003
Teacher's family history of diabetes mellitus (Yes/no)	1.84	1.12-3.01	0.015
The teacher himself is diabetic (Yes/No)	2.35	1.40-3.92	0.001
The teacher has/had a diabetic student/s in her class (Yes/no)	2.02	1.31-3.13	0.002
The teacher has received training in caring diabetic students in schools (Yes/no)	3.38	1.78-6.49	< 0.001

aOR: adjusted Odds Ratio; CI: Confidence interval. Variables initially included in the anaylysis were: all demographic characteristics of teachers and school setting (variables in Table I) and diabetes related characteristics of the participants (variables in Table II); * Final -2*Log-Likelihood of the model: 503.18; Cases included: 502; Likelihood Ratio: 89.178; P-value = < 0.001.

case and 72.1% correctly recognized that hypoglycemic coma is more dangerous than hyperglycemic coma and 74.0% of the participants were aware that diabetic student can fully participate in sport activities like all of her classmates.

Figure 1, depicts the main sources of the participants' information about type 1 diabetes. family/friends (38.1%), common internet sites (35.4%), social media (29.3%), TV/radio (22.6%) and educational institutions (4.9%) were the main sources.

In the multivariate logistic regression analysis (Tab. IV), the following factors were found have an independent positive association with teacher's good knowledge: (1) received training in caring diabetic students (adjusted Odds Ratio (aOR): 3.38, 95% CI: 1.78-6.49, $p < 0.001$); (2) have/ever had diabetic student/s in her class (aOR: 2.02, 95% CI: 1.31-3.11, $p = 0.002$); (3) the teacher himself is diabetic or have a near contact with diabetic patient (aOR: 2.35, 95% CI: 1.40-3.92, $p = 0.001$); (4) family history of diabetes (aOR: 1.84, 95% CI: 1.12-3.01, $p = 0.015$); and teacher capacity to inject insulin (aOR: 1.98, 95% CI: 1.27-3.10, $p = 0.003$).

Discussion

Schools have an important role to play in ensuring that students with diabetes have the support they need to stay healthy, enjoy the same opportunities for learning and having fun as their peers, and are prepared to do their best in school [8]. For effective diabetes management in school, teachers and other school staff should be well-prepared and equipped to play their role. Knowledge is a prerequisite for establishing prevention beliefs, forming positive attitudes, and promoting positive behaviors [18]. We aimed in this study to assess factual knowledge about type I diabetes among teachers in public female elementary schools in Hail region, northern Saudi Arabia.

In our study, a high percentage (43.7%) of teachers were having had or currently having students with T1D in their classrooms, which is similar to findings of other studies [9]. This high frequency implies that teachers should be well-prepared to deal with this sensitive health problem among students. Findings of our study revealed that, only one in four who achieved good knowledge score compatible with being an effective support person for diabetic students in school based on criteria used in similar tool kits evaluating teachers' knowledge of diabetes [9, 17], and indicate that teachers in our schools have insufficient knowledge level needed to care students with T1D. This result is consistent with findings of other studies elsewhere [9-11, 19, 20].

Our study uncovered significant teachers' misconceptions about the nature and management of T1D. The vast majority incorrectly thought that type 1 diabetes

develops as a result of excessive sugar intake and lack of physical activity, some of them believed that the disease is contagious and just one in four who can differentiate between type 1 and type 2 diabetes. Furthermore, less than half of the participants who recognized that there is no cure for type 1 diabetes and can only be controlled and just 57.8% who recognized that type 1 diabetes is primarily treated with insulin. Our study population is not an exception of such misconceptions, as being also reported by other research [9-11, 20].

In our work, two key themes were identified independently explained teachers' good knowledge; namely received training in T1D and exposure to direct experience with diabetes. Specifically, teachers in our study who received training in caring for diabetic students, were three and half times more likely to have a good level of knowledge about the disease, compared to those who did not receive such training. Inappropriately, less than one-third of our schools which carried out specific training programs for T1D for teachers and disappointingly, just one in ten (10.8%%) who attended such programs. The inadequacy specific training among teachers and other school staff was also observed in other studies worldwide [9-14, 21]. Evidence from previous research established that teachers who received training, not only acquired factual knowledge, but also felt more confident when helping students with diabetes and promoted positive impact on teacher-student relationship [22-26].

We can describe the knowledge of our study group as working knowledge, gained from experience. Five out of the six independent predictors for good teachers' knowledge about Type 1 Diabetes in our study were related to the practical experience gained from intimate contact with diabetic patients or being themselves having diabetes. Teachers who had previous experiences with children with diabetes showed in other research a much higher level of knowledge than those who did not [11, 24]. Proper dealing with diabetic emergencies in schools is an important task for students' safety and well-being. Younger children may not be adept at dealing with problems such as hypoglycaemia and will be dependent upon the adult caring for them at the time; which in school time is the teacher. The ability to deal with this sort of problem is important not only to the diabetic child, but to the rest of the class since a poorly managed episode might be generally disturbing [27]. When we see that only one in four (24.6%) of the teachers in our study who reported a self-efficacy in recognizing signals of hypoglycemia in his diabetic student, it will be very disappointing and show how much we are in need to train and raise the capacity of our teachers to recognize and deal with such jeopardizing emergencies. Another important point in teachers role in caring students with T1D is awareness about the dietary requirements and of the need to take extra carbohydrate before exercise as an is important necessity for the diabetic student safety. Despite that 74.0% of teachers in our study group agreed that the diabetic student can fully take part in sport activities like all of her classmates, yet, only 46.0% of them who recognized that the diabetic student must eat sweets or juices before the physical activity class.

A discouraging note about our study participants is that only about half (55.7%) of teachers who appreciated attending training programs about type 1 diabetes. This denotes that a considerable number of teachers were either unaware about their responsibilities or unwilling to take the responsibility of caring for their diabetic students. This finding confirms a result of a recent report carried out in 2019, among parents or legal guardian of diabetic children to examine the safety of schools and availability of trained staff who may aid in the management of children with type 1 diabetes, parents found to have poor perceptions about diabetes care at school. They reported that children are mostly responsible for their own diabetes care, glucose checking, and insulin administration [28]. These findings indicates the need to discuss and clarify the roles and responsibilities of teachers in caring diabetic students and to create favorable attitude towards students' safety and well-being. The role of teachers should not be restricted to effectively dealing with the diabetic students, but also should be extended to support their mental health and effectively dealing with psychological issues that might occur. Recent studies carried out among teachers in the same setting reported low self-efficacy and capacity to play this role [29].

Study limitation

Our study is not exempt from limitations. First, we approached public female school sector to carry out the study to decrease administrative efforts and facilitate study conduction, so that our results might not reflect the situation in male schools and private sector. Second, the majority of schools were located in urban community in Hail city, where more than two-thirds of the population of the region lives in the city and the Hail Governorate, so that the study results cannot be completely apply to rural community schools in other goneronrates. However, a strength of our study is that the data collection tool used to evaluate diabetes knowledge was based on a reliable set of questions used in earlier studies and revealed high internal consistency in our study.

Conclusion

In conclusion, teachers in female elementary schools in our region need to improve their knowledge about diabetes in children, especially recognizing and management of diabetic emergencies. Pre-service and ongoing professional learning for teachers is crucially needed for acquiring factual knowledge and self-confidence in helping students with diabetes and to promote positive impact on teacher-student relationship.

Ethics approval and consent to participate

The protocol of the study was reviewed and approved by the Regional Bioethics Committee of the General

Directorate of Health Affairs, Hail region, with the approval number 2019/19 dated October 6, 2019. Agreed participants signed the study consent form. Participants were guaranteed anonymity confidentiality of the responses and voluntary participation and they can withdraw for any reason and any time, without any implications.

Acknowledgements

Funding sources: this research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.
We thank participant school directors who facilitated our study conduction. We also thank teachers and other school staff who devoted the time to participate in the study and completing the study questionnaire.

Conflict of interest statement

The authors declare no conflict of interest.

Authors' contributions

Both authors conceived the study idea, participated in development of the data collection tool and interpretation of results. FA, coordinated questionnaire distribution, collection, carried out data entry and participated in interpretation of the study results. HH, designed the study, carried out data analysis and drafted the manuscript.

References

[1] Aathira R, Jain V. Advances in management of type 1 diabetes mellitus. World J Diabetes 2014;5:689-96. https://doi.org/10.4239/wjd.v5.i5.689

[2] World Health Organization. Diabetes Fact sheet. Available at: https://www.who.int/news-room/fact-sheets/detail/diabetes. (accessed 29 August 2020).

[3] International Diabetes Federation Atlas. 8th edition. Brussels, Belgium: 2017. http://www.diabetesatlas.org

[4] Juvenile Diabetes Research Foundation. School advisory toolkit for families. https://www.jdrf.org/wp-content/docs/JDRF_School_Advisory_Toolkit.pdf

[5] Klingensmith G, Kaufman F, Schatz D, Clarke W; American Diabetes Association. Care of children with diabetes in the school and day care setting. Diabetes Care 2003;26(Suppl 1):S131-5. https://doi.org/10.2337/diacare.26.2007.s131

[6] Lawrence SE, Cummings EA, Pacaud D, Lynk A, Metzger DL. Managing type 1 diabetes in school: Recommendations for policy and practice. Paediatr Child Health 2015;20:35-44. https://doi.org/10.1093/pch/20.1.35

[7] Canadian Paediatric Society. Diabetes at school. Type 1 diabetes: an overview. https://www.diabetesatschool.ca/Type1diabetes (accesses 14/5/2019).

[8] National Institute of Diabetes and Digestive and Kidney Diseases. Helping the student with diabetes succeed. https://www.niddk.nih.gov/health-information/professionals/clinical-tools-patient-management/diabetes/helping-student-diabetes-succeed-guide-school-personnel (accessed September 6, 2020).

[9] Gutiérrez-Manzanedo JV, Carral-San Laureano F, Moreno-Vides P, de Castro-Maqueda G, Fernández-Santos JR, Ponce-González JG. Teachers' knowledge about type 1 diabetes in south of Spain public schools. Diabetes Res Clin Pract 2018;143:140-5. https://doi.org/10.1016/j.diabres.2018.07.013

[10] Chatzistougianni P, Tsotridou E, Dimitriadou M, Christoforidis A. Level of knowledge and evaluation of perceptions regarding pediatric diabetes among Greek teachers. Diabetes Res Clin Pract 2020;159:107952. https://doi.org/10.1016/j.diabres.2019.107952

[11] Greco D. Una valutazione delle conoscenze degli insegnanti della scuola sul diabete mellito tipo 1 [An assessment of the knowledge of school teachers on type 1 diabetes mellitus]. Recenti Prog Med 2018;109:509-12. https://doi.org/10.1701/3010.30088

[12] Aycan Z, Önder A, Çetinkaya S, Bilgili H, Yıldırım N, Baş VN, Peltek Kendirci HN, Ağladıoğlu SY. Assessment of the knowledge of diabetes mellitus among school teachers within the scope of the managing diabetes at school program. J Clin Res Pediatr Endocrinol 2012;4:199-203. https://doi.org/10.4274/jcrpe.756

[13] Carral San Laureano F, Gutiérrez Manzanedo JV, Moreno Vides P, de Castro Maqueda G, Fernández Santos JR, Ponce González JG, Ayala Ortega MDC. Teachers' attitudes and perceptions about preparation of public schools to assist students with type 1 diabetes. Endocrinol Diabetes Nutr (Engl Ed) 2018;65:213-219. https://doi.org/10.1016/j.endinu.2017.11.007

[14] Gutzweiler RF, Neese M, In-Albon T. Teachers' Perspectives on Children With Type 1 Diabetes in German Kindergartens and Schools. Diabetes Spectr 2020;33:201-9. https://doi.org/10.2337/ds19-0054

[15] General Authority for Statistics (GAStat), KSA. Demographic survey 2016. https://www.stats.gov.sa/sites/default/files/en-demographic-research-2016_2.pdf (accessed 2 Sept 2018).

[16] General Authority for Statistics (GAStat), KSA. The sixteenth services guide 2017, Hail Region. https://www.stats.gov.sa/sites/default/files/hail_region_en.pdf (accessed 2 Sept 2018).

[17] Husband A, Grebenc K, Mckeil E, Pacaud D. Canadian Diabetes Association. Test your diabetes knowledge. 2001. http://www.diabetes.ca/Filkes/kwd_quiz.pdf (accessed 14 June 2019).

[18] McEachan R, Taylor N, Harrison R, Lawton R, Gardner P, Conner M. Meta-analysis of the reasoned action approach (RAA) to understanding health behaviors. Ann Behav Med 2016;50:592-612. https://doi.org/10.1007/s12160-016-9798-4.

[19] Kise SS, Hopkins A, Burke S. Improving school experiences for adolecents with type 1 diabetes. J Sch Health 2017;87:363-75. https://doi.org/10.1111/josh.12507

[20] Abdel Gawwad ES. Teacher's Knowledge, Attitudes and management practices about diabetes care in Riyadh's schools. J Egypt Public Health Assoc 2008;83:205-22.

[21] Pinelli L, Zaffani S, Cappa M, Carboniero V, Cerutti F, Cherubini V, Chiarelli F, Colombini MI, La Loggia A, Pisanti P, Vanelli M, Lorini R. The ALBA project: an evaluation of needs, management, fears of Italian young patients with type 1 diabetes in a school setting and an evaluation of parents' and teachers' perceptions. Pediatr Diabetes 2011;12:485-93. https://doi.org/10.1111/j.1399-5448.2010.00722.x

[22] Bechara GM, Castelo Branco F, Rodrigues AL, Chinnici D, Chaney D, Calliari LEP, Franco DR. "KiDS and Diabetes in Schools" project: Experience with an international educational intervention among parents and school professionals. Pediatr Diabetes 2018;19:756-60. https://doi.org/10.1111/pedi.12647

[23] Pansier B, Schulz PJ. School-based diabetes interventions and their outcomes: a systematic literature review. J Public Health Res 2015;4:467. https://doi.org/10.4081/jphr.2015.467

[24] Gökçe T, Sakarya S, Muradoğlu S, Mutlu GY, Can E, Cemhan K, Kurtulmuş MF, Gülşen M, Aycan Z, Darendeliler F, Ülger Ö,

Bulanık M, Yardım N, Hatun Ş. An evaluation of the knowledge and attitudes of school staff related to diabetes care at school: The 10th year of the "diabetes program at school" in Turkey. Pediatr Diabetes 2021;22:233-240. https://doi.org/10.1111/pedi.13157

[25] Gutierrez C. Improving the care of students with diabetes in rural schools utilizing an online diabetes education program for school personnel. Rural Remote Health 2020;20:5596. https://doi.org/10.22605/RRH5596

[26] Dixe MDACR, Gordo CMGO, Catarino HBP, Kraus T, Menino EPDSG. Effects of an education program on knowledge and self-perception of school personnel in preparing to care for type 1 diabetes students. Einstein (Sao Paulo) 2020;18:eAO5101. https://doi.org/10.31744/einstein_journal/2020AO5101

[27] Bradbury AJ, Smith CS. An assessment of the diabetic knowledge of school teachers. Arch Dis Child 1983;58:692-6. https://doi.org/10.1136/adc.58.9.692

[28] Alaqeel AA. Are children and adolescents with type 1 diabetes in Saudi Arabia safe at school? Saudi Med J 2019;40:1019-26. https://doi.org/10.15537/smj.2019.10.24582

[29] Ahmed Kamel, Hassan Kasim Haridi, Thikra Mohammed Alblowi, Asmaa Saleh Albasher, Nwayer Abdulaziz Alnazhah. Beliefs about students' mental health issues among teachers at elementary and high schools, Hail Governorate, Saudi Arabia. Middle East Curr Psychiatry 2020;27(30). https://doi.org/10.1186/s43045-020-00039-8

Received on April 29, 2021. Accepted on March 11, 2021.

Correspondence: Hassan Kasim Haridi, Academic Affairs & Postgraduate Studies, General Directorate of Health Affairs, Najran region King Saud Bin Abdel Aziz Road, Najran City, Saudi Arabia - Tel.: +966507114741- E-mail: hassankasim@hotmail.com

How to cite this article: Alshammari FM, Haridi HK. Teachers' knowledge about type 1 diabetes in public female elementary schools in Northern Saudi Arabia. J Prev Med Hyg 2021;62:E673-E680. https://doi.org/10.15167/2421-4248/jpmh2021.62.3.2064

Research article

Association between dairy product intake and high blood pressure in Chilean adults

YADIRA MOREJÓN-TERÁN[1,2], RAFAEL PIZARRO[3], LACEY MAURITZ[4], DOMINIQUE DÍAZ[4], SAMUEL DURÁN AGÜERO[4]
[1] Programa de Pesquisa *Social Change, Asthma and Allergy in Latin America* - SCAALA, Universidade Federal de Bahia, Salvador, Brazil; [2] Grupo de Prevención de la violencia de género (E-previo), Facultad de Enfermería. Pontificia Universidad Católica del Ecuador, Quito, Pichincha, Ecuador; [3] Facultad de Ciencias de la Salud, Universidad San Sebastián. Providencia, Chile; [4] Facultad de Ciencias para el Cuidado de la Salud, Universidad San Sebastián, Providencia, Chile

Keywords

Dairy • Low fat dairy • High blood pressure • Lifestyles • Food frequency

Summary

Background. *Hypertension is a major risk for cardiovascular disease. Several studies have connected dairy consumption with lower blood pressure (BP). However, these have not considered the Latin American population. The aim of this study was to examine the relationship between consumption of full-fat or low fat/fat free dairy products and high blood pressure in Chilean adults.*
Methods. *Cross-sectional study containing data from 3,807 adults between 20 and 98 years old from the National Health Survey (NHS) of Chile 2016-2017. Information on lifestyle, food frequency, and socio-demographics was collected using standardized questionnaires. Trained fieldworkers took anthropometric and blood pressure measurements. The frequency of consumption data included seven ad-hoc questions on habitual eating and frequency options, based on the Mediterranean diet (fish products, fruit and vegetable, and dairy products) and its protective effect on cardiovascular diseases. The selection of foods was supported by expert opinion.*
Results. *Of the 3,807 adults, 37% were male and 63% were female. Sex, education level, frequency of dairy products and fish, smoking, and sport or physical activity had a direct relationship with consumption of dairy products ($P < 0.05$). Consumption of low fat/fat free dairy products was protectively associated with high blood pressure in the unadjusted model (OR: 0.76, CI 95% 0.64-0.91). However, after adjustment for confounding variables (education level modifies the effect 10.2%), this association was attenuated (OR: 0.88; CI 95% 0.71-1.08).*
Conclusion. *We found limited evidence that the type of dairy products consumed is associated with high blood pressure in the Chilean population.*

Introduction

One of the risk factors for the development of cardiovascular disease and stroke is high blood pressure. It is expected that 29% of the adult population in the world will develop hypertension by 2025 and prevention and management are a public health priority[1]. Hypertension is defined as a blood pressure (BP) greater than 140 mmHg/90 mmHg in the United States and in Europe as 130 mmHg/80 mmHg [2, 3]. The World Health Organization (WHO) has classified hypertension as the leading cause of preventable death [4], mainly due to environmental factors, including diet and other lifestyle aspects including overweight and/or obesity, excessive drinking, smoking, poor eating habits, and reduced physical activity [5, 6]. The prevalence of high blood pressure is worrying because of its direct, independent relationship with chronic disease risk[7]. Cardiovascular disease, strokes, and high blood pressure were listed as the leading causes of death for over 17,759 Chileans and they are responsible for more than 7 million deaths worldwide each year [7, 8].
Diet is an important determinant of blood pressure. Scientific evidence has emerged supporting a beneficial relationship between the consumption of dairy products and the control of blood pressure in adults, for example Dietary Approaches to Stop Hypertension (DASH) notes the effects of dietary patterns on blood pressure [9]. In this trial, adults diagnosed with hypertension consumed a controlled diet for 8 weeks and demonstrated that the consumption of fruit, vegetables and low-fat dairy products led to an additional reduction in both systolic blood pressure (SBP) and diastolic blood pressure (DBP) of 2.7 mmHg and 1.9 mmHg respectively [9].
Furthermore, meta-analyses of subsequent studies [10, 11] showed a lower risk (16%) of elevated blood pressure and hypertension (HTN) (3%) in adults for every 200 grams/day of total dairy intake: 0.97 (95% CI, 0.95-0.99) for total dairy, 0.96 (95% CI, 0.93-0.99) for low-fat dairy and 0.96 (95% CI, 0.94-0.98) for milk. However, subsequent randomized controlled intervention studies have shown inconsistent results on the BP lowering effects of dairy products. This may be related to the consumption of milk products with varying fat compositions and differences in study design (e.g. short trial duration and low statistical power) [12–16].
The relationship between the fat content of dairy products consumed and hypertension has been investigated previously in European or North American populations showing an inverse association [17, 18]. At

present, it is not known if this association between high blood pressure and types of dairy product consumption is found in other locations. For example, there is a lack of evidence on this association from Latin America and in particular Chile. The purpose of this study was to investigate the association between the consumption of dairy products with different fat contents and high blood pressure in a representative sample of adults in Chile. We hypothesized that the consumption of dairy products with a low-fat content is a protective factor for hypertension in this population.

Methods

Study design

Data for this study came from the National Health Survey (NHS) 2016-2017. A multistage stratified cluster sampling design was used. The survey is representative of the 15 regions, rural and urban strata. The sample was calculated using an absolute sampling error of 2.6% at the national level, the root of the design effect of 1.797, estimated with 95% confidence and relative error less than 30%, resulting in a final sample of 6,233 individuals ≥ 15 years old. The data was collected between August 2016 and March 2017. The methodology of the NHS has been described in detail in the report of the Chilean Ministry of Health [19]. For this study, 3,807 Chileans were selected (Fig. 1).

Chile is a country in western South America with an estimated total population of 17.5 million as of 2017 and the territory is divided into fifteen regions. The country has an ethnically mixed population of white, mestizos, indigenous Amerindians or Native people. The GINI is 44.4 and the Human Development Index (HDI) is 0.847 [20].

Inclusion and exclusion criteria

For this analysis, we excluded participants < 20 years old (n = 399) and those undergoing pharmacological treatment for diagnosed hypertension (n = 1427). All participants signed an informed consent form [19].

Measurements

Anthropometric and metabolic measurements

The anthropometric measurements were performed by trained personnel and under protocols described in detail in the NHS [19]. Nutritional status was classified according to BMI based on the recommendations of WHO [21]. BP was measured using standardized methods previously described in the NHS along with their respective cut-off points (SBP ≥ 140 or DBP ≥ 90 mmHg). Three blood pressure measurements were taken prior to reading the person rested five-minute exactly by a clock, and each measurement had an interval of exactly two minutes. An automatic pressure device (Omron HEM 742®) was used. The third blood pressure measurement was taken to evaluate individual variability [19].

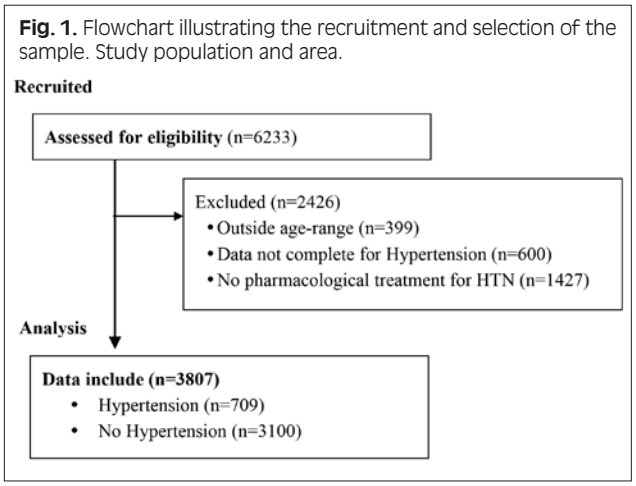


Fig. 1. Flowchart illustrating the recruitment and selection of the sample. Study population and area.

Food Frequency

Seven *ad-hoc* questions about habitual diet were included. The questions were based on the Mediterranean diet (omega fatty acids, dietary fiber, and phytonutrients) as a way to establish basic epidemiological surveillance considering its protective effect on cardiovascular risk. The selection of the foods was supported by expert opinion. Three food groups were considered [19]:

- *Dairy products*

To determine the consumption of the different types of dairy products, we used multiple-choice survey questions: How often do you consume milk, cheese, fresh cheese or yogurt? The answer choice options were: 2 or more times a day, less than 3 times a day, once a day, every other day, at least once a week, between one and three times a month, and less than once a month or never. What type of dairy such as milk, fresh cheese or yogurt do you prefer? The answer choice options were: *semi-fat, fat-free or low-fat* and *whole or full fat* [19].

- *Fish or Shellfish*

How often do you eat fish or shellfish (any type of preparation or presentation)? The answer choice options were: More than 1 time per week or once a week, less than 3 times a month, and less than once a month or never.

- *Fruits and vegetables*

The consumption of fruits and vegetables was included according to the WHO strategy "5 a day". For this pictures were used with examples of servings of typical Chilean fruits and vegetables (1 serving = 80 g). We used questions to determine the consumption: How many servings of fruit do you eat on one of those days? How many servings of vegetables do you eat on one of those days?

Lifestyles and other variables

To determine smoking habits, a known lifestyle associated with hypertension, questions based on the Pan American Health Organization were selected [22]. Demographic variables such as age, sex, and education level were collected using questionnaires validated in the national population [19]. The levels of physical activity (PA) in the population include activities of daily living (like commuting) and activities of moderate or vigorous intensity. These activities were assessed by the "Global Physical Activity Questionnaire" [19].

Statistical analysis

Descriptive statistics were used to characterize the categorical variables as frequencies and percentages (%), χ^2 test analysis for categorical variables were used with dairy products. Bivariate analyses were conducted to examine the association between the hypertension and other variables. The association between the type of dairy consumed and hypertension was examined using a Logistic Regression model. Results were presented as Odds Ratio (OR) and their respective 95% confidence intervals (95% CI). Sex, age, education, frequency of fish consumption, physical activity level, smoking and body mass index (BMI) were considered a *priori* confounders since these factors are associated with both the dependent variable (blood pressure) and the independent variables (dairy intake). Confounding was investigated using a *forward stepwise analysis* and variables were considered as confounders if the difference between the two measures of association was 10% or more. A likelihood ratio test was performed to check for interaction between dairy intake and the potential confounders. For all analyses, the complex sample analysis module of the STATA SE v15 program was used and all results were estimated using expanded samples according to the NHS 2016-2017 [19]. The significance level was defined as $p < 0.05$.

Ethical considerations

This survey received ethics approval for the protocol that was granted by the Ethics Committee of the School of Medicine of the Pontifical Catholic University of Chile. The adults received both written and verbal information in Spanish about the survey and provided written informed consent.

Results

Table I provides a description of the population per type of dairy products consumed. It was observed that 37.2% of individuals who consume low fat / fat-free dairy were hypertensive. Sixty-five percent of men consume mostly whole dairy products, as did almost eighty percent of people with more than 8 years of education. Frequency of dairy consumption, frequency of consumption of fish, smoking, and sport or physical activity presented statistically significant differences concerning the type of dairy products consumed.

Hypertension was lower among women compared with men (15.2 vs 24.4; OR = 0.55; 95% CI 0.46-0.65), those aged 20-44 years (5.9%), and was higher among those with < 8 years of education (7.6 vs 39.9; OR = 8.07; 95% CI 6.12-10.65), morbidly obese (14.4 vs 24.6; OR = 1.93; 95% CI 1.23-3.01), and those whose consumption of fish was "*less than once a month or never*" (16.4 vs 19.9; OR = 1.27; 95% CI 1.05-1.54). Regarding lifestyles, hypertension was higher among former smokers (19.6 vs 21.4; OR = 1.11; 95% CI 0.91-1.36) and those who did not engage in sports or physical activity in the last month (9.9 vs 21.1; OR = 2.42; 95% CI 1.75-3.34) (Tab. II).

Overall, the chances of hypertension were lower among adults who consume low fat/fat free dairy products (OR = 0.76, 95% CI 0.64-0.91). After adjustment for sex, age, education level, frequency of fish consumption, physical activity, BMI and smoking history, the association became insignificant (OR = 0.88; 95%CI 0.71-1.08) (Tab. III).

The level of education of the individual was found to be a potential confounder since it modifies 10.2% the effect. Regarding the interaction analysis, no statistical significance was observed in the variables included in the model. Forty-three percent of individuals with hypertension who consume whole/full fat dairy products have a low education level (< 8 years), while 38.8% of individuals without hypertension and who consumed low-fat/fat-free dairy products had a high educational level (> 12 years) (Fig. 2).

Discussion

Our findings contribute to the literature: First, to our knowledge, this is the first nationally representative study to examine the association between hypertension and consumption of dairy products in Chilean adults. Second, educational level was shown to be a confounding variable, this being an important finding, which leads us to think of hypertension as a social problem, in which educational level plays an important role. Third, this study showed an inverse relationship between dairy consumption and hypertension.

An inverse association between dairy consumption and hypertension may be attributed to the many beneficial components of low-fat dairy foods. These may contribute to their protective effects, such as calcium [23] and peptides derived from casein [24]. In general, studies have shown a beneficial effect of low fat dairy on BP [25, 26], but when consumption is predominantly high fat dairy, the research suggests that the amount of fat consumed may negatively influence BP levels [27, 28]. Follow-up studies identified that the association between BP and dairy foods is much stronger than the association of BP with calcium intake alone. It has therefore been suggested that the components of dairy foods may play an important role. There are also studies that show a modified, high fat, DASH diet (which includes high fat dairy) that is low in carbohydrates was not associated with increased BP [29].

Tab. I. Characteristics of participants according to dairy products in Chilean adults (n=3809).

Variables	Dairy Products		p-value
	Whole of Full-Fat n (%)	Low-fat/Fat-free n (%)	
Sex			
Male	854(65.1)	454(34.9)	< 0.001
Female	1153(53.1)	1017(46.87)	
Age			
20-44 years	999(58.2)	718(41.8)	0.530
45-64 years	669(57.8)	489(42.23)	
≥ 65 years	330(55.6)	264(44.4)	
Education Level			
≥ 12 years	414(44.6)	515(55.4)	< 0.001
8-12 years	1131(60.7)	732(39.3)	
< 8 years	433(67.7)	211(32.8)	
Body Mass Index BMI			
Normal/Thin	495(58.9)	345(41.1)	0.596
Overweight	782(56.4)	605(43.62)	
Obese	643(58.0)	465(41.9)	
Morbidly Obese	70(60.34)	46(39.66)	
Frequency of dairy consumption (milk, cheese, fresh cheese or yogurt)			
More than 3 times per day	102(45.9)	120(54.1)	< 0.001
Less than 3 times per day	792(49.8)	798(50.2)	
Every other day	442(63.5)	254(36.5)	
1 time per month or never	662(68.9)	299(31.1)	
Consumption of fruits or vegetables per day			
≥ 5 servings per day	145(57.8)	106(42.2)	0.439
< 5 servings per day	1835(57.7)	1345(42.3)	
0 servings per day	18(47.4)	20(52.6)	
Frequency of consumption of fish			
More than 1 time per week or once a week	765(51.1)	731(48.9)	< 0.001
Less than 3 times a month	494(61.1)	314(38.9)	
Less than once a month or never	739(63.4)	426(36.6)	
Smoking			
No, I have never smoked	893(57.9)	648(42.1)	0.007
Yes, one or more cigarettes	532(61.4)	334(38.6)	
Yes. Less than one cigarette a day	156(56.5)	120(43.48)	
Ex-smoker	417(53.1)	369(46.9)	
Sport or Physical activity in the last month 30 minutes or more			
Yes, 3 or more times a week	194(48.1)	209(51.9)	< 0.001
Less than 3 times a week	246(56.6)	189(43.45)	
No, I did not engage in sports or physical activity in the last month	1558(59.2)	1073(40.8)	

Meta-analyses of observational studies have also shown that consumption of low fat dairy is associated with a lower risk of high BP (RR = 0.84, 95% CI 0.74, 0.95; I2 = 38%) [10] and non-communicable diseases [11]. Another meta-analysis showed that dairy intake was associated with a lower risk of metabolic syndrome components, such as hyperglycemia, high blood pressure, hypertriglyceridemia and low high-density lipoproteins (HDL) cholesterol [30]. In our study only 42.4% of the participants reported consuming low fat or fat free dairy products. These dairy products included milk, cheese and yogurt.

A clinical study, in which 55 healthy men and women with high BP were randomly assigned to 3 isoenergy diets for a period of weeks (diet 1: no dairy, diet 2: containing low fat dairy and diet 3: including high fat dairy), found no difference in BP between the three groups [31]. Another study where a group was given 30 grams of Grana Padano cheese for a period of 3 months showed a significant reduction in systolic and diastolic blood pressure at the end of the study [32]. Another crossover, randomized, controlled study that compared a Mediterranean Diet with 3 to 4 daily servings of dairy (Mediterranean Dairy) and a low fat control diet resulted in a reduction in systolic and diastolic BP and other cardiometabolic parameters [33]. Our results might have shown a greater effect on BP, however, only 5.8% of the participants consumed more than 3 servings of dairy per day. 41.7% of the participants consume 1 to 3 servings per day, but unfortunately, the NHS survey does not

Tab. II. Hypertension according to potentially associated factors products in Chilean adults (n=3809).

Variables	Total Adults	With HTN n (%)	Crude OR	95% CI
		709 (18.6)		
Sex				
Male	1299	348 (24.4)	1	-
Female	2170	361 (15.2)	**0.55****	**0.46; 0.65**
Age				
20-44 years	1717	110(5.9)	1	-
45-64 years	1158	294 (22.8)	**4.70****	**3.72; 5.93**
≥ 65 years	596	305(46.9)	**14.12****	**11.03; 18.07**
Education Level				
≥ 12 years	929	72 (7.6)	1	-
8-12 years	2863	333(16.3)	**2.37****	**182; 3.07**
< 8 years	644	293(39.9)	**8.07****	**6.12; 10.65**
Body Mass Index BMI				
Normal/Thin	840	134 (14.4)	1	-
Overweight	1387	274(18.1)	**1.30****	**1.04; 1.63**
Obese	1108	265(21.8)	**1.64****	**1.31; 2.07**
Morbidly Obese	116	31(24.6)	**1.93****	**1.23; 3.01**
Frequency of dairy consumption (milk, cheese, fresh cheese or yogurt)				
More than 3 times per day	222	33(14.9)	1	-
Less than 3 times per day	1590	276(17.4)	1.20	0.81; 1.78
Every other day	696	132(18.9)	1.34	0.88; 2.03
1 time per month or never	961	268(20.6)	**1.48***	**1.00; 2.20**
Consumption of fruits or vegetables per day				
≥ 5 servings per day	251	52(18.9)	1	-
< 5 servings per day	3180	651(18.7)	0.98	0.72; 1.34
0 servings per day	38	6(12.0)	0.58	0.23; 1.44
Consumption of fish				
More than 1 time per week or once a week	1496	266 (16.4)	1	-
Less than 3 times a month	808	182 (20.8)	**1.33***	**1.08; 1.65**
Less than once a month or never	1165	261 (19.9)	**1.27***	**1.05; 1.54**
Smoking				
No, I have never smoked	1541	332(19.6)	1	-
Yes, one or more cigarettes	866	154(15.9)	**0.77***	**0.62; 0.95**
Yes. Less than one cigarette a day	276	41(13.7)	**0.65***	**0.95; 0.92**
Ex-smoker	786	182(21.4)	1.11	0.91: 1.36
Sport or Physical activity in the last month 30 minutes or more				
Yes, 3 or more times a week	403	44(9.9)	1	
Less tan 3 times a week	435	52(11.4)	1.16	0.76; 1.78
No, I did not engage in sports or phsycial activity in the last month	2631	613(21.1)	**2.42****	**1.75; 3.34**

* p-value < 0.05; ** p-value < 0.001.

Tab. III. Association between fat content of dairy (milk, fresh cheese or yogurt) products in Chilean adults (n=3809).

Type of Dairy (Milk, fresh cheese or yogurt)	Total Adults	With HTN n (%)	Model 1*	Model 2**
			OR (95%CI)	AOR (95% CI)
Whole/Full Fat	1998	400(20.02)	1	1
Low fat or Fat free	1471	237(16.11)	**0.76 (0.64; 0.91)**	0.88 (0.71; 1.08)

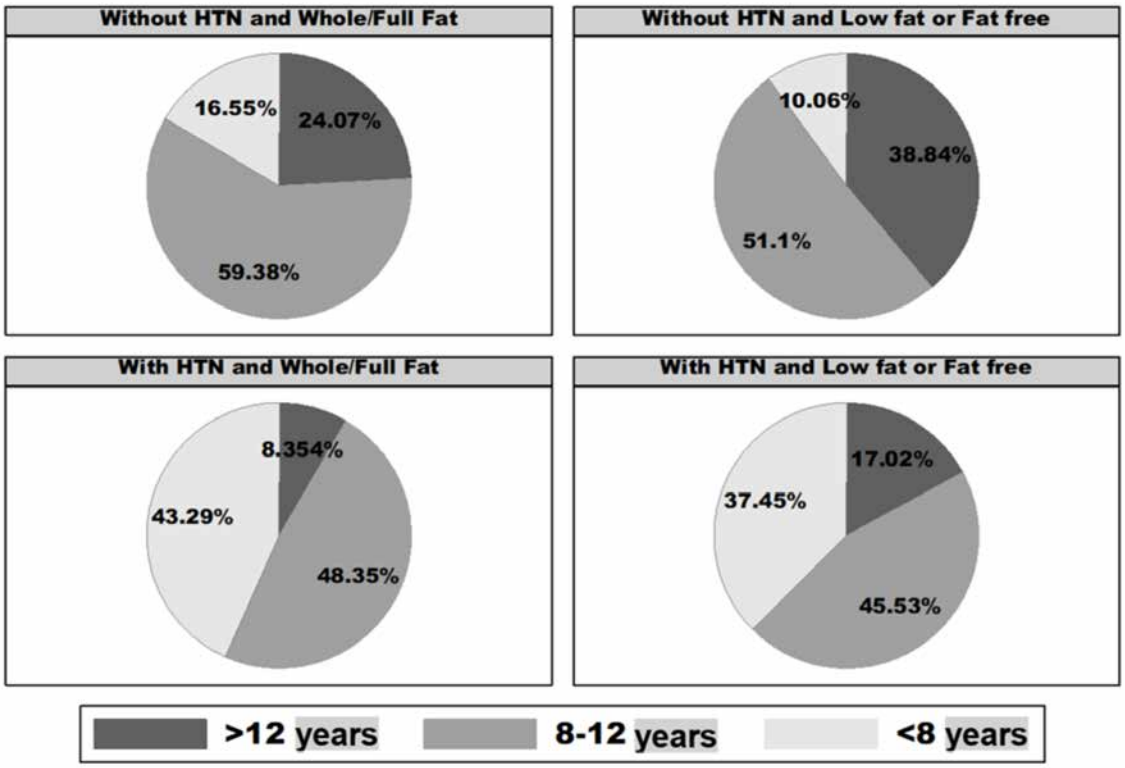
* Crude Odds Ratio; ** Adjusted Odds Ratio: sex, age, education level, frequency of fish consumption, physical activity, BMI and smoking history.

distinguish between 1, 2 or 3 servings. Therefore, we could not analyse a more refined association between dairy consumption and blood pressure.

Several agencies stress the importance of reducing saturated fats to optimize cardiometabolic health and it is recommended that saturated fats contribute <10% of total energy intake [34,35]. Another clinical study with 60 adults with high BP used a crossover trial design and randomised participants to 4 servings of high fat dairy vs no dairy (4 weeks per each dietary intervention), finding no significant effect on high BP [36].

In developing countries like Chile, low educational levels can still be observed in the population. This factor becomes crucial when thinking about the diet-

Fig. 2. Education level according to Hypertension and Type of Dairy products.



disease relationship. In a study developed by Geaney et al (2015) [37], it was observed that higher nutrition knowledge was associated with lower blood pressure, providing evidence that nutrition knowledge is significantly associated with diet quality. It is possible that people with higher levels of education have access to information that allows them to make better dietary choices. There is also an association between higher incomes and the possibility to pay for better food. Finally, people who complete higher education learn more about nutrition, generally earn higher incomes, and thus have both the knowledge and the access to eat a more varied and balanced diet.

Among the strengths of our study is that a representative sample of Chilean adults was used, but because of the type of survey, we could not analyse separately the frequency of consuming milk, cheese, yogurt, or other dairy, the portion sizes consumed and its relation with high blood pressure. Furthermore, since it is a cross-sectional study, we cannot speak of causality but only association. However, we encourage further studies to understand this relationship and especially to work with the most vulnerable populations for the prevention of comorbidities associated with uncontrolled blood pressure.

Conclusions

In our study, low fat dairy consumption was associated with lower blood pressure in the unadjusted models. However, after adjustment for confounders (particularly education), the association between blood pressure and type of dairy products consumed was not statistically significant. It is necessary to delve deeper into the importance of education in our populations to prevent chronic non-communicable diseases.

Acknowledgements

The authors thank Chilean Ministry of Health for his assistance with data access. The present study was not funded.

Conflicts of interest

The authors declare no conflicts of interest

Author contributions

The authors' contributions are as follows: Y.A.M. and S.D.A contributed to the study design, data analyses and interpretation of the findings and wrote the manuscript; R.F, L.M, and D.D contributed to the study design, subject briefings. All authors read and approved the final version of the manuscript. The authors have no financial or personal conflicts of interest to declare.

References

[1] Kearney PM, Whelton M, Reynolds K, Muntner P, Whelton PK, He J. Global burden of hypertension: analysis of worldwide data. Lancet 2005;365:217-23. https://doi.org/10.1016/S0140-6736(05)17741-1

[2] Chopra HK, Ram CVS. Recent Guidelines for Hypertension. Circ Res 2019;124:984-6. https://doi.org/10.1161/CIRCRESAHA.119.314789

[3] Unger T, Borghi C, Charchar F, Khan NA, Poulter NR, Prabhakaran D, et al. 2020 International Society of Hypertension Global Hypertension Practice Guidelines. Hypertension 2020;75:1334-57. https://doi.org/10.1161/HYPERTENSIONAHA.120.15026

[4] Olsen MH, Angell SY, Asma S, Boutouyrie P, Burger D, Chirinos JA, et al. A call to action and a lifecourse strategy to address the global burden of raised blood pressure on current and future generations: the Lancet Commission on hypertension. Lancet 2016;388:2665-712. https://doi.org/10.1016/S0140-6736(16)31134-5

[5] Kim I-G, So W-Y, Sung DJ. The relationships between lifestyle factors and hypertension in community-dwelling Korean adults. J Phys Ther Sci 2015;27:3689-92. https://doi.org/10.1589/jpts.27.3689

[6] Landi F, Calvani R, Picca A, Tosato M, Martone AM, Ortolani E, et al. Body Mass Index is Strongly Associated with Hypertension: Results from the Longevity Check-up 7+ Study. Nutrients 2018;10. https://doi.org/10.3390/nu10121976

[7] Roger VL, Go AS, Lloyd-Jones DM, Adams RJ, Berry JD, Brown TM, et al. Heart Disease and Stroke Statistics–2011 Update. Circulation 2011;123. https://doi.org/10.1161/CIR.0b013e3182009701

[8] Departamento de Estadística e Información de Salud. Base de datos de Defunciones, Departamento de Estadísticas e Información de Salud (DEIS). Minist Salud 2020. https://deis.minsal.cl/

[9] Appel LJ, Moore TJ, Obarzanek E, Vollmer WM, Svetkey LP, Sacks FM, et al. A Clinical Trial of the Effects of Dietary Patterns on Blood Pressure. N Engl J Med 1997;336:1117-24. https://doi.org/10.1056/NEJM199704173361601

[10] Ralston RA, Lee JH, Truby H, Palermo CE, Walker KZ. A systematic review and meta-analysis of elevated blood pressure and consumption of dairy foods. J Hum Hypertens 2012;26:3-13. https://doi.org/10.1038/jhh.2011.3

[11] Soedamah-Muthu SS, Verberne LDM, Ding EL, Engberink MF, Geleijnse JM. Dairy consumption and incidence of hypertension: a dose-response meta-analysis of prospective cohort studies. Hypertens (Dallas, Tex 1979) 2012;60:1131-7. https://doi.org/10.1161/HYPERTENSIONAHA.112.195206

[12] Alonso A, Zozaya C, Vázquez Z, Alfredo Martínez J, Martínez-González MA. The effect of low-fat versus whole-fat dairy product intake on blood pressure and weight in young normotensive adults. J Hum Nutr Diet 2009;22:336-42. https://doi.org/10.1111/j.1365-277X.2009.00967.x

[13] Crippa G, Zabzuni D, Bravi E, Rossi F. OS 04-04 Antihypertensive effect of milk-derivative tripeptides. Randomized, double-blind, placebo-controlled study on the effects of grana padano cheese dop in hypertensive patients. J Hypertens 2016;34:e55-6. https://doi.org/10.1097/01.hjh.0000499995.03316.c3

[14] Stancliffe RA, Thorpe T, Zemel MB. Dairy attentuates oxidative and inflammatory stress in metabolic syndrome. Am J Clin Nutr 2011;94:422-30. https://doi.org/10.3945/ajcn.111.013342

[15] Van Beresteijn EC, van Schaik M, Schaafsma G. Milk: does it affect blood pressure? A controlled intervention study. J Intern Med 1990;228:477-82. https://doi.org/10.1111/j.1365-2796.1990.tb00266.x

[16] Wennersberg MH, Smedman A, Turpeinen AM, Retterstøl K, Tengblad S, Lipre E, et al. Dairy products and metabolic effects in overweight men and women: results from a 6-mo intervention study. Am J Clin Nutr 2009;90:960-8. https://doi.org/10.3945/ajcn.2009.27664

[17] Ivey KL, Hodgson JM, Kerr DA, Thompson PL, Stojceski B, Prince RL. The effect of yoghurt and its probiotics on blood pressure and serum lipid profile; a randomised controlled trial. Nutr Metab Cardiovasc Dis 2015;25:46-51. https://doi.org/10.1016/j.numecd.2014.07.012

[18] Rietsema S, Eelderink C, Joustra ML, van Vliet IMY, van Londen M, Corpeleijn E, et al. Effect of high compared with low dairy intake on blood pressure in overweight middle-aged adults: results of a randomized crossover intervention study. Am J Clin Nutr 2019;110:340-8. https://doi.org/10.1093/ajcn/nqz116

[19] Ministerio de Salud de Chile. Encuesta Nacional de Salud 2016-2017 Primeros resultados 2017:61. https://www.minsal.cl/wp-content/uploads/2017/11/ENS-2016-17_PRIMEROS-RESULTADOS.pdf (accessed August 10, 2020).

[20] Instituto Nacional de Estadísticas. Censo 2017. Santiago, Chile: 2017.

[21] WHO/FAO. Diet, nutrition and the prevention of chronic diseases: report of a joint WHO/FAO expert consultation. Geneva: 2002.

[22] Organización Panamericana de la Salud. Unidad de Información y Análisis de Salud (HA). Iniciativa Regional de Datos Básicos en Salud; Glosario de Indicadores. Washington, DC, 2015.

[23] Cormick G, Ciapponi A, Cafferata ML, Belizán JM. Calcium supplementation for prevention of primary hypertension. Cochrane Database Syst Rev 2015;2015(6):CD010037. https://doi.org/10.1002/14651858.CD010037.pub2

[24] Fekete ÁA, Givens DI, Lovegrove JA. Casein-derived lactotripeptides reduce systolic and diastolic blood pressure in a meta-analysis of randomised clinical trials. Nutrients 2015;7:659-81. https://doi.org/10.3390/nu7010659

[25] Machin DR, Park W, Alkatan M, Mouton M, Tanaka H. Effects of non-fat dairy products added to the routine diet on vascular function: A randomized controlled crossover trial. Nutr Metab Cardiovasc Dis 2015;25:364-9. https://doi.org/10.1016/j.numecd.2015.01.005

[26] Aljuraiban GS, Stamler J, Chan Q, Van Horn L, Daviglus ML, Elliott P, et al. Relations between dairy product intake and blood pressure: the INTERnational study on MAcro/micronutrients and blood Pressure. J Hypertens 2018;36:2049–58. https://doi.org/10.1097/HJH.0000000000001779.

[27] Roy SJ, Lapierre SS, Baker BD, Delfausse LA, Machin DR, Tanaka H. High dietary intake of whole milk and full-fat dairy products does not exert hypotensive effects in adults with elevated blood pressure. Nutr Res 2019;64:72-81. https://doi.org/10.1016/j.nutres.2019.01.003

[28] Roy SJ, Fico BG, Baker BD, Lapierre SS, Shah JA, Gourley DD, et al. Effects of full-fat dairy products on subclinical vascular function in adults with elevated blood pressure: a randomized clinical trial. Eur J Clin Nutr 2020;74:9-16. https://doi.org/10.1038/s41430-019-0435-8

[29] Chiu S, Bergeron N, Williams PT, Bray GA, Sutherland B, Krauss RM. Comparison of the DASH (Dietary Approaches to Stop Hypertension) diet and a higher-fat DASH diet on blood pressure and lipids and lipoproteins: a randomized controlled trial. Am J Clin Nutr 2016;103:341-7. https://doi.org/10.3945/ajcn.115.123281

[30] Lee M, Lee H, Kim J. Dairy food consumption is associated with a lower risk of the metabolic syndrome and its components: a systematic review and meta-analysis. Br J Nutr 2018;120:373-84. https://doi.org/10.1017/S0007114518001460

[31] Rancourt-Bouchard M, Gigleux I, Guay V, Charest A, Saint-Gelais D, Vuillemard J-C, et al. Effects of regular-fat and low-fat dairy consumption on daytime ambulatory blood pressure and other cardiometabolic risk factors: a randomized controlled feeding trial. Am J Clin Nutr 2020;111:42-51. https://doi.org/10.1093/ajcn/nqz251.

[32] Crippa G, Zabzuni D, Bravi E, Piva G, De Noni I, Bighi E, et al. Randomized, double blind placebo-controlled pilot study of the antihypertensive effects of Grana Padano D.O.P. cheese consumption in mild - moderate hypertensive subjects. Eur Rev Med Pharmacol Sci 2018;22:7573-81. https://doi.org/10.26355/eurrev_201811_16299

[33] Wade AT, Davis CR, Dyer KA, Hodgson JM, Woodman RJ, Murphy KJ. A Mediterranean diet supplemented with dairy foods improves markers of cardiovascular risk: results from the MedDairy randomized controlled trial. Am J Clin Nutr 2018;108:1166-82. https://doi.org/10.1093/ajcn/nqy207

[34] World Health Organization (WHO). Healthy diet 2020. https://www.who.int/news-room/fact-sheets/detail/healthy-diet (accessed August 10, 2020).

[35] Dietary fat and its relation to heart attacks and strokes. Report by the Central Committee for Medical and Community Program of the American Heart Association. JAMA 1961;175:389-91.

[36] OECD, Food and Agriculture Organization of the United Nations. OECD-FAO Agricultural Outlook 2018-2027. Dairy and Dairy products - 2018.

[37] Geaney F, Fitzgerald S, Harrington JM, Kelly C, Greiner BA, Perry IJ. Nutrition knowledge, diet quality and hypertension in a working population. Prev Med Reports 2015;2:105-13. https://doi.org/10.1016/j.pmedr.2014.11.008

Received on Marc 22, 2021. Accepted on June 7, 2021.

Correspondence: Yadira A Morejón**,** Programa de Pesquisa SCAALA. Universidade Federal de Bahia, Rua Basílio da Gama, S/N, Campus Universitário Canela, Salvador, 40.110-040, Brazil - Tel. +55 71 32837491 - Fax +55 71 33360695 – E-mail: ymorejon@hotmail.com

How to cite this article: Morejón-Terán Y, Pizarro R, Mauritz L, Díaz D, Durán Agüero S. Association between dairy product intake and high blood pressure in Chilean adults. J Prev Med Hyg 2021;62:E681-E688. https://doi.org/10.15167/2421-4248/jpmh2021.62.3.2077

Research article

Social connectedness and health risk behaviours among in-school adolescents in urban and rural areas of Oyo State, Nigeria

AKINWUMI OYEWOLE AKINDELE[1], AYODEJI MATTHEW ADEBAYO[1,2]
[1] Department of Community Medicine, University College Hospital, Ibadan, Nigeria;
[2] Department of Community Medicine, College of Medicine, University of Ibadan, Ibadan, Nigeria

Keywords

In-school adolescents • Sexual behaviour • Family connectedness • Rural-urban secondary schools • Adolescent health

Summary

Adolescents are considered vulnerable due to their ability to venture into Health Risk Behaviours (HRBs) that may have a long-term detrimental effect on their total wellbeing. The major focus of previous adolescents' studies in Nigeria has been on parent-adolescent communication and the relationship it has with their academic performance and sexual behaviour; none has explored the association of social connectedness and HRBs among in-school adolescents. Thus, the aim of this study is to assess and compare social connectedness and HRBs among in-school adolescents in urban and rural areas of Oyo State.

A school-based comparative cross-sectional design was employed wherein 2071 in-school adolescents were selected via a multistage cluster sampling in Ibarapa Central and Ibadan North Local Government Areas (LGAs) of Oyo State. The independent variables were socio-demographic characteristics, family characteristics and social connectedness while the dependent variable was HRBs. The data was analysed using descriptive statistics, chi square, t-test, ANOVA and logistic regression with level of statistical significance set at 5%.

Overall, slightly over one-half of the respondents (51.9%) were from the urban LGA and 54.2% were females. The mean age of respondents was 13.7 ± 2.1 years and 46.7% were early adolescents aged 10-13 years. The prevalence of HRBs among in-school adolescents was high (91.8%) and the mean score of social connectedness among in-school adolescents was high, with a slightly higher mean in rural area (131.71 ± 16.43) compared to (131.04 ± 14.47) in urban area. However, this was not statistically significant ($p = 0.322$). The mean scores of the domains of religious connectedness ($p = 0.176$), school connectedness ($p < 0.001$), peer connectedness ($p < 0.001$) and social-media connectedness ($p = 0.003$) were higher in the rural areas. However, the mean score of family connectedness among respondents was higher in the urban area ($p < 0.001$). The odds of having engaged in HRBs were significantly 1.57 times more likely among respondents who were males than those who were females {AOR = 1.57, 95% CI: 1.12- 2.19}. The odds of having engaged in HRBs was significantly 1.44 times more likely among respondents who live in an urban area than among those who live in a rural area {AOR = 1.44, 95% CI: 1.03-2.01}. For a unit increase in the total score of social-media connectedness of the students, the odds of having engaged in HRBs was reduced by 0.95 {AOR = 0.95, 95% CI: 0.92-0.99}.

There were significantly lower mean scores for social connectedness among respondents who had engaged in HRBs compared to their counterpart who had not engaged in HRBs.

Therefore, various efforts targeted at improving social connectedness with its domains could be recommended to prevent in-school adolescents from engaging in HRBs.

Introduction

Adolescents are an important segment of the Nigerian society as they constitute one-fifth of the population [1, 2]. Adolescence constitutes a critical and unique developmental period in life, which is usually regarded as the years between the onset of puberty and the establishment of social independence [3, 4]. Adolescents include the ages of 10-19 years, and represent the transitional stage between childhood and adulthood, which characterizes a stage of increasing demands from family, schools, and the broader society [3, 5-7].

Behavioural changes therefore, are elicited and established as a prominent consequence of both biological and environmental changes occurring at this period [8]. As a result of the many changes that are associated with this period, adolescents tend to engage in experimentation as they define their principles and seek autonomy [9]. Adolescence is a stage of identity formation and great pressure, thus, it presents an opportunity for picking up bad habits, and it also presents a golden opportunity for behaviour modification. During the adolescence phase, parents cease being the sole agent of socialization for adolescents [10] because this period is characterized as one where relationships with non-parental adults/individuals take on increased meaning because adolescents are seeking support, information and guidance from adults/individuals outside of their home. It is a period when adolescents begin to challenge family, school and religious controls, while there is increased influence by their peers and the social media [11]. The adolescence period is a turbulent phase of self-recognition when they come to rely more on extra familial relationships such as those found in schools, with friends, and social media. They are therefore considered vulnerable due to their ability to venture into Health Risk Behaviours (HRBs)

which may have a long-term detrimental effect on their total wellbeing [12]. Accordingly, many behaviours that lead to illness or premature death later in life such as sexual risk behaviours, substance use, unhealthy diet, and physical inactivity are often initiated and established during adolescence period since they are addictive behaviours [13, 14].

Globally, HRBs contribute to the leading causes of death and disability among adolescents [11, 15], as such, it is a public health burden whereby reducing HRBs among adolescents has become a global priority [16]. The initiation of HRBs in adolescents has been associated with sustained involvement in HRBs through adulthood [17, 18]. HRBs are defined by the Centres for Disease Control and Prevention (CDC) as those behaviours that contribute to the leading causes of morbidity, disability and mortality among adolescents [19]. The HRBs are preventable behaviours which pose immediate and future threats to adolescent health and they include behaviours that worsen the odds of illness [18]. These HRBs are classified into six categories namely: behaviours that contribute to unintentional injuries and violence; sexual behaviours related to unintended pregnancy and sexually transmitted diseases, including HIV infection; alcohol and other drug use; tobacco use; unhealthy dietary behaviours; and inadequate physical activity [20-23]. The initiation of HRBs in an adolescent is influenced by multiple factors at the level of the adolescent as well as those at the levels of their peer, family, community and society.

Connectedness has been defined as a sense of being cared for, supported, and belonging, and can be centered on feeling connected to school, family (i.e. parents and caregivers), or other important people and organizations in their lives [24]. Social connectedness comprises family connectedness, peer connectedness, religion connectedness, school connectedness and social media connectedness [25]. Adolescent's health and wellbeing are directly and indirectly influenced by the relationship with family and peers, number of close friends, level of confidence in neighbours, and involvement in religious events within the community. Studies have also shown that higher levels of social connectedness are associated with reduced stress, lower blood pressure, improved immunity, lower sexual risk behaviours as well as lower morbidity and mortality rates [25-28]. The ability of an adolescent to refuse indulgence in HRBs can be very difficult if the social environment is less supportive. The HRBs remain a public health burden and efforts at reducing it among adolescents have become a global priority. Therefore, interventions targeted at helping adolescents to avoid the initiation of HRBs are essential.

There are over 1.2 billion adolescents globally, with about 90% of them living in the developing countries [29]. Adolescents are increasingly establishing patterns of behaviour and lifestyle choices that affect both their current and future health, consequent upon which about 75% of adolescent illnesses and deaths are related to HRBs [19]. It is estimated that 70% of premature deaths among adults are due to HRBs initiated during adolescence [18].

Adolescents in Nigeria had previously received few interventions targeted at reducing HRBs because it was assumed that parents/guardians occupy a good position to shape and influence adolescent's behaviours; hence they were wrongly adjudged to be a healthy segment of the population. Moreover, it has been documented that appropriate interventions among adolescents have a far-reaching effect in reducing their HRBs [18]. In recent decades, health promotion interventions aimed at adolescents have predominantly focused on reducing individual health risk behaviour such as reducing sexual behaviour only, tobacco use only or alcohol use only [17]. The implementation of interventions that target HRBs are economical since HRBs are a constellation of multiple risk behaviours. Thus, it is more cost effective to target HRBs holistically compared to the implementation of several programs each targeting individual HRBs. The study was conducted to assess and compare social connectedness and HRBs among in-school adolescents in urban and rural areas of Oyo State.

Materials and methods

Study area

The study was carried out in Oyo State, Nigeria which is one of the 36 states of the Federal Republic of Nigeria; located in the South-Western geo-political zone of Nigeria. The National population census figures for 2006 indicate that the state has a population of 5,580,894 [1, 30] with a 2019 projection of 8,405,041 assuming an annual growth rate of 3.2% [31-33]. The secondary school enrolment rate in Oyo State is 66.6% [2]. Ibadan North Local Government Area is an urban LGA located in Oyo South Senatorial district, with a population of about 308,119 [30] according to the 2006 head count and population census in Nigeria. Assuming an annual growth rate of 3.2% [31-33], a 2019 projection of 464,039 was estimated. Ibarapa Central LGA has a population of about 103,243 [30] as per the 2006 head count and population census in Nigeria. Assuming an annual growth rate of 3.2% [31-33], a 2019 projection of 155,488 was estimated.

Study design

A school-based comparative cross-sectional design was conducted among urban and rural secondary school students using a quantitative approach, wherein 2071 in-school adolescents were selected via a multistage cluster sampling in Ibarapa Central and Ibadan North Local Government Areas of Oyo State.

Study instruments

Semi-structured interviewer-assisted questionnaire which was adapted and modified from the Global School-based Health Survey questionnaire [34] and from published literature [11. 25] was used.

Data collection methods

Data collection took place over an eight-week period between October and November 2019, and was conducted by the investigator and four research assistants with a minimum qualification of Ordinary National Diploma (OND). They were trained by the researcher and an epidemiologist over a two-day period on the contents and methods of questionnaire administration as well as maintenance of ethical standards. The research assistants were supervised regularly on the field to ensure good quality of data collection. Appropriate community entry was done at both the LGAs and the secondary schools' levels.

Eligibility criteria

All junior and senior secondary school students aged 10-19 years in urban and rural secondary schools in Oyo State were eligible while ill students and those absent from school on the day of the survey were excluded.

Measurement of variables

Family connectedness

Family connectedness scale is a 5-point likert-type 9-item scale ranging from 1, strongly disagree, to 5, strongly agree. Negative statements were reverse-coded so that in all cases, a high score reflected high connectedness. The total obtainable minimum and maximum scores were 9 and 45 respectively. The mean score of the responses to the nine statements was computed.

Religious connectedness

Religious connectedness scale is a 5-point likert-type 8-item scale ranging from 1, strongly disagree, to 5, strongly agree. Negative statements were reverse-coded so that in all cases, a high score reflected high connectedness. The total obtainable minimum and maximum scores were 8 and 40 respectively. The mean score of the responses to the nine statements was computed.

School connectedness

School connectedness scale is a 5-point likert-type 6-item scale ranging from 1, strongly disagree, to 5, strongly agree. Negative statements were reverse-coded so that in all cases, a high score reflected high connectedness. The total obtainable minimum and maximum scores were 6 and 30 respectively. The mean score of the responses to the seven statements was computed.

Peer connectedness

Peer connectedness scale is a 5-point likert-type 6-item scale ranging from 1, strongly disagree, to 5, strongly agree. Negative statements were reverse-coded so that in all cases, a high score reflected high connectedness. The total obtainable minimum and maximum scores were 6 and 30 respectively. The mean score of the responses to the seven statements was computed.

Social-media connectedness

Social-media connectedness scale is a 5-point likert-type 4-item scale ranging from 1, strongly disagree, to 5, strongly agree. Negative statements were reverse-coded so that in all cases, a high score reflected high connectedness. The total obtainable minimum and maximum scores were 4 and 20 respectively. The mean score of the responses to the seven statements was computed.

Social connectedness

Scores for family, religious, school, peer and social-media connectedness were totalled, forming a composite score of social connectedness, thereafter, the mean score was computed.

Inadequate physical activity

Physical inactivity: adolescents who had < 60 minutes of moderate-to-vigorous physical activity on any of the days within the past 7 days preceding the survey were identified as being physically inactive [35]. Physical activity included walking to school, riding a bicycle to school, playing football, running, and jogging.

Physical violence

Participation in physical violence were measured according to the question, "During the past 12 months, how many times were you in a physical fight?" [36].

Sexual intercourse

Participation in sexual intercourse was measured according to the question [36, 37]; "Have you ever had sexual intercourse?" The responses were 'No' or 'Yes'.

Unhealthy dietary behaviour

Participation in unhealthy dietary behaviour was measured according to the questions, "During the past 30 days, how many times per day did you usually eat fruit such as oranges, pineapple, pawpaw, bananas, pears or apples?" [38]. "During the past 30 days, how many times per day did you usually eat vegetables such as greens, ugwu, okro, ewedu, or carrots? [38]. Respondents who had less than five servings of fruits and vegetables on any of the days in the last 30 days preceding the survey were classified as having unhealthy dietary behaviour [35, 39, 40].

Alcohol use

Participation in alcohol and other drug use was measured according to the question [37]; "Have you ever taken alcohol? "The responses were 'No' or 'Yes'.

Tobacco use

Participation in tobacco use was measured according to the question [41]; "Have you ever smoked tobacco products?" The responses were 'No' or 'Yes'.

HRBs

The presence of at least one of the domains of HRBs was regarded as presence of HRBs in the adolescent.

Parents' socio-economic status

The adolescents' social status was determined by allocating them into their parents' or guardians' social classes, since they were still dependent. Parents' social classification was done according to their occupation level and highest educational attainment at the time of data collection, based on Oyedeji's socio-economic classification [42] and other published literature [35].

The grouping of adolescents' parents' occupational class was done as follows:

- Class 5 was allocated to senior public servants, professionals, managers, businessmen and contractors;
- Class 4 was allocated to intermediate grade civil servants, senior secondary school teachers and nurses;
- Class 3 was allocated to skilled workers such as junior school teachers, artisans and professional drivers;
- Class 2 was allocated to unskilled workers such as petty traders and labourers;
- Class 1 was allocated to housewives, full house husbands, unemployed and subsistence farmers.

The grouping of highest educational attainment class was done as follows:

- Class 5 was allocated to university graduates or equivalents;
- Class 4 was allocated to teaching or other professional training certificate holders, e.g. National College of Education, school of nursing;
- Class 3 was allocated to secondary school certificate holders;
- Class 2 was allocated to primary school certificate holders;
- Class 1 was allocated to illiterates and those who could only read and/or write.

Social status was determined by adding an adolescent's father's occupational class and mother's educational class scores [35]. For paternal orphans, the surviving mother's occupational class and educational class scores was summed. While, for maternal orphans, the surviving father's occupational class and educational class scores were summed. The minimum and maximum obtainable scores were 2 and 10 respectively. Scores ranging from 2 to 4 were classified as low social class, 5 to 7 classified as middle social class and 8 to 10 classified as high social class [35].

Statistical analyses

Data were analysed using SPSS version 20. The recoding of variables was done as needed.

Descriptive statistics: categorical variables such as type of school, class, sex, ethnic group, religion, parents' marital status, parents' highest level of educational attainment and family structure were summarised as frequencies, proportions and percentages. Appropriate tables and charts were used to display results. Quantitative variable such as mean-age was summarised with means and standard deviation. Comparisons were made in each case between urban and rural students.

Bivariate analyses: bivariate analyses were run with HRBs as the dependent variable and socio-demographic characteristics, family characteristics as well as social connectedness (family, religion, school, peer and social-media) as independent variables at 5% level of significance. Chi-square tests were used for binary and categorical variables such as sex, ethnicity and parents' socio-economic status; student t-test was used to compare means of normally distributed continuous variables such as age and mean scores of social connectedness with its domains (family, religion, school, peer and social-media); while, ANOVA examined differences of numeric variables between two or more groups.

Multivariate analyses: variables significant from the bivariate analysis at 5% were entered into the logistic regression to identify the predictors of HRBs among adolescents.

Check for internal consistency of scales

The internal consistency of family, religion, school, peer and social media connectedness scales were assessed using Cronbach's alpha (a test of internal consistency which measures if the same concepts are being measured across the scales).

Limitations

Social desirability bias: it is possible for some students to under-report their HRBs. This was minimized by privacy in data collection, and assurance of confidentiality and anonymity.

Inability to determine causality: the cross-sectional nature of data collection was likely to preclude any inferences about the cause-and-effect relationships between social connectedness and the independent variables as time sequence criteria cannot be fulfilled. Rather only statistical associations could be established.

Tab. I. Internal consistency of connectedness scales.

Variable	Mean	SD	N. of items	Cronbach's alpha
Family connectedness	38.66	5.55	9	0.800
Religious connectedness	33.26	4.91	8	0.702
School connectedness	25.21	3.63	6	0.592
Peer connectedness	22.24	4.53	6	0.633
Social-media connectedness	12.95	4.00	4	0.598
Social connectedness	132.32	15.62	33	0.848

Tab. IIa. Socio-demographic and school characteristics of in-school adolescents by location.

Variables	Location		Total	χ^2	p-value
	Urban (N = 1075) n (%)	Rural (N = 996) n (%)	(N = 2071) n (%)		
Sex					
Male	527 (49.0)	421 (42.3)	948 (45.8)	9.502	**0.002***
Female	548 (51.0)	575 (57.7)	1123 (54.2)		
Age (years)					
10-13	518 (48.2)	449 (45.1)	967 (46.7)	2.004	0.367
14-16	464 (43.2)	456 (45.8)	920 (44.4)		
17-19	93 (8.6)	91 (9.1)	184 (8.9)		
Mean ± SD	13.57 ± 2.14	13.82 ± 2.01	13.69 ± 2.08	-2.667[§]	**0.008***
Ethnicity					
Yoruba	934 (86.8)	955 (95.9)	1889 (91.2)	54.070	**< 0.001***
Igbo	76 (7.1)	22 (2.2)	98 (4.7)		
Hausa	44 (4.1)	9 (0.9)	53 (2.6)		
Others[#]	21 (2.0)	10 (1.0)	31 (1.5)		
Religion					
Christianity	622 (57.9)	436 (43.8)	1058 (51.1)	41.048	**< 0.001***
Islam	453 (42.1)	560 (56.2)	1013 (48.9)		
School type					
Public	644 (59.9)	606 (60.8)	1250 (60.4)	0.189	0.663
Private	431 (40.1)	390 (39.2)	821 (39.6)		
Class					
JSS (1-3)	550 (51.2)	577 (57.9)	1127 (54.4)	9.550	**0.002***
SSS (1-3)	525 (48.8)	419 (42.1)	944 (45.6)		
Marital status					
Single	1073 (99.8)	988 (99.2)	2061 (99.5)	4.098	**0.043***
Married	2 (0.2)	8 (0.8)	10 (0.5)		
Family structure (N = 2056)					
Monogamy	860 (80.1)	653 (66.5)	1513 (73.6)	48.657	**< 0.001***
Polygamy	214 (19.9)	329 (33.5)	543 (26.4)		

[#] Ebira, Igede, Fulani, Tiv, Ijaw, Urhobo, Itsekiri, Okun. [§] t-test. * Statistically significant at $p < 0.05$.

Ethical considerations

Ethical approval for the study was sought and obtained from the Oyo State Research Ethics Review Committee (AD13/479/960). Permission was obtained from the school authorities. Letters were written to their parents for their consent. Informed consent was obtained from participants 18 years and below while assent was gotten from participants < 18 years. Findings from the study were communicated to the school heads and the Parent Teachers Association chairman as feedback.

Results

Introduction

Totally, 2128 in-school adolescents were approached for the study in both the urban and rural LGAs. However, two thousand and seventy-one (2071) consented to be interviewed giving a response rate of 97.3%. Of the 2071 in-school adolescents, 1075 (51.9%) were from the urban LGA while 996 (48.1%) were from the rural LGA.

Socio-demographic and other characteristics of in-school adolescents

The socio-demographic and other characteristics of the in-school adolescents are shown in Tables II. The variables that showed statistically significant differences between the urban and rural areas were sex ($p = 0.002$), ethnicity ($p = 0.008$), religion ($p < 0.001$), marital status ($p = 0.043$), family structure ($p < 0.001$), parents' marital status ($p < 0.001$), living status ($p = 0.045$), class ($p = 0.02$), educational sponsor ($p = 0.010$), fathers' highest education ($p < 0.001$), mothers' highest education ($p < 0.001$) and parents' socio-economic status ($p < 0.001$).

Overall, there were more females 1123 (54.2%) than males 948 (45.8%). A significantly higher proportion 575 (57.7%) of the in-school female adolescents were from the rural area compared to 548 (51.0%) from the urban area. The highest proportion 967 (46.7%) of respondents were early adolescents aged 10-13 years. The mean age of respondents in the rural LGA was 13.8 ± 2.0 years which was slightly higher than those in the urban LGA, 13.6 ± 2.1 years.

One thousand eight hundred and eighty-nine (91.2%) of

Tab. IIb. Family characteristics of in-school adolescents by location.

Variables	Location		Total	χ^2	p-value
	Urban (N = 1075) n (%)	Rural (N = 996) n (%)	(N = 2071) n (%)		
Parents' marital status					
Never married	6 (0.6)	30 (3.0)	36 (1.7)	38.055	**< 0.001***
Married/together‡	1027 (95.5)	882 (88.6)	1909 (92.2)		
Married/not together‡‡	42 (3.9)	84 (8.4)	126 (6.1)		
Living status					
Both parents	883 (82.2)	787 (79.0)	1670 (80.7)	9.722	**0.045***
Father only	25 (2.3)	34 (3.4)	59 (2.8)		
Mother only	95 (8.8)	121 (12.2)	216 (10.4)		
Relatives	69 (6.4)	51 (5.1)	120 (5.8)		
Others###	3 (0.3)	3 (0.3)	6 (0.3)		
Sponsor					
Father only	72 (6.7)	86 (8.6)	158 (7.6)	11.370	**0.010***
Mother only	90 (8.4)	117 (11.8)	207 (10.0)		
Both parents	887 (82.5)	763 (76.6)	1650 (79.7)		
Guardian	26 (2.4)	30 (3.0)	56 (2.7)		
Fathers' highest education (N = 2032)					
Primary or none	50 (4.7)	105 (10.8)	155 (7.6)	40.630	**< 0.001***
Secondary	317 (30.0)	346 (35.5)	663 (32.6)		
Tertiary	691 (65.3)	523 (53.7)	1214 (59.8)		
Mothers' highest education (N = 2061)					
Primary or none	79 (7.4)	117 (11.8)	196 (9.5)	28.621	**< 0.001***
Secondary	355 (33.2)	395 (39.9)	750 (36.4)		
Tertiary	636 (59.4)	479 (48.3)	1115 (54.1)		
Parents' SES					
Low	36 (3.3)	90 (9.0)	126 (6.1)	66.496	**< 0.001***
Middle	704 (65.5)	725 (72.8)	1429 (69.0)		
High	335 (31.2)	181 (18.2)	516 (24.9)		

‡ Married and currently living together. ‡‡ Married and currently not living together. ### Living alone and with guardians. SES: Socio-economic status. * Statistically significant at $p < 0.05$

the in-school adolescents are of Yoruba descent (one of the major ethnic groups in Nigeria) with a higher proportion in the rural area 955 (95.9%) compared to 934 (86.8%) in the urban area. A significantly higher proportion 622 (57.9%) of respondents were Christians in the urban area compared to 436 (43.8%) in the rural area. Majority of the in-school adolescents 2061 (99.5%) were single, with a higher proportion in the urban area 1073 (99.8%) compared to 988 (99.2%) in the rural area. A higher proportion of respondents were from the monogamous family setting in the urban area 860 (80.1%) compared to 653 (66.5%) of the respondents from the rural area. The proportion of respondents' parents' marital status who were married and living together were higher in the urban area 1027 (95.5%) compared to 882 (88.6%) in the rural area. In terms of living arrangement, a significantly higher proportion 883 (82.2%) of respondents live with both parents in the urban area compared to 787 (79.0%) in the rural area. A higher proportion of respondents' education was sponsored by both parents in urban area 887 (82.5%) compared to 763 (76.6%) of respondents in the rural area. A higher proportion 691 (65.3%) of the in-school adolescents' fathers had tertiary education in the urban area compared to 523 (53.7%) of respondents in the rural area. A significantly higher proportion 636 (59.4%) of respondents' mothers had tertiary education in the urban area compared to 479 (48.3%) in the rural area. In terms of parents' social class, there was a higher proportion 725 (72.8%) of in-school adolescents in the middle social class in rural area compared to 704 (65.5%) in the urban area.

Prevalence of HRBs

Overall, 91.8% of the respondents had ever engaged in HRBs, with a significantly higher proportion 93.9% in the urban area compared to 89.7% in the rural area ($p < 0.001$).

Association between respondents' characteristics and social connectedness in urban and rural areas

Among the in-school adolescents in the urban area, being a male, being an early adolescent, being of minority ethnic group, being in a Junior Secondary School (JSS) class and education being sponsored by both parents were significantly associated with social connectedness ($p < 0.05$).

Tab. IIIa. Mean comparison of respondents' characteristics and social connectedness in urban and rural areas.

Variables	Social connectedness (Mean ± SD)	
	Urban (N = 1075)	Rural (N = 996)
Sex		
Male	132.22 ± 14.32	132.18 ± 15.86
Female	129.90 ± 14.54	131.37 ± 16.84
	t test = 2.636; p = 0.009*	t test = 0.776; p = 0.438
Age (years)		
10-13	132.83 ± 13.98	132.73 ± 15.08
14-16	130.27 ± 14.56	132.16 ± 17.25
17-19	124.89 ± 14.79	124.40 ± 16.93
	F (2, 1072) = 13.304; p < 0.001*	F (2, 993) = 10.251; p < 0.001*
Ethnicity		
Yoruba	131.63 ± 14.29	131.78 ± 16.41
Igbo	127.68 ± 15.41	128.00 ± 19.84
Hausa	122.80 ± 14.86	134.44 ± 16.46
Others#	134.00 ± 14.47	130.50 ± 10.42
	F (3, 1071) = 7.053; p < 0.001*	F (3, 992) = 0.481; p = 0.696
Religion		
Christianity	130.72 ± 14.49	132.03 ± 16.78
Islam	131.47 ± 14.44	131.46 ± 16.16
	t test = -0.849; p = 0.396	t test = 0.548; p = 0.584
School type		
Public	130.48 ± 14.78	130.28 ± 16.81
Private	131.86 ± 13.96	133.93 ± 15.59
	t test = -1.536; p = 0.125	t test = -3.439; p = 0.001*
Class		
JSS (1-3)	132.29 ± 13.69	133.38 ± 15.82
SSS (1-3)	129.72 ± 15.14	129.42 ± 16.99
	t test = 2.924; p = 0.003*	t test = 3.783; p < 0.001*
Marital status		
Single	131.06 ± 14.47	131.80 ± 16.43
Married	118.00 ± 5.66	120.75 ± 13.58
	t test = 1.276; p = 0.202	t test = 1.897; p = 0.058
Family structure (N = 2056)		
Monogamy	131.13 ± 14.44	132.46 ± 16.18
Polygamy	130.77 ± 14.58	130.76 ± 16.77
	t test = 0.326; p = 0.744	t test = 1.533; p = 0.126

JSS: Junior Secondary School. SSS: Senior Secondary School. # Ebira, Igede, Fulani, Tiv, Ijaw, Urhobo, Itsekiri, Okun. * Statistically significant at p < 0.05.

Respondents who were males had higher mean social connectedness score (132.22 ± 14.32) than those who were females (129.90 ± 14.54). The mean social connectedness score decreases with increasing age. The highest mean social connectedness score was observed among early adolescents (132.83 ± 13.98) and least among late adolescents (124.89 ± 14.79). Respondents from ethnic minority group had higher mean social connectedness score (134.00 ± 14.47) than those from Yoruba ethnic group (131.63 ± 14.29), Igbo ethnic group (127.68 ± 15.41) and Hausa ethnic group (122.80 ± 14.86). Respondents in Senior Secondary School (SSS) class had lower mean social connectedness score (129.72 ± 15.14) than those in JSS class (132.29 ± 13.69). Respondents whose education were sponsored by both parents had higher mean social connectedness score (131.92 ± 14.32) than those sponsored by mothers only (127.74 ± 14.83), guardian (127.31 ± 13.82) and fathers only (125.61 ± 14.41).

Among the in-school adolescents in the rural area, being an early adolescent, attending a private school, being in a JSS class, parent being married and living together, living with both parents, education being sponsored by both parents, fathers' highest education being tertiary, mothers' highest education being tertiary and being in high social class were significantly associated with social connectedness ($p < 0.05$).

The mean social connectedness score decreases with increasing age. The highest mean social-media connectedness score was observed among early adolescents (132.73 ± 15.08) and least among late adolescents (124.40 ± 16.93). Students in public schools had lower mean social connectedness score (130.28 ± 16.81) than those in private schools (133.93 ± 15.59). Respondents in JSS class had higher mean social connectedness score (133.38 ± 15.82) than those in SSS class (129.42 ± 16.99). Respondents whose parents

Tab. IIIb. Mean comparison of respondents' characteristics and social connectedness.

Variables	Social connectedness (Mean ± SD)	
	Urban (N = 1075)	Rural (N = 996)
Parents' marital status		
Never married	120.83 ± 11.05	123.63 ± 19.98
Married/together‡	131.24 ± 14.47	132.26 ± 16.18
Married/not together‡‡	127.43 ± 14.13	128.81 ± 16.79
	F (2, 1072) = 2.913; p = 0.055	**F (2, 993) = 5.480; p = 0.004***
Living status		
Both parents	131.53 ± 14.43	132.54 ± 16.00
Father only	127.52 ± 14.02	124.00 ± 16.07
Mother only	129.72 ± 15.51	131.01 ± 18.06
Relatives	127.88 ± 13.13	126.35 ± 17.11
Others###	129.67 ± 20.74	120.00 ± 16.46
	F (4, 1070) = 1.651; p = 0.159	**F (4, 991) = 4.224; p = 0.002***
Sponsor		
Father only	125.61 ± 14.41	125.15 ± 18.72
Mother only	127.74 ± 14.83	128.92 ± 17.02
Both parents	131.92 ± 14.32	133.05 ± 15.87
Guardian	127.31 ± 13.82	127.33 ± 15.25
	F (3, 1071) = 6.709; p < 0.001*	**F (3, 992) = 8.268; p < 0.001***
Fathers' highest education (N = 2032)		
Primary or none	127.32 ± 15.74	126.24 ± 17.38
Secondary	130.59 ± 14.24	129.15 ± 15.59
Tertiary	131.49 ± 14.48	134.27 ± 16.21
	F (2, 1072) = 2.138; p = 0.118	**F (2, 993) = 16.975; p < 0.001***
Mothers' highest education (N = 2061)		
Primary or none	129.82 ± 15.72	127.47 ± 15.86
Secondary	130.41 ± 13.96	129.14 ± 16.65
Tertiary	131.63 ± 14.53	135.04 ± 15.73
	F (2, 1072) = 1.135; p = 0.322	**F (2, 993) = 19.281; p < 0.001***
Parents' SES		
Low	127.36 ± 16.51	125.41 ± 17.78
Middle	131.26 ± 14.18	131.40 ± 16.18
High	130.96 ± 14.83	136.09 ± 15.61
	F (2, 1072) = 1.251; p = 0.287	**F (2, 993) = 13.501; p < 0.001***

‡ Married and currently living together. ‡‡ Married and currently not living together. ### Living alone and with guardians. SES: Socioeconomic status. * Statistically significant at p < 0.05.

were married and currently living together had higher mean social connectedness score (132.26 ± 16.18) than those married and not currently living together (128.81 ± 16.79) and those never married (123.63 ± 19.98). Respondents who lived with both parents had higher mean social connectedness score (132.54 ± 16.00) than those who lived with mothers only (131.01 ± 18.06), relatives (126.35 ± 17.11), fathers only (124.00 ± 16.07) and those that lived alone as well as with guardians (120.00 ± 16.46). Respondents whose education were sponsored by both parents had higher mean social connectedness score (133.05 ± 15.87) than those sponsored by mothers only (128.92 ± 17.02), guardian (127.33 ± 15.25) and fathers only (125.15 ± 18.72). The mean scores for social connectedness was lowest for respondents whose fathers had primary or no education (126.24 ± 17.38) and it progressively increased with higher education, while fathers with tertiary education had the highest mean scores for social connectedness (134.27 ± 16.21). The mean scores for social connectedness was highest for respondents whose mothers had tertiary education (135.04 ± 15.73) and progressively reduced with lower education, while mothers with primary or no education had the lowest mean scores for social-media connectedness (127.47 ± 15.86). The higher the socioeconomic status the higher the mean social-media connectedness score. The mean scores for social-media connectedness was low for respondents from low socioeconomic level (125.41 ± 17.78), higher for respondents from middle socioeconomic level (131.40 ± 16.18) and highest for respondents from high socioeconomic level (136.09 ± 15.61) (Tab. IIIa-b).

Association between respondents' characteristics and HRBs

Among the in-school adolescents in the urban area, religion and type of school were significantly associated

Tab. IVa. Respondents' characteristics and HRBs in urban and rural areas.

Variables	Urban (N = 1075) HRBs		Rural (N = 996) HRBs	
	No n (%)	Yes n (%)	No n (%)	Yes n (%)
Sex				
Male	32 (6.1)	495 (93.9)	31 (7.4)	390 (92.6)
Female	34 (6.2)	514 (93.8)	72 (12.5)	503 (87.5)
	χ^2 = 0.008; p = 0.928		χ^2 = 6.975; p = 0.008*	
Age (years)				
10-13	31 (6.0)	487 (94.0)	50 (11.1)	399 (88.9)
14-16	30 (6.5)	434 (93.5)	49 (10.7)	407 (89.3)
17-19	5 (5.4)	88 (94.6)	4 (4.4)	87 (95.6)
	χ^2 = 0.201; p = 0.904		χ^2 = 3.856; p = 0.145	
Ethnicity				
Yoruba	58 (6.2)	876 (93.8)	97 (10.2)	858 (89.8)
Igbo	3 (3.9)	73 (96.1)	2 (9.1)	20 (90.9)
Hausa	3 (6.8)	41 (93.2)	3 (33.3)	6 (66.7)
Others[#]	2 (9.5)	19 (90.5)	1 (10.0)	9 (90.0)
	χ^2 = 1.123[¶]; p = 0.771		χ^2 = 3.542[¶]; p = 0.315	
Religion				
Christianity	30 (4.8)	592 (95.2)	40 (9.2)	396 (90.8)
Islam	36 (7.9)	417 (92.1)	63 (11.2)	497 (88.8)
	χ^2 = 4.439; p = 0.035*		χ^2 = 1.139; p = 0.286	
School type				
Public	30 (4.7)	614 (95.3)	64 (10.6)	542 (89.4)
Private	36 (8.4)	395 (91.6)	39 (10.0)	351 (90.0)
	χ^2 = 6.115; p = 0.013*		χ^2 = 0.081; p = 0.777	
Class				
JSS (1-3)	30 (5.5)	520 (94.5)	59 (10.2)	518 (89.8)
SSS (1-3)	36 (6.9)	489 (93.1)	44 (10.5)	375 (89.5)
	χ^2 = 0.917; p = 0.338		χ^2 = 0.020; p = 0.888	
Marital status				
Single	66 (6.2)	1007(93.8)	103 (10.4)	885 (89.6)
Married	0 (0.0)	2 (100.0)	0 (0.0)	8 (100.0)
	Fisher's exact test; p = 1.000		Fisher's exact test; p = 1.000	
Family structure (N = 2056)				
Monogamy	49 (5.7)	811 (94.3)	61 (9.3)	592 (90.7)
Polygamy	17 (7.9)	197 (92.1)	40 (12.2)	289 (89.5)
	χ^2 = 1.499; p = 0.221		χ^2 = 1.881; p = 0.170	

[#] Ebira, Igede, Fulani, Tiv, Ijaw, Urhobo, Itsekiri, Okun. [¶] Likelihood Ratio. * Statistically significant at p < 0.05.

with HRBs (p < 0.05). More Christians (95.2%) than Muslims (92.1%) had ever engaged in HRBs. A higher proportion (95.3%) of respondents in public schools than 91.6% in private schools had ever engaged in HRBs.

Among the in-school adolescents in the rural area, only sex was significantly associated with HRBs (p < 0.05). More males (92.6%) than females (87.5%) had ever engaged in HRBs (Tab. IV).

Mean comparison of social connectedness and HRBs in urban and rural areas

Social connectedness was significantly associated with having engaged in HRBs (p < 0.05) in both urban and rural areas. There were lower mean scores for social connectedness among respondents who had engaged in HRBs compared to their counterparts who had never engaged in HRBs in the urban area (130.69 ± 14.53) and rural area (131.24 ± 16.69) respectively.

Association between respondents' characteristics and HRBs in Oyo State

Among the in-school adolescents in Oyo State, sex, location, religion and family structure were significantly associated with HRBs (p < 0.05) More males (93.4%) than females (90.6%) had engaged in HRBs. More respondents in the urban area (93.9%) than 89.7% in the rural area had engaged in HRBs. A higher proportion (93.4%) of Christians than 90.2% of Muslims had engaged in HRBs. More respondents in monogamous family (92.7%) than 89.5% in polygamous family had engaged in HRBs (Tab. V).

Tab. IVb. Respondents' characteristics and HRBs in urban and rural areas.

Variables	Urban (N = 1075) HRBs		Rural (N = 996) HRBs	
	No n (%)	Yes n (%)	No n (%)	Yes n (%)
Parents' marital status				
Never married	0 (0.0)	6 (100.0)	3 (10.0)	27 (90.0)
Married/together‡	63 (6.1)	964 (93.9)	95 (10.8)	787 (89.2)
Married/not together‡‡	3 (7.1)	39 (92.9)	5 (6.0)	79 (94.0)
	χ^2 = 0.830¶; p = 0.660		χ^2 = 1.925; p = 0.382	
Living status				
Both parents	52 (5.9)	831 (94.1)	77 (9.8)	710 (90.2)
Father only	1 (4.0)	24 (96.0)	4 (11.8)	30 (88.2)
Mother only	8 (8.4)	87 (91.6)	19 (15.7)	102 (84.3)
Relatives	5 (7.2)	64 (92.8)	3 (5.9)	48 (94.1)
Others###	0 (0.0)	3 (100.0)	0 (0.0)	3 (100.0)
	χ^2 = 1.616¶; p = 0.806		χ^2 = 5.562¶; p = 0.234	
Sponsor				
Father only	2 (2.8)	70 (97.2)	12 (14.0)	74 (86.0)
Mother only	5 (5.6)	85 (94.4)	11 (9.4)	106 (90.6)
Both parents	58 (6.5)	829 (93.5)	78 (10.2)	685 (89.8)
Guardian	1 (3.8)	25 (96.2)	2 (6.7)	28 (93.3)
	χ^2 = 2.321¶; p = 0.508		χ^2 = 1.703; p = 0.621	
Fathers' highest education (N = 2032)				
Primary or none	2 (4.0)	48 (96.0)	7 (6.7)	98 (93.3)
Secondary	25 (7.9)	292 (92.1)	33 (9.5)	313 (90.5)
Tertiary	37 (5.4)	654 (94.6)	61 (11.7)	462 (88.3)
	χ^2 = 2.839; p = 0.242		χ^2 = 2.749; p = 0.253	
Mothers' highest education (N = 2061)				
Primary or none	6 (7.6)	73 (92.4)	8 (6.8)	109 (93.2)
Secondary	24 (6.8)	331 (93.2)	36 (9.1)	359 (90.9)
Tertiary	36 (5.7)	600 (94.3)	59 (12.3)	420 (87.7)
	χ^2 = 0.776; p = 0.678		χ^2 = 4.186; p = 0.123	
Parents' SES				
Low	2 (5.6)	34 (94.4)	9 (10.0)	81 (90.0)
Middle	45 (6.4)	659 (93.6)	71 (9.8)	654 (90.2)
High	19 (5.7)	316 (94.3)	23 (12.7)	158 (87.3)
	χ^2 = 0.226; p = 0.893		χ^2 = 1.339; p = 0.512	

‡ Married and currently living together. ‡‡ Married and currently not living together. ### Living alone and with guardians. SES Socioeconomic status. ¶ ikelihood Ratio. *Statistically significant at p < 0.05.

Predictors of HRBs among in-school adolescents in Oyo State

Table VI shows the predictors of having engaged in HRBs among in-school adolescents in Oyo State. The model included sex, religion, location, family structure, religious connectedness, school connectedness, peer connectedness and social-media connectedness.

The predictors of having engaged in HRBs in Oyo State were sex, location and social-media connectedness. The odds of having engaged in HRBs was significantly 1.57 times more likely among respondents who was males {AOR = 1.57, 95% CI: 1.12-2.19} than among females. The odds of having engaged in HRBs was significantly 1.44 times more likely among respondents who live in an urban area {AOR = 1.44, 95% CI: 1.03-2.01} than among those who live in a rural area. For a unit increase in the total score of social-media connectedness of the students, the odds of having engaged in HRBs was reduced by 0.95 {AOR = 0.95, 95% CI: 0.92-0.99} (Tab. VI).

Discussion

This study explored the predictors of HRBs among in-school adolescents in urban and rural areas of Oyo State. The mean age of respondents in the rural area was 13.8 ± 2.0 years which was slightly higher than those in the urban area, 13.6 ± 2.1 years. This is similar to findings from a study by Ilori and colleagues where there was a higher proportion in the rural area (14.3 ± 1.9 years) than in the urban area 13.9 ± 2.0 years [43]. This is of great interest because adolescents in older age groups

Table Va. Respondents' characteristics and HRBs in urban and rural areas

Variables	HRBs		χ^2	p-value
	No n (%)	Yes n (%)		
Sex				
Male	63 (6.6)	885 (93.4)	5.352	**0.021***
Female	106 (9.4)	1017 (90.6)		
Age (years)				
10-13	81 (8.4)	886 (91.6)	2.907	0.234
14-16	79 (8.6)	841 (91.4)		
17-19	9 (4.9)	175 (95.1)		
Location				
Urban	66 (6.1)	1009 (93.9)	12.179	**< 0.001***
Rural	103 (10.3)	893 (89.7)		
Ethnicity				
Yoruba	155 (8.2)	1734 (91.8)	2.128‡	0.546
Igbo	5 (5.1)	93 (94.9)		
Hausa	6 (11.3)	47 (88.7)		
Others#	3 (9.7)	28 (90.3)		
Religion				
Christianity	70 (6.6)	988 (93.4)	6.881	**0.009***
Islam	99 (9.8)	914 (90.2)		
School type				
Public	94 (7.5)	1156 (92.5)	1.725	0.189
Private	75 (9.1)	746 (90.9)		
Class				
JSS (1-3)	89 (7.9)	1038 (92.1)	0.229	0.633
SSS (1-3)	80 (8.5)	864 (91.5)		
Marital status				
Single	169 (8.2)	1892 (91.8)	§	1.000
Married	0 (0.0)	10 (100.0)		
Family structure (N = 2056)				
Monogamy	110 (7.3)	1403 (92.7)	5.576	**0.018***
Polygamy	57 (10.5)	486 (89.5)		

§ Fishers exact test. ‡ Likelihood Ratio. # Ebira, Igede, Fulani, Tiv, Ijaw, Urhobo, Itsekiri, Okun. * Statistically significant at p < 0.05.

are more likely to engage in HRBs than those in lower age groups.

A significantly higher proportion (82.2%) of respondents lived with both parents in the urban area compared to (79.0%) in the rural area. This is similar to findings from a Malaysian study where a higher proportion (95.6%) of adolescents lived with both parents in the urban area compared to 87.5% in the rural area.[44] Adolescents who lived with both parents could be better supervised compared to their colleagues who lived alone, with one parent or with a relative. Consequently, those respondents who lived with both parents had reduced chances of engaging in HRBs.

A higher proportion of respondents were from monogamous family settings in the urban area (80.1%) compared to respondents from the rural area (66.5%). Findings from this current study is significant because it has been reported that the odds of having engaged in HRBs was twice more likely among respondents who come from polygamous family than among those from monogamous family [36].

In terms of parents' social class, there was a higher proportion (31.2%) of in-school adolescents in the high social class in urban area compared to the rural area (18.2%). This is lower than findings from a study which reported 58.2% in the urban area and 38.6% in the rural area [45]. There are indications that family values and practices in our environment are changing with higher social class attainment as both parents are likely to be working or involved in trade thus, leading to reduced supervision of adolescents [46].

The predictors of HRBs in Oyo State were sex, location and social-media connectedness.

The odds of engaging in HRBs was more likely among respondents who were males than among females. Findings in the present study are consistent with earlier findings from Nigeria [36], Ethiopia [25, 47], Iran [48], Malaysia [44, 49] and Serbia [13] where the odds of having engaged in HRBs was more in males than in females. The more likely explanations are that males are more willing to take risks [50, 51], and have more freedom than females in their families [41, 52]. All these may lead to increased incidence of HRBs among males. Another reason is social desirability reporting bias in which

Table Vb. Respondents' characteristics and HRBs in urban and rural areas

Variables	HRBs		χ^2	p-value
	No n (%)	Yes n (%)		
Parents' marital status				
Never married	3 (8.3)	33 (91.7)	0.587	0.746
Married/together	158 (8.3)	1751 (91.7)		
Married/not together	8 (6.3)	118 (93.7)		
Living status				
Both parents	129 (7.7)	1541 (92.3)	6.749	0.150
Father only	5 (8.5)	54 (91.5)		
Mother only	27 (12.5)	189 (87.5)		
Relatives	8 (6.7)	112 (93.3)		
Others	0 (0.0)	6 (100.0)		
Sponsor				
Father only	14 (8.9)	144 (91.1)	0.757	0.860
Mother only	16 (7.7)	191 (92.3)		
Both parents	136 (8.2)	1514 (91.8)		
Guardian	3 (5.4)	53 (94.6)		
Fathers' highest education (N = 2032)				
Primary or none	9 (5.8)	146 (94.2)	1.466	0.480
Secondary	58 (8.7)	605 (91.3)		
Tertiary	98 (8.1)	1116 (91.9)		
Mothers' highest education (N = 2061)				
Primary or none	14 (7.1)	182 (92.9)	0.483	0.786
Secondary	60 (8.0)	690 (92.0)		
Tertiary	95 (8.5)	1020 (91.5)		
Parents' SES				
Low	11 (8.7)	115 (91.3)	0.058	0.971
Middle	116 (8.1)	1313 (91.9)		
High	42 (8.1)	474 (91.9)		

* Fishers exact test.

boys may exaggerate their HRBs, while girls under-report their HRBs [53].

The odds of having engaged in HRBs was more likely among respondents who live in the urban area than among those who live in the rural area. The finding is in contrast with earlier studies from Ethiopia in 2014 [47], Iran in 2017 [48] and Canada in 2019 [54] which reported that living in rural area was a significant predictor for engaging in HRBs among adolescents. Findings from this present study showed that there are more high social class families in the urban area compared to the rural area. This is noteworthy because studies have reported that students from higher social class families are more inclined to engage in HRBs compared to those from low social class families [48, 55].

For a unit increase in the total score of social-media connectedness of the students, the odds of having engaged in HRBs was reduced by 0.95. This is probably because most parents of in-school adolescents in this present study have at least secondary education as the highest educational attainment and also most families belong to the middle-high social class. The findings suggest that respondents have access to internet enabled devices and learnt health promoting behaviours via the contents viewed on social media specifically teachings that prevented unhealthy dietary behaviour. This also suggests that parents need to monitor their adolescents' use of the social-media so as to ensure that they are exposed to correct and age-appropriate contents which will reduce their chances of engaging in HRBs.

Conclusions

A high proportion of the respondents had ever engaged in HRBs, with a significantly higher proportion in the urban area compared to those in the rural area. Overall, the mean score of social connectedness among in-school adolescents was high, with no difference between the rural area and the urban area. There were significantly lower mean scores for social connectedness among respondents who had engaged in HRBs compared to their counterpart who had not engaged in HRBs. The odds of having engaged in HRBs was significantly 1.57 times more likely among respondents who were males than among females. The odds of having engaged in HRBs was significantly 1.44 times more likely among respondents who live in an urban area than among those who live in a rural area. For a unit increase in the total score of social-media connectedness of the students, the odds

Tab. VI. Multivariable logistic regression of selected variables and HRBs among respondents in Oyo State.

Variables	Odd ratio	95% Confidence interval		p-value
		Lower	Upper	
Sex				
Male	1.570	1.123	2.193	**0.008***
Female **(Ref)**	1.000			
Religion				
Christianity	0.726	0.521	1.010	0.057
Islam **(Ref)**	1.000			
Location				
Urban	1.439	1.031	2.009	**0.033***
Rural **(Ref)**	1.000			
Family structure				
Monogamy	0.751	0.530	1.064	0.107
Polygamy **(Ref)**	1.000			
Religious connectedness	0.984	0.944	1.025	0.443
School connectedness	0.958	0.910	1.008	0.100
Peer connectedness	0.966	0.922	1.011	0.135
Social-media connectedness	0.954	0.916	0.993	**0.022***

* Statistically significant at $p < 0.05$.

of having engaged in HRBs was reduced by 0.95. The Government-directed health promotion efforts would be more effective by building social connectedness in addition to only focusing interventions on individual risky behaviours. Findings suggest that schooling has protective effects on the adolescent's development beyond academic competence, thus, efforts are necessary to ensure that all school-aged adolescents are enrolled in school. Future research should examine the individual components of HRBs and social connectedness in order to elicit any associations. Also, longitudinal studies should be conducted to establish future risks of engaging in HRBs among adolescents.

Acknowledgements

Data for this publication was extracted from the dissertation submitted by AOA for the Fellowship of the West African College of Physicians in Community Health; AMA supervised the dissertation. The dissertation was self-funded.

Conflict of interest statement

The authors declare that they have no competing interests.

Authors' contributions

AOA participated in the study design, led data collection and statistical analysis, and drafted the manuscript; AMA participated in the study design, reviewed data analysis results, critically reviewed and finalised the manuscript. Both authors read and approved the final manuscript.

References

[1] NBS. National Bureau of Statistics. Annual Abstract of Statistics, 2016. Federal Republic of Nigeria 2016, pp. 1-10.

[2] National Population Commission (NPC) [Nigeria] and ICF. 2019. Nigeria Demographic and Health Survey 2018. Abuja, Nigeria, and Rockville, Maryland, USA: NPC and ICF 2019.

[3] UNICEF. United Nations Children's Fund. Progress for Children: A report card on adolescents - 2012, pp. 1-56.

[4] Curtis AC. Defining Adolescence. Journal of Adolescent and Family Health 2015;7:1-39. https://doi.org/http://scholar.utc.edu/jafh/vol7/iss2/2/

[5] Kelly M, Millar M. Exploring Adolescence and Parenthood: A Transitional Life Stage and Abrupt Life Change. J Comm Pub Health Nurs 2017;03:1-6. https://doi.org/10.4172/2471-9846.1000162

[6] Tanihata T, Kanda H, Osaki Y, Ohida T, Minowa M, Wada K, Suzuki K, Hayashi K. Unhealthy lifestyle, poor mental health, and its correlation among adolescents: A nationwide cross-sectional survey. Asia Pac J Public Health 2015;27:NP1557-NP1565. https://doi.org/10.1177/1010539512452753

[7] Qidwai W, Ishaque S, Shah S, Rahim M. Adolescent lifestyle and behaviour: A survey from a developing country. PLoS ONE 2010;5:1-6. https://doi.org/10.1371/journal.pone.0012914

[8] Mercy ON, Peter AS. Risky Sexual Behaviours Among Female in-School Adolescents in Delta, Nigeria: Self-Esteem, Parental Involvement and Religiosity As Predictors. Eur Sci J 2014;10:157-77.

[9] Kunnuji MON. Parent-child communication on sexuality-related matters in the city of Lagos, Nigeria. Afr Dev 2012;37:41-56.

[10] Han Y, Kim H, Lee D. Application of social control theory to examine parent, teacher, and close friend attachment and substance use initiation among Korean Youth. Sch Psychol Int 2016;37:340-58. https://doi.org/10.1177/0143034316641727

[11] Omotowo BI, Ndu AC, Agwu Umahi OR, Ezeoke UE, Arthur IC, Ancilla UK. Assessment of Health Risk Behaviours among Secondary School Students in Enugu, South-East, Nigeria. Glob J Health Sci 2017;9:57-66. https://doi.org/10.5539/gjhs.v9n7p57

[12] Okigbo CC, Kabiru CW, Mumah JN, Mojola SA, Beguy D. Influence of parental factors on adolescents' transition to first sexual intercourse in Nairobi, Kenya: A longitudinal study. Re-

prod Health 2015;12:1-12. https://doi.org/10.1186/s12978-015-0069-9

[13] Boričić K, Simić S, Erić JM. Demographic and socio-economic factors associated with multiple health risk behaviours among adolescents in Serbia: A cross sectional study. BMC Public Health 2015;15:1-9. https://doi.org/10.1186/s12889-015-1509-8

[14] Goldfarb SS, Locher JL, Preskitt J, Becker D, Davies SL, Sen B. Associations between participation in family activities and adolescent school problems. Child Care Health Dev 2017;43:361-8. https://doi.org/10.1111/cch.12434

[15] CDC. Centers for Disease Control and Prevention. Youth Risk Behavior Survey (YRBS) 2017 Standard Questionnaire Item Rationale. CDC 2017;75:1-45. https://doi.org/10.1001/jama.2010.1635.Centers

[16] WHO. Adolescent Health. The missing population in universal health coverage [Internet]. 2018 [cited 2019 May 10], pp. 1-32.

[17] Brooks FM, Magnusson J, Spencer N, Morgan A. Adolescent multiple risk behaviour: An asset approach to the role of family, school and community. J Public Health (Oxf) 2012;34(Suppl 1):48-56. https://doi.org/10.1093/pubmed/fds001

[18] WHO. World Health Organisation. Global Health Risks: Mortality and burden of disease attributable to selected major risks. Bull World Health Organ 2009;87:1-70. https://doi.org/10.2471/BLT.09.070565

[19] CDC. Centers of Disease Control and Prevention. 2017 National Youth Risk Behavior Survey. 2017, pp. 1-23.

[20] Booth FW, Roberts CK, Laye MJ. Lack of exercise is a major cause of chronic diseases. Compr Physiol 2012;2:1143-211. https://doi.org/10.1002/cphy.c110025.Lack

[21] CDC. Centers for Disease Control and Prevention. The Power of Prevention Chronic Disease. The public health challenge of the 21st century - 2009, pp. 1-18.

[22] Ekelund U, Steene-Johannessen J, Brown WJ, Fagerland MW, Owen N, Powell KE, Bauman A, Lee I. Does physical activity attenuate, or even eliminate, the detrimental association of sitting time with mortality? A harmonised meta-analysis of data from more than 1 million men and women. The Lancet 2016;388:1302-10. https://doi.org/10.1016/S0140-6736(16)30370-1

[23] Bhupathiraju SN, Tucker KL. Coronary heart disease prevention: Nutrients, foods, and dietary patterns. Clin Chim Acta 2011;412:1493-514. https://doi.org/10.1016/j.cca.2011.04.038

[24] CDC. Centers for Disease Control and Prevention. Adolescent and School Health. Adolescent connectedness has lasting effects. [Internet]. Atlanta, GA, US: Department of Health and Human Services 2017, p. 1.

[25] Handebo S, Kebede Y, Morankar SN. Does social connectedness influence risky sexual behaviours? Finding from Ethiopian youths. Int J Adolesc Youth 2017;23:1-14. https://doi.org/10.1080/02673843.2017.1306448

[26] Munsell EP, Kilmer RP, Cook JR, Reeve CL. The Effects of Caregiver Social Connections on Caregiver, Child, and Family Well-Being. Am J Orthopsychiatry 2013;82:137-45. https://doi.org/10.1111/j.1939-0025.2011.01129.x.The

[27] Stickley A, Koyanagi A, Koposov R, Schwab-Stone M, Ruchkin V. Loneliness and health risk behaviours among Russian and U.S. adolescents: A cross-sectional study. BMC Public Health 2014;14:1-12. https://doi.org/10.1186/1471-2458-14-366

[28] Varga S, Piko BF. Being lonely or using substances with friends? A cross-sectional study of Hungarian adolescents' health risk behaviours Health behavior, health promotion and society. BMC Public Health 2015;15:1-9. https://doi.org/10.1186/s12889-015-2474-y

[29] UNICEF. Adolescent Demographics. UNICEF DATA: Monitoring the situation of children and women. United Nations Children's Fund [Internet]. 2019; https://doi.org/https://data.unicef.org/topic/adolescents/demographics/

[30] NBS. National Bureau of Statistics. Annual Abstract of Statistics, 2011. Federal Republic of Nigeria 2011, pp. 1-697.

[31] USAID. United States Agency for International Development. President 's Malaria Initiative: Malaria Operational Plan FY 2019. Nation State Agency for International Development (USAID). 2019, pp. 1-79.

[32] Allen AA, Adekola PO. Combating infant mortalilty in Ibadan North Local Government Area, South West, Nigeria: need for sustainable development. J Sustain Dev Afr 2014;16:14-30.

[33] Adekola PO, Allen AA, Akintunde EA. Environmental factors affecting infant mortality in Ibadan North Local Government Area of Nigeria. Afr. J Soc Sci 2014;4:53-67.

[34] GSHS. Global school-based student health survey (GSHS) purpose and methodology: 2013 core questionnaire modules. World Health Organization, Department of Chronic Diseases and Health Promotion. 2013, pp. 1-16.

[35] Idowu A, Fatusi AO, Olajide FO. Clustering of behavioural risk factors for non-communicable diseases (NCDs) among rural-based adolescents in south-west Nigeria. Int J Adolesc Med Health 2016;30:1-9. https://doi.org/10.1515/ijamh-2016-0008

[36] Akanni OO, Koleoso ON, Olashore AA, Adayonfo EO, Osundina AF, Ayilara OO. Gender and other risk factors associated with risky behaviours among Nigerian adolescents. J Adolesc 2017;57:13-7. https://doi.org/10.1016/j.adolescence.2017.03.002

[37] Sangowawa AO, Adebiyi AO. Factors Associated With Sexual Abstinence Among Out-of-School Females in a Transitional Town in Oyo State, South-Western Nigeria. Health Care Women Int 2013;34:917-32. https://doi.org/10.1080/07399332.2013.769998

[38] Peltzer K, Pengpid S. Fruits and vegetables consumption and associated factors among in-school adolescents in seven African countries. Int J Public Health 2010;55:669-78. https://doi.org/10.1007/s00038-010-0194-8

[39] Slavin JL, Lloyd B. Health benefits of fruits and vegetables. Adv Nutr2012;3:506-16. https://doi.org/10.3945/an.112.002154.506

[40] Kjøllesdal M, Htet AS, Stigum H, Hla NY, Hlaing HH, Khaine EK, Khaing W, Khant AK, Khin Khin NO, Aye Mauk KK, Moe EE, Moe H, M KK, Mya KS, Myint CK, Myint CY, Myint O, New AA, Oo ES, Oo KS, Pyone ZZ, Soe YY, Wai MM, Win N, Bjertness E. Consumption of fruits and vegetables and associations with risk factors for non-communicable diseases in the Yangon region of Myanmar: a cross-sectional study. BMJ Open 2016;6:1-8. https://doi.org/10.1136/bmjopen-2016-011649

[41] Olugbenga-Bello AI, Adebimpe WO, Akande RO, Oke OS. Health risk behaviors and sexual initiation among in-school adolescents in rural communities in southwestern Nigeria. International Int J Adolesc Med Health 2014;26:503-10. https://doi.org/10.1515/ijamh-2013-0326

[42] Oyedeji GA. Socio economic and Cultural Background of Hospitalized Children in Ilesha. Nigerian Nig J Paediatr 1985;12:111-7.

[43] Ilori OR, Awodutire P, Ilori O. Awareness and utilization of adolescent reproductive health services among in-school adolescents in urban and rural communities in Oyo state. Niger Med J 2020;61:67-72.

[44] Azmawati MN, Hazariah, Siti Hamid A, Shamsul AS, Norfazilah A, Azimatun NA, Rozita H. Risk taking behaviour among urban and rural adolescents in two selected districts in Malaysia. S Afr Fam Pract 2015;57:160-5. https://doi.org/10.1080/20786190.2014.977048

[45] Omisore AG, Omisore B, Abioye-kuteyi EA, Bello IS, Olowookere SA. In-school adolescents' weight status and blood pressure profile in South-western Nigeria: urban-rural comparison. BMC Obesity 2018;5:1-9. https://doi.org/10.1186/s40608-018-0179-3

[46] Olayiwola F, Owagbemi OG. Strains in traditional family values in a Yoruba community: a study of families in Akoko-land in Ondo State, Nigeria. Eur Sci J 2012;8:160-71.

[47] Fentahun N, Mamo A. Risky sexual behaviors and associated factors among male and female students in Jimma Zone preparatory schools, South West Ethiopia: comparative study. Ethiop J Health Sci 2014;24:59-68. https://doi.org/10.4314/ejhs.v24i1.8

[48] Ameri Z, Mirzakhani F, Nabipour AR, Khanjani N, Sullman MJM. The Relationship Between Religion and Risky Behaviors Among Iranian University Students. J Relig Health 2017;56:2010-22. https://doi.org/10.1007/s10943-016-0337-1

[49] Hamid SH, Nawi AB. Family Characteristics Associate with Risk Taking Behaviour among Urban and Rural Adolescents in Two Districts in Selangor. A Comparative Study. Procedia Soc Behav Sci 2013;91:581-7. https://doi.org/10.1016/j.sbspro.2013.08.457

[50] Verdonk P, Seesing H, de Rijk A. Doing masculinity, not doing health? a qualitative study among dutch male employees about health beliefs and workplace physical activity. BMC Public Health 2010;10:712-26. https://doi.org/10.1186/1471-2458-10-712

[51] Cobey KD. Sex differences in risk taking behaviour among dutch cyclists. Evol Psychol 2013;11:350-64.

[52] Janssen HJ, Eichelsheim VI. Sex differences in longitudinal pathways from parenting to delinquency. Eur J Crim Pol Res 2017;23:503-21. https://doi.org/10.1007/s10610-017-9350-5

[53] Somefun OD. Religiosity and sexual abstinence among Nigerian youths: does parent religion matter? BMC Public Health 2019;19:416-27.

[54] Geczy I, Saewyc EM, Poon CS, Homma Y. Health-Risk Behaviors and Protective Factors among Adolescents in Rural British Columbia. J Rural Health 2019;00:1-12. https://doi.org/10.1111/jrh.12389

[55] Conry M, Morgan K, Curry P. The clustering of health behaviours in Ireland and their relationship with mental health, self-rated health and quality of life. BMC Public Health 2011;11:1-10.

Received on April 17, 2021. Accepted on June 3, 2021.

Correspondence: Akinwumi Oyewole Akindele, Department of Community Medicine, University College Hospital, PMB 5116, Ibadan, Nigeria – Tel. 2348067536303 - E-mail: akintent@yahoo.com.

How to cite this article: Akindele AO, Adebayo AM. Social connectedness and health risk behaviours among in-school adolescents in urban and rural areas of Oyo State, Nigeria. J Prev Med Hyg 2021;62:E689-E703. https://doi.org/10.15167/2421-4248/jpmh2021.62.3.2107

RESEARCH ARTICLE

Low awareness of venous thromboembolism among the general population: a call for increased public enlightenment programs

HELEN OKOYE[1], THERESA NWAGHA[1], EYIUCHE EZIGBO[2], OJI NNACHI[3], ONOCHIE OBODO[1], OLUOMACHI NNACHI[3] NNEKA AMU[1], IKECHUKWU ANIGBOGU[4]

[1] Department of Haematology University of Nigeria Teaching Hospital Ituku Ozalla Enugu; [2] Department of Medical Laboratory, Faculty of Health science UNEC Enugu; [3] Alex Ekwueme Teaching Hospital Abakiliki; [4] Aminu Kano Teaching Hospital Ebonyi

Keywords

Venous thromboembolism • Awareness • General population • Deep vein thrombosis

Summary

Background. *Venous thromboembolism (VTE) is a notable but often ignored cause of disability and death. Improved public awareness of the symptoms and risks associated with VTE reduces the burden of disease.*

Aim. *We aimed to determine the awareness of VTE among the general population.*

Methods. *We conducted a population-based study using a pre-tested, pre-validated Ipsos-Reid questionnaire between October 2019 to March 2020. The questionnaire was distributed to consenting adults in the capital cities of Enugu and Ebonyi states of South-Eastern Nigeria to determine their awareness and knowledge of the symptoms and risk factors of VTE.*

Results. *A total of 284 adults participated with a mean age of 32.73 ± 10.33 years and majority (70.8%) had a post-secondary education. While majority were aware of other medical conditions like a heart attack (96.1%), stroke (97.2%), diabetes (98.2%), HIV/AIDS (98.6%), cancer (97.2%) and malaria (98.2), just a few of the subjects were aware of thrombosis (41.5%) and DVT (33.8%). Less than half (42.4%) correctly described DVT as a blood clot in the vein and 13.7% of the respondents knew what PE feels like. A minority of them knew the risk factors of VTE included hospital stay (19.0%), surgery (37.2%), cancer (31.6%), pregnancy (31.6%) and old age (29.6%). Age and gender showed no statistically significant association with awareness of VTE, p value, 0.491 and 0.287, respectively.*

Conclusion. *The awareness of VTE in the general population is low. Public awareness programs should be a public health priority to reduce morbidity and mortality associated with VTE.*

Introduction

Venous thromboembolism is a clinical disorder comprising of deep venous thrombosis (DVT) and pulmonary embolism (PE). They occur as a result of abnormal formation of blood clots within the vessels, and in this case, more commonly in the deep veins of the lower limbs and the pulmonary vasculature [1, 2]. DVT can also occur in the veins of the upper limbs [3]. PE typically occurs following a DVT and can be life threatening [2].

VTE is a preventable disease that has been largely ignored and has continued to cause significant morbidity and mortality. It is considered to be amongst the leading contributors to disease burden worldwide, and has been recognised as a growing public health concern [1, 4]. It is associated with an increased risk of morbidity and mortality especially in hospitalised patients [5]. This increased risk can partly be attributed to paucity of knowledge about the risk factors that cause VTE, ability to recognise clinical features of VTE as most of them are non-specific, and ability to seek urgent clinical attention. There are several studies assessing the awareness and knowledge of VTE and use of thromboprophylaxis in different population of subjects including clinicians, patients and nurses [6-9]. Results show a varying level of awareness and knowledge depending on the population under study, while it may be good among clinicians, there is still lack of adequate knowledge among patient population. Furthermore, in surveys seeking the level of knowledge and practice pattern of thromboprophylaxis among physicians, there still exist conflicting reports with knowledge gap [6, 8].

There is dearth of data on the awareness of VTEs amongst the general population. A survey by Wendelboe et al, to evaluate the global public awareness of VTE showed that on a global level, public awareness about thrombosis overall, and VTE in particular, is low, with suggestions that campaigns to increase public awareness about VTE were needed to reduce the burden from this largely preventable thrombotic disorder [10].

The gap in knowledge on VTE, and the need to bridge this gap led to several calls to raise public awareness about VTE [11, 12]. The International Society on Thrombosis and Haemostasis (ISTH) in 2014 heeded to these calls, and declared 13 October as World Thrombosis Day. This day is set aside specifically to propagate the knowledge of VTE, with several countries all over the world including Nigeria celebrating this day annually.

In order to assess the degree of awareness about VTE, the extent of recognition of the symptoms and signs of deep vein thrombosis (DVT) and pulmonary embolism

https://doi.org/10.15167/2421-4248/jpmh2021.62.3.2159

(PE), and knowledge about the key risk factors for VTE amongst the general population, this survey was designed. The ultimate goal of this survey is to use the information gathered to inform future World Thrombosis Day campaigns to enhance awareness about VTE among the general public, thereby contributing to the reduction of morbidity and mortality associated with VTE.

Methods

This was a population-based study was carried out in the state capital cities of Enugu (Enugu) and Ebonyi (Abakaliki) states. Both states are part of the six geopolitical zones in south-east Nigeria with Igbo as the major ethnic group.

Using modified, pretested and pre-validated Ipsos-Reid questionnaire, a survey was conducted between October 2019 to March 2020 to assess the awareness of VTE, which includes DVT and PE compared to other thrombotic and non-thrombotic disorders such as heart attack, stroke, diabetes and malaria among the general public. Close ended questions were asked about awareness of risk factors for VTE as well as the symptoms and signs of DVT and PE. Both correct and incorrect options were offered in the response options offered.

The demographic data including age, gender, state of origin etc were collected. The survey required about 5 to 10 minutes to complete and where needed, interpreters (who are also members of the research team) were used to assist participants in their local dialects. Statistical analysis: Data was analysed using statistical package for social sciences (SPSS) version 22. Data was presented in prose and Tables.

Tab. I. Socio-demographic features of respondents.

Variables	Frequency (n = 284)	Per cent
Sex		
Male	155	54.6
Female	129	45.4
Age group (years)		
15-24	70	24.6
25-34	105	37.0
35-44	76	26.8
45-54	23	8.1
≥ 55	10	3.5
Mean age = 32.73 ± 10.33 years		
Education level		
Primary	4	1.4
Secondary	79	27.8
Tertiary	138	48.6
Postgraduate	63	22.2
Occupation		
Business/trading	34	12.0
Student	83	29.2
Lecturer/teacher	45	15.8
Professional/ health worker	11	3.9
Public servant	15	5.3
Civil servant	75	26.4
Artisan/self employed	15	5.3
Unemployed	6	2.1
State of origin		
Ebonyi	113	39.8
Enugu	93	32.6
Imo	28	9.9
Anambra	20	7.0
Abia	11	3.9
Others	19	6.7

Results

Demographic data

The total participants in the survey were numbered 284, which constituted 155 (54.6%) males and 129 (45.4%) females. The mean age of participants was 32.73 ± 10.33 years, and the most represented age category was the 25-34 years old. Most (138, 48.6%) of the participants had obtained a tertiary level education and involved in occupations including civil service, lecturing, and business/trading, accounting for 26.4%, 15.8% and 12.0% respectively. The survey participants were residents of Enugu and Abakaliki in Enugu and Ebonyi states respectively, who originates from the 5 states in South-eastern Nigeria (Tab. I).

Awareness of and concerns over VTE as a medical condition

The survey reveals a relatively low awareness of DVT (33.8%) and thrombosis (41.5%). The awareness of other conditions was high, they include heart attack 96.1%, stroke (97.2%), diabetes mellitus (98.2%), HIV/AIDS (98.6%), cancer (97.2%) and malaria (98.2%). Haemo-distension syndrome which is not a true medical condition had the lowest level of awareness (25.4%). It was introduced in other to check over-agreement. This typically reveals how low the awareness of VTE could be. In response to the level of concerns of among the participants toward listed medical conditions, the survey finds that 36.4% and 38.6% were extremely concerned over thrombosis and DVT respectively, while extreme concerns for other medical conditions ranged from 59.7% to 66.9%. Extreme concerns were highest for HIV/AIDS (Tab. II).

Recognition of symptoms and signs of VTE.

About half (128, 50.2%) of our respondents were not sure of the cause of DVT and108 (42.4%) correctly said it was due to blood clot in the vein. Other causes listed include lack of oxygen in the vein (7, 2.7%) and a tumour in the vein (7, 2.7%). Five (2.0%) of the respondents said the cause was not listed. When asked the knowledge of what DVT would feel, 240 (84.5%) answered no while 44 (15.5%) said yes. When asked about symptoms of blood clot, leg sweeling (131, 67.2%) was the highest in

Tab. II. Concerns about risk of medical conditions

Medical conditions	Responses				
	Extremely not concerned (1)	Not concerned (2)	Rarely concerned (3)	Concerned (4)	Extremely concerned (5)
Heart attack	35 (13.4)	21 (8.0)	24 (9.2)	20 (7.6)	162 (61.8)
Thrombosis	68 (30.9)	23 (10.5)	18 (8.2)	31 (14.1)	80 (36.4)
Stroke	34 (13.0)	17 (6.5)	25 (9.6)	25 (9.6)	160 (61.3)
Diabetes	30 (12.1)	18 (7.3)	23 (9.3)	29 (11.7)	148 (59.7)
Deep vein thrombosis	72 (32.7)	29 (13.2)	17 (7.7)	17 (7.7)	85 (38.6)
HIV/AIDs	42 (16.0)	17 (6.5)	13 (4.9)	15 (5.7)	176 (66.9)
Cancer	25 (9.7)	19 (7.4)	21 (8.2)	22 (8.6)	170 (66.1)
Malaria	28 (10.6)	18 (6.8)	22 (8.3)	29 (11.0)	167 (63.3)

frequency, followed by pain or tenderness in the leg (79, 40.5%) and colour change (64, 32.8%). Others are leg paralysis (58, 29.7%), differential warmth (45, 23.1%) and leg itching (44, 22.6%).

Awareness of the symptoms of blood clot was relatively low, ranging from 22.6% to 40.5%, except for 67.2% who were aware of Leg Swelling as a symptom of blood clot. The awareness of the clinical features of PE ranged from 21.8 % to 56.3%, where Shortness of breath and chest pain were the most common symptoms identified by the participants, constituting 56.3% and 51.0% respectively; followed by coughing out blood (40.8%) light headedness or passing out (24.3%), and rapid heart rate (30.6%). Only 13.7% knew what PE would feel like. Again, some wrong options like slow shallow breath (66%), pain radiating down to the arm (22.3%), and frequent headache (21.8%") were selected by our study respondents as features of PE which were actually included to check over-agreement. This study finds that awareness of the symptoms of VTE is relatively poor among the participants.

Tab. III. Awareness of risk factors of blood clot.

Variable	Frequency	Per cent
Risk factors (multiple response, n = 957)		
Hospital stay	48	19.0
Surgery	94	37.2
Cancer	80	31.6
Immobility	118	46.6
Pregnancy or just giving birth	80	31.6
Use of oral contraception pills or hormone replacement therapy	65	25.7
A family history of clot	86	34.0
Older age (65years plus)	75	29.6
Too much exercise	32	12.6
High blood cholesterol	99	39.1
Donating blood	34	13.4
High blood pressure	69	27.3
Other factors	5	2.0
None	3	1.2
Not sure of any	69	27.3

Risk factors for VTE

Participants showed low awareness of the risk factors of VTE which include hospital stay, surgery, cancer, immobility, pregnancy, use of contraception, family history and old age constituted 19.0%, 37.2%, 31.6%, 46.6%,31.6%, 25.7%, 34.0% and 29.6% respectively. Some of the participants picked wrong options like too much exercise (12.6%), high blood cholesterol (39.1%) and donating blood (13.4%) as risk factors of VTE (Tab. III).

Assertions to blood clot awareness

Assertions were made to certain statements about blood clot, where 48.9% Strongly disagree that people under 40 years do not have to worry about blood clot; 43.8% Strongly disagree that Most blood clots cannot be prevented; 35.2% Strongly disagree that it is not likely that an untreated blood clot can travel to the lungs; 53.1% strongly disagree that having a blood clot is not considered a medical emergency while 70.8% strongly agree that Blood clot can cause death.

Fishers' Exact test and logistic regression finds no statistical significance in the association between VTE and sex nor with age at 95% confidence interval and 0.05 alpha level. However, females were more aware of VTE: thrombosis (45.0%) and DVT (39.5%) than males, with 38.7% for thrombosis and 29.2% for DVT (Tab. IV).

Discussion

This study was designed to evaluate the extent of the public knowledge and perception of the risks, symptoms, and complications of venous thromboembolism. The findings were then compared to their knowledge of other diseases of public health importance such as Malaria, Myocardial infarction, Diabetes, HIV/AIDS etc.

The study showed a generally low levels of awareness of VTE as a medical condition as majority of the respondents were not able to identify VTE as such. The awareness of the causes and risk factors of VTE among the general population was also found to be low likewise the knowledge about the clinical features of the condition. Significantly and to further buttressed

Tab. IV. Influence of sex and age on awareness of medical conditions.

Medical conditions	Sex				Age group			
	Male	Female	P-value	OR (95%CI)	≤ 35 years	> 35 years	P-value	OR (95%CI)
Heart attack	150 (96.8)	123 (95.3)	0.554	1.2 (0.63, 2.33)	178 (95.7)	95 (96.9)	0.753	1.3 (0.48, 3.40)
Thrombosis	60 (38.7)	58 (45.0)	0.287	0.9 (0.71, 1.11)	80 (43.0)	38 (38.8)	0.491	0.9 (0.64, 1.24)
Stroke	152 (98.1)	124 (96.1)	0.475	1.5 (0.60, 3.62)	180 (96.8)	96 (98.0)	0.719	1.4 (0.41, 4.67)
Diabetes	154 (99.4)	125 (96.9)	0.180	2.8 (0.48, 15.98)	182 (97.8)	97 (99.0)	0.662	1.7 (0.30, 10.11)
Deep vein thrombosis	45 (29.2)	51 (39.5)	0.068	0.8 (0.63, 1.03)	58 (31.2)	38 (39.2)	0.178	1.3 (0.91, 1.74)
HIV/AIDs	152 (98.1)	128 (99.2)	0.629	0.7 (0.41, 1.29)	183 (98.4)	97 (99.0)	1.000	1.4 (0.25, 7.62)
Cancer	152 (98.1)	124 (96.1)	0.475	1.5 (0.60, 3.62)	179 (96.2)	97 (99.0)	0.270	2.8 (0.45, 17.71)
Malaria	153 (98.7)	126 (97.7)	0.662	1.3 (0.47, 4.03)	183 (98.4)	96 (98.0)	1.000	0.9 (0.29, 2.55)
Haemo-distension syndrome	41 (26.5)	31 (24.0)	0.682	1.1 (0.84, 1.34)	44 (23.7)	28 (28.6)	0.391	1.2 (0.83, 1.67)

Sex = female; Age ≥ 35 years.

this finding, more than half of the participants showed little or no interest concerning the risk factors of VTE, while majority of the participants admitted to having little or no idea of the likely symptoms of VTE. However, they had impressive knowledge of other medical conditions of public health importance such as myocardial Infarction, malignancy, malaria, cerebrovascular accidents, and HIV/AIDS.

The above findings are in keeping with those noted in similar studies done elsewhere like the Mcfarland et al. ExPeKT (Exploring prevention and knowledge of venous thromboembolism: a two stage, mixed method study protocol study of 2013 [13] and the findings of Boulton et al. from a street survey done in Birmingham United Kingdom [14]. However, ours is one of first studies evaluating awareness of VTE in the general population in a developing country.

The study findings showed that for the participants that had prior knowledge of the symptoms of venous thrombosis, leg swelling, pain or tenderness on leg and noticeable skin changes were the most frequently identified while slow shallow breath, shortness of breath and chest pain were the most frequently identified symptoms or pulmonary embolism. In addition, amongst this group the most implicated risk factors for VTE were in descending order, extended periods of immobility, increased levels of serum cholesterol, surgery, family history of VTE, malignancies and pregnancy/puerperium. Other mentioned risk factors were high blood pressure, old age and use of oral contraceptives.

Interestingly some members of this group, did not have any idea/were not sure of any risk factors of VTE, while others cited too much exercise and blood donation as risk factors of VTE.

The impact of socio-demographic factors on awareness of the risk factors of VTE was also noted in the study. It showed females and Individuals below 35 years were more likely to be better informed more than males about the symptoms and risk factors of VTE. Probable reasons for this are that a significant percentage of women already associate VTE with the use of oral contraceptives, also generally, women tend to show more interest in diseases especially if they are of public health importance.

Strength and limitations

There might have been overestimation of the true awareness since we included a number of closed-ended questions to evaluate the population-based knowledge which could have affected it, however, we included a number of incorrect options to help check over agreement and at the same time include questions that may check their knowledge if they were to have the condition. Again, this study was not internet based unlike a previous similar study [10] which could have limited participation by those who do not have access to internet. We carried out the study in among individuals we met at public gatherings like markets, academic meetings, churches, etc. However, we might have missed the elderly ones who may not be able to come out due to ill health and whom may have experienced the condition, being in the age group at increased risk of VTE.

Conclusions

The awareness of VTE in the general population is low. Participants were more concerned about other medical conditions when compared to VTE. A good number of them had no knowledge of the risk factors and clinical features of VTE. The creation of awareness programs should be a public health priority to reduce morbidity and mortality associated with VTE.

What is known?

The awareness of VTE among different populations has been determined including among health workers and hospitalize patients. VTE awareness has also been determined among the general population in the developed world but not in south-eastern Nigeria.

What is new?

This study provides the data on the level and determinants of awareness of VTE among the general population in a developing country.

Acknowledgements

Funding sources: this research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Conflict of interest statement

The authors declare no conflict of interest.

Authors' contributions

The concept and design of the study were done by Dr Helen Okoye and Dr Nwagha while the all authors contributed in the literature review collection of data, and preparation and editing of the manuscript for publication.

References

[1] Beckman M, Hooper W, Critchley S, Ortel T Venous thromboembolism: a public health concern. Am J Prev Med 2010;38:495-501. https://doi.org/10.1016/j.amepre.2099.12.017

[2] Anderson F Jr, Spencer F. Risk factors for venous thromboembolism. Circulation 2003;107:9-16. https://doi.org/10.1161/01.CIR.0000078469.07362.E6

[3] Kucher N. Clinical practice. Deep-vein thrombosis of the upper extremities. N Engl J Med 2011;364:861-9. https://doi.org/10.1056/NEJMcp1008740

[4] ISTH Steering Committee for World Thrombosis Day. Thrombosis: a major contributor to the global disease burden. J Thromb Haemost 2014;12:1580-90. https://doi.org/10.1111/jth.12698

[5] Alikhan R, Peters F, Wilmott R, Cohen AT. Fatal pulmonary embolism in hospitalized patients: a necropsy review. J Clin Pathol 2004;57:1254-7. https://doi.org/10.1136/jcp.2003.013581

[6] Omunakwe HE, Ekeke ON, Korubo KI. Clinicians' awareness on thromboprophylaxis in cancer-associated thrombosis. Afr J Med Health Sci 2015;14:135-9. https://doi.org/10.4103/2384-5589.170187

[7] Almodaimegh H, Alfehaid L, Alsuhebany N , Bustami R, Alharbi S, Alkatheri1 A, Albekairy A. Awareness of venous thromboembolism and thromboprophylaxis among hospitalized patients: a cross-sectional study. Thrombosis Journal 2017;15:19. https://doi.org/10.1186/s12959-017-0144-2

[8] Nwogoh B, Okoye HC, Korubo KI, Madu AJ. Perception and practice of thromboprophylaxis in patients with haematological malignancies among hemato-oncology practitioners in Nigeria. Ann Trop Pathol 2018;9:32-6. https://doi.org/10.4103/atp.atp_15_18

[9] Al-Mugheed K, Bayraktar N. Knowledge and practices of nurses on deep vein thrombosis risks and prophylaxis: A descriptive cross sectional study. J Vasc Nurs 2018;36:71-80. https://doi.org/10.1016/j.jvn.2018.02.001

[10] Wendelboe AM, McCumber M, Hylek EM, Buller H, Weitz, JI, Raskob G, ISTH Steering Committee for World Thrombosis Day. Global public awareness of venous thromboembolism. J Thromb Haemost 2015;13:1365-71. https://doi.org/10.111/jth.13031

[11] Bikdeli B. When the game demons take real lives: a call for global awareness raising for venous thromboembolism. Thromb Res 2012;129:207. https://doi.org/10.1016/j.thromes.2011.09.034

[12] Ghaji N, Boulet SL, Tepper N, Hooper WC. Trends in venous thromboembolism among pregnancy-related hospitalizations, United States, 1994-2009. Am J Obstet Gynecol 2013;209:e1-8. https://doi.org/10.1016/j.ajog.2013.06.039

[13] McFarland L, Ward A, Greenfield S, Murray E, Heneghan C, Harrison S, Fitzmaurice D. ExPeKT-Exploring prevention and knowledge of venous thromboembolism: a two-stage mixed-method study protocol. BMJ Open 2013;3:1-7. https://doi.org/10.1136/bmjopen-2013-002766

[14] Boulton A, Fenton M, Loka T, Sharif Z, Greenfield S.Public knowledge of deep vein thrombosis: a street survey in the suburbs of Birmingham UK. Qual Prim Care 2015;23:31-9.

Received on May 15, 2021. Accepted on June 20, 2021.

Correspondence: Dr Theresa Nwagha, Department of Haematology University of Nigeria Teaching Hospital Ituku Ozalla Enugu - E-mail: theresa.nwagha@unn.edu.ng

How to cite this article: Okoye H, Nwagha T, Ezigbo E, Nnachi O, Obodo O, Nnachi O, Amu N, Anigbogu I. Low awareness of venous thromboembolism among the general population: a call for increased public enlightenment programs. J Prev Med Hyg 2021;62:E704-E708. https://doi.org/10.15167/2421-4248/jpmh2021.62.3.2159

Research paper

Deindustrialisation, demographic decline, aging, economic crisis and social involution in a metropolitan area analysed by applying Socio-Economic and Health Deprivation Indices

MARINA VERCELLI[1], ROBERTO LILLINI[2]
[1] Department of Health Sciences (DISSAL), University of Genoa, Genoa, Italy;
[2] Analytical Epidemiology & Health Impact Unit, Fondazione IRCCS "Istituto Nazionale Tumori", Milan, Italy

Keywords

Metropolitan area • Deindustrialization • Socio-economic crisis • Aging • Deprivation • Deprivation indices

Summary

Aims. *Genoa is a city hit by a strong economic, demographic and social involution. The changes in the demographic and socio-economic (SE) situation were analysed and the capacity of two Socio-Economic and Health Deprivation Indices (SEHDI) in describing the evolutions of the recent period were verified.*
Material and methods. *The data about the evolution of demographic and SE situation in Genoa came from publications of Statistics Offices of Genoa Municipality and Liguria Region and from published analyses of Bank of Italy. The two SEHDIs, referring to 2001 and 2011 population, were computed at census tract level by linear regression, factor and clusters analyses and had been already validated and published.*
Results. *Wide transformations in aging and population composition by age groups and gender occurred in Genoa between 1951 and 2016. Internal (from other Italian regions) and external (from other countries) migrations concurred to change the profile of Genoese population. These changes followed the industrial history of city and its deindustrialization occurred since 2001. A progressive SE involution, worsened by the Italian and international crises, carried out the recent impoverishment of the city. Between 2001 and 2011 the population at medium-high deprivation increased and the SEHDIs 2001 and 2011 contributed to describe the population distribution by deprivation groups, either geographically, and by groups of citizenships (Italians and Foreigners). The first identified in 2001 some aspects of a well-off society regarding education, labour market and characteristics of the family and housing structure. The second depicted in 2011 an impoverished society in aging, lack of family support and of property of the main house, diminishing of educational level.*
Discussion. *Genoa city demonstrated an its own specific decline. Starting from the deindustrialization, a worsening of welfare, independently from the national and international economic troubles, was evident. The aging and the changed equilibria among age groups testified the growing difficulties of society in keeping up with the deep social and economic changes. The results demonstrated that specific deprivation indices aid to better define the populations under analysis, because they identify the subpopulations that could have the maximum benefit from investments of resources targeted to the correction of inequalities.*

Introduction

The city of Genoa is an emblematic example of a metropolitan area hit by a wide deindustrialisation and a deep socio-economic (SE) involution, accompanied by demographic crisis and extreme aging.
In this paper the changes in demographic and SE situation were displayed and the capacity of two socio-economic status (SES) indices in describing the evolutions of the recent period were analysed.
This description was preparatory to a next article describing the effects of this decadence on the health of residents and on their different capacity to care the disease diversified by SES.
This analysis was conducted in the belief that the Genoese experience could represent both a warning and an incentive not to delay the adoption of policies aimed at tackling inequalities.

Materials and methods

The data about the historical evolution of demographic and SE situation in Genoa came from publications of the Statistics Offices of Genoa Municipality and Liguria Region and from analyses of the Bank of Italy [1-3].
About the Socio-Economic and Health Deprivation Indices (SEHDI) 2001 and 2011, their composing variables came from the 2001 and 2011 censuses [4, 5]. They were built at Census Tract (CT) level by performing the following steps [6-9]: 1) selection of composing variables by Pearson's Correlation between the demographic and SE variables 2001 and 2011 and the mortality 2000-2003 and 2009-2013 respectively (statistical significance at $p < 0.05$); 2) exclusion of the collinear variables by tolerance check ($p < 0.001$); 3) factor analysis (Principal Component Analysis or PCA; conditions: eigenvalues > 1, varimax orthogonal rotation) in order to extract the independent factors which composed the final indices; 4) linear combination

of the extracted factors, standardising the resulting quantitative index on a percentage scale.
The CTs were classified in five normalised groups at growing deprivation, applying a cluster discriminant analysis [10], which allowed to aggregate cases maintaining one or more clustering variables with a quite normal distribution through the generated clusters (normalisation level tested at $p < 0.05$). This classification choice was made to respect the normal distribution of deprivation phenomena in the population [11, 12]. All the analyses were performed by statistical software SPSS 19.0 and Stata 13.0. The indices were already validated and published [6-9].

Results

Demographic and socio-economic trends after the 2nd World War [1]

To understand the involution of the city, we briefly analysed the demographic and SE trends after the 2nd World War. From 1951 to 1965, year of the historical maximum of 848,121 inhabitants, the resident population of Genoa increased (+23.2%). The baby boom, occurred in the 1961-65 period, contributed to the positivity of the natural balance, even if the real boom was due to internal migration, especially from the Southern regions, which flowed to the cities of the "industrial triangle" (Turin, Milan, Genoa) (Fig. 1). All this accounted for 95% of the overall population growth. Since 1966, after twenty years of continuous increase, an uninterrupted phase of decrease began. In the 1971-81 period, the natural and migratory balances were constantly negative and the population decreased (-6.6%). In the 80s and 90s, the industrial and port crisis (80s) worsened and the long transition/transformation of Genoa (90s) developed.
The watershed between the two periods was the end of the state industry (IRI, Istituto per la Ricostruzione Industriale - closed in the summer of 2000), which concluded a phase of more than 70 years of industrial, social and political life in Genoa.
The employment figures faithfully recorded the breadth and depth of mutation. Between 1981 and 2001 the workers reduced by 40,000 units (-15.7%). The downsizing concerned only the male employment, while the female one grew by almost 10,000 units (+11.9%, from 16.7% in 1951 to 28.6% in 2001). The drop in employment concerned the industry, which lost more than 30,000 units (-15.2%, from 38.1% in 1971 to 22.9% in 2001).
Between 1965 and 2006, over 230,000 Genoese people "disappeared": the negative natural balance accounted for 61.4%, the "residence transfers" for the remaining 38.6% [2].
When in 2008 the Italian economic and financial crisis arose, in a first phase the Genoese economy was less harshly hit than other areas, as testified by the Figure 2. The trends were upward in all Italian areas up to 2008. Therefore, following the economic crisis, the slope in 2009 changed, with small fluctuations at the national and North-Western regional levels, and wider oscillations in Liguria until 2014, while in Genoa province the descent continued in a steeper way. This happened, despite that some structural factors tended to reduce the sensitivity of Genoa to the economic cycle, such as the very relevant transformation from industry to tertiary sector, the lesser opening to international trade, the large share of family income deriving from pensions and public salaries [3].
With the prolongation of difficulties and their extension from the financial to the real economy, in the city even the local productive factories were greatly affected. This led to contractions in consumption, investments and employment, to a reduction in disposable income

Fig. 1. Natural and migratory balance (in percent) in the period 1951-2015.

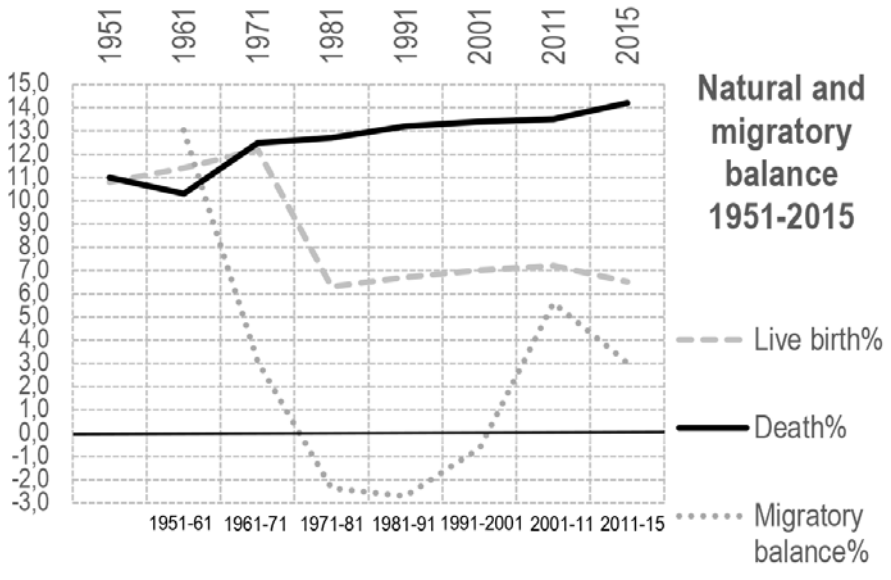
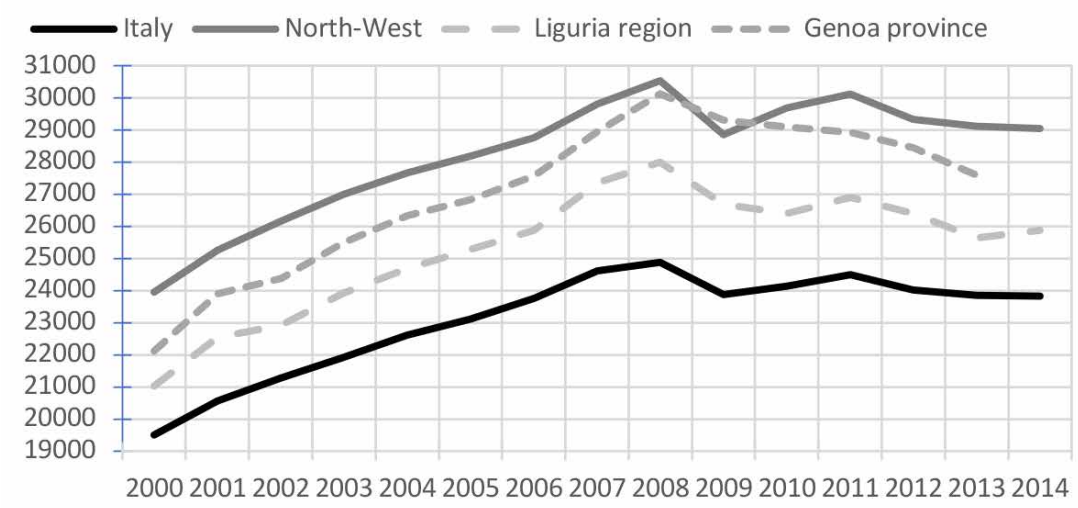


Fig. 2. Gross value added (in €, at basic prices for inhabitant) in Italy, North-West regions, Liguria region and Genoa province in the period 2000-2014.



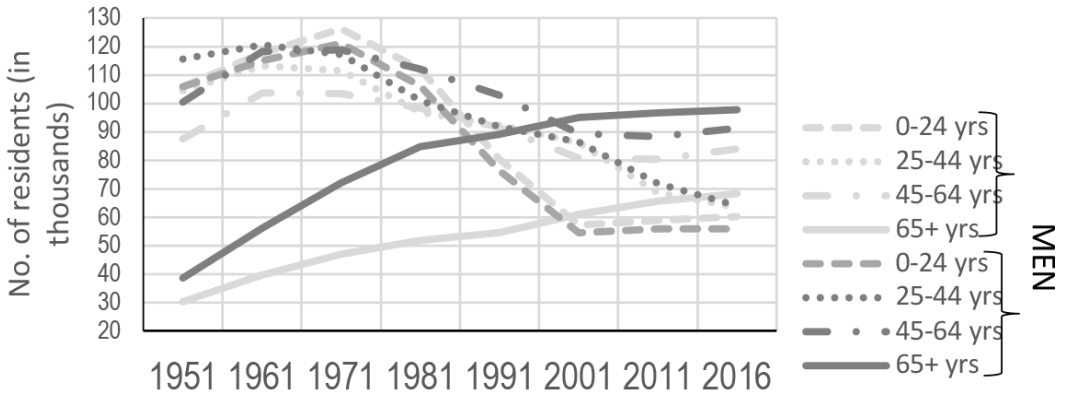
for households, to a fall in bank credit and a substantial increase in impaired loans that continue until now [3].
Another aspect which could be particularly relevant for the Genoese case is the collapse in the price of real estate. As an example, over the last 10 years the real estate prices of Genoa have decreased by -52.6%, with a worse trend than the national average which stands at -30.8%. To penalize the capital was above all the quality of the houses as well as the above cited economic and structural issues and the natural events that affected the town in recent years.

The demographic changes in the 1951-2016 period [1, 2].

The events described above was accompanied by a deep demographic change, as described in Figure 3 which shows the residents by age groups and gender from 1951 to 2016.

Four age groups were chosen in order to describe the demographic trends of Genoese population: 0-24 years (the young), 25-44 years (the young adults), 45-64 years (the middle age adults) and ≥ 65 years (the elderly) (in the description that follows the values are in thousands).
The two younger age classes predominated in the period 1951-71 in both sexes.
The young started from 106 in both sexes in 1951, rose to 126 in men and 121 in women in 1971, decreased to 54-57 in 2001 and grew to 56-60 in 2016. The young adults started from 115 in women and 105 in men in 1951, gone up to 121 and 113 in 1961, then fell to 63-64 in 2016.
The middle-aged women from 100 of 1951 grew to 119 in 1971, decreased to 88 in 2011, rose to 91 in 2016.
The middle-aged men from 88 of 1951, rose to 103 in 1961-71 period, descended to 80 in 2011, grew to 84 in 2016.
The elderly, starting from 39 in women and 30 in men

Fig. 3. Residents in Genoa by age groups and gender between 1951 and 2016.



in 1951, grew continuously until 2016, reaching 98 in women and 68 in men.

The arrival and integration of foreign migrants [1, 2]

A third aspect must be taken into consideration: the arrival of foreign migrants. From the early 70s, the port of Genoa became the first for the arrival of thousands of foreigners, even though it was often just a point of passage for other destinations. The phenomenon of foreign immigration, starting from the second half of the 80s, rarely caused problems of intolerance [13], even if established in the most difficult years of the industrial and port crisis. The main relevant intolerance action against immigrant was to the constitution of many "neighbourhood watch" groups (the so-called "ronde"). And this was the very first case in Italy. After that, in several Italian cities similar movements raised.

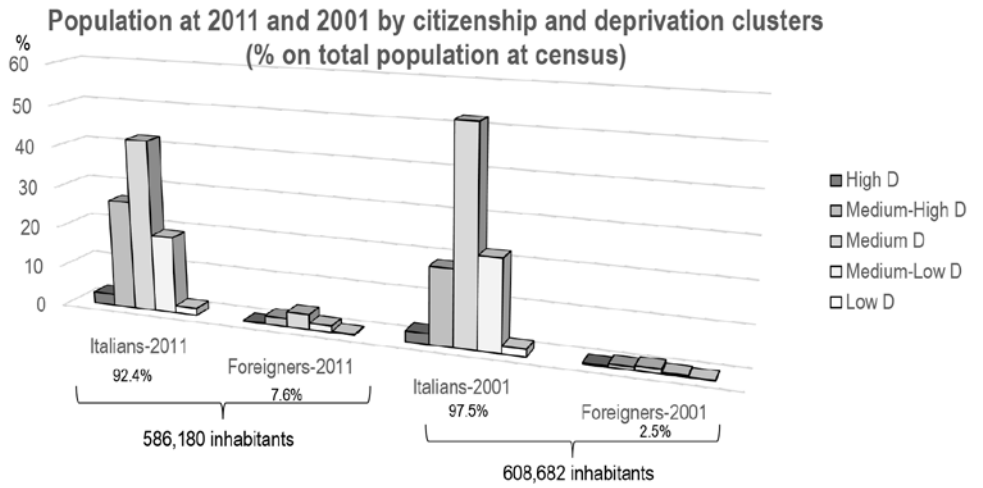
The waves of migration followed, one after another, from different countries of origin. Since the early 1990s, a sharp increase in arrivals was observed, especially from Latin America (Ecuador in particular) and a strong female presence established. This accentuated female prevalence was linked to the growing demand for home and personal services, effect of the extraordinary aging of the native population [14, 15].

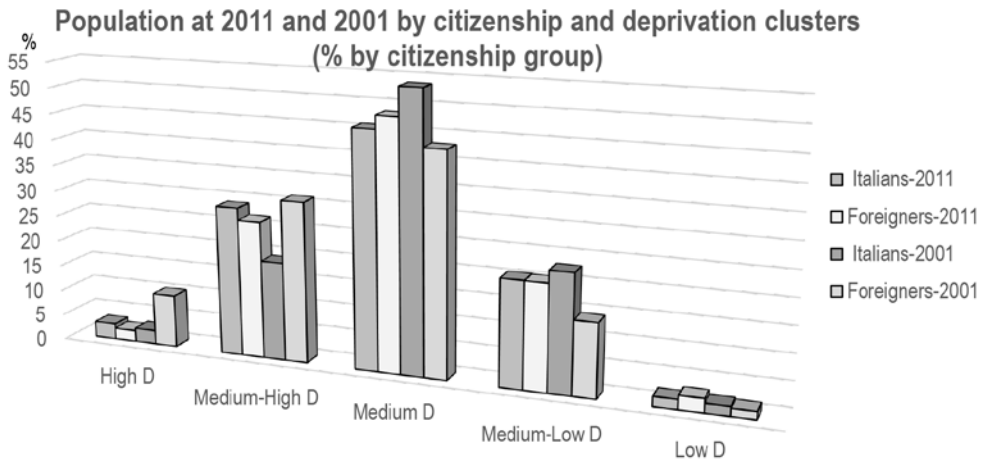
After taking up residence, a small part of migrants integrated into the population, as illustrated in Figure 4, which shows residents in 2001 and 2011 by citizenship and deprivation groups.

The first graph highlights the numbers of Italian and foreigners in population as derived by the 2001 and 2011 censuses; the figure below illustrates the distributions of the two group by deprivation.

The decrease of Italian citizens and the growth of the foreigners are evident. Among Italians the shift towards poverty was broad (the medium and medium-low deprivation groups decreased, the medium-high deprivation groups increased). Instead, in the foreigners there was a shift towards medium-deprived classes, due to their integration in the Genoese society.

Fig. 4. Distribution of Genoa's population at 2001 and 2011 census by citizenship and SEHDI's deprivation clusters.





The SEHDI 2001 and SEHDI 2011 composition

In Table I the composition of the SEHDI 2001 and SEHDI 2011 factors and the percentages of variance explained by each factor is described.

The chosen variables for the indices pertained to the same four domains: education, labour market, family structure, characteristic of the house [6-9].

The total explained variance by the two indices is analogous (72 *vs* 72.2%), but the composing variables presented a deep variation, sharing only two items between them (the percentage of married, the percent of 2-members families).

The differences between the indices were relevant. The first identified aspects of a well-off society regarding education, labour market and family and housing structure.

The second depicted an impoverished society. The factors were composed by variables which stressed the ageing, loneliness and dependence of elderly (factor 1), the need of family assistance (factor 3), the poverty of the youngest and even of foreigners also in the field of education (factors 2 and 4).

The distribution of the population by SEHDI clusters 2001 and 2011

The distributions of population at censuses 2001 (609,682 inhabitants) and 2011 (586,180 inhabitants) are illustrated by deprivation groups in Table II.

The changes between periods were wide. The clusters at medium and medium-low deprivation diminished (-7.4 and -2.1%), the cluster at medium-high deprivation notably increased (+8.3%), while those in high deprivation and the ones in low deprivation increased only imperceptibly (+0.1 and +0.2%).

As regards age and gender distribution, the total amounts of children (0-14 years) has been similar between periods, while differs by gender (males from 12 to 13%, females from 9 to 10%).

The two clusters at higher deprivation and the two richer ones increased in both sexes (around +2-3%); the group at medium deprivation negligibly decreased (males -6%, females -5%).

The young (15-34 years) diminished (males from 23 to 19%, females from 20 to 16%). The ones at higher deprivation stayed quite stable (from 5 to 6%), those at medium deprivation decreased (from 11-12 to 8-9%) and even the richer diminished (from 5 to 3-4%).

The adults (35-64 years) stayed quite stable (42-44%), but the distribution by deprivation changed.

The share of deprived increased (from 9-10 to 13-14%), with a higher rise for those at medium-high deprivation; the individuals at medium deprivation decreased (from 22-23 to 19-21%); the richest stayed quite stable (10-11%).

For the older groups analogous changes in distributions by group were evidenced.

The younger elderly (65-74 years) represented 12.5% of men and 14% of women. A rise in the more deprived (from 2-3 to 4-5%), a decrease of people at medium deprivation (from 7-8 to 6%) and a diminishing of the richest (from 3-4 to 2.5%) were observed.

The older elderly (75+ years) increased (men from 9 to 11.5%, women from 15 to 17.5%). A rise of people at higher deprivation was evident in women (men from 1.5 to 4%, women from 3 to 6%), the group at medium deprivation stayed stable (men 5, women 8%) and a fair decrease of the richest was recorded (men from 2.5 to 2%, women from 4 to 3%).

Family structure and educational level distribution by deprivation at the 2001 and 2011 censuses [4, 5].

To reinforce the meaning of changes between SEHDI 2001 and SEHDI 2011, in Table III, the percentages of single-parents families, unmarried, divorced and separated as regards the family structure, the graduates (adding the higher university degrees) and the individuals who have achieved only the lower license or no license as regards the educational level, were distributed by deprivation group.

The amount of single-parent families was present only for 2011 census, because the variable was not freely available for 2001 census. Their amounting in 2011 was 10.5 as average, but the trend is increasing with deprivation and the percent of the most deprived was 4.6 times higher than for the richest one.

Tab. I. Factors of the SEHDI 2001 (total explained variance 72%) and SEHDI 2011 (total explained variance 72,2%). Percent of total explained variance and variables composing each factor.

2001	Factor 1 = 26,8%	Factor 2 = 15,2%	Factor 3 = 15,0%	Factor 4 = 15,0%
	% entrepreneurs and professionals % high school diploma and university degree	% married	% 2-members families	% of house with very small kitchen or kitchenette
2011	Factor 1 = 21,2%	Factor 2 = 21,2%	Factor 3 = 16,0%	Factor 4 = 13,8%
	Index of structural dependence Old age index % widowers/windows	% single-parent families % single-parent families with children < 15 years	% married % 2-members families	% rented homes % lower secondary school

Tab. II. Population distribution by SEHDI 2001 and SEHDI 2011: number and percent of resident in 2001 (applying SEHDI 2001) and in 2011 (applying SEHDI 2011) by deprivation groups.

Year	High deprivation		Medium-high deprivation		Medium deprivation		Medium-low deprivation		Low deprivation	
2001	17.503	2.9%	118.237	19.4%	325.250	53.3%	137.967	22.6%	11.025	1.8%
2011	17.380	3.0%	168.228	28.7%	268.861	45.9%	120.169	20.5%	11.542	2.0%

Tab. III. Family structure and educational level by deprivation group at the 2001 and 2011 censuses.

Deprivation groups	Family structure					Educational level			
	% single-parent families	% unmarried		% divorced & separated		% graduates & other university degree		% up to the lower license	
	2011	2001	2011	2001	2011	2001	2011	2001	2011
High deprived	19.8	49.1	38.8	7.9	8.0	5.7	8.6	71.3	63.3
Medium-high deprived	12.3	39.0	37.1	5.2	6.6	5.8	10.2	67.2	56.7
Medium deprived	10.2	34.3	38.7	4.4	7.0	8.3	14.1	59.6	49.8
Medium-low deprived	8.8	33.4	41.2	4.2	7.0	18.8	18.8	43.6	43.1
Low deprived	4.3	29.3	46.7	4.0	6.6	30.8	20.1	33.2	39.5
All population	*10.5*	*36.0*	*39.4*	*4.8*	*6.9*	*10.4*	*14.3*	*58.1*	*50.0*
Trend	L↑	L↑	L↓	L↑	NS	L↓	L↓	L↑	L↑

The unmarried represented more than a third of population, but trends were linearly positive in 2001, linearly negative in 2011, testifying SES-determined different behaviours in population.
The divorced and separated presented low, but increasing, percentages between censuses. The percent became a little bit higher at decreasing deprivation, so the trend, previously positive, became not significant.
About education level, the two opposite were considered. The graduates or with other university degree represented the 10.4% of population in 2001, growing up to the 14.3% in 2011, but the little increasing regarded the groups at more deprivation and the wide decreasing those at low deprivation, -10.7%. The trends were linearly positive, but the ratio between the richest and the poorest decreased from 5.4 to 2.4.
The individuals up to the lower license or those with no license represented more than 50% of population. The trends were linearly negative in both periods, with a higher gap in 2001 and an improvement in all groups in 2011, except those at low deprivation, which worsened of 6.3%.

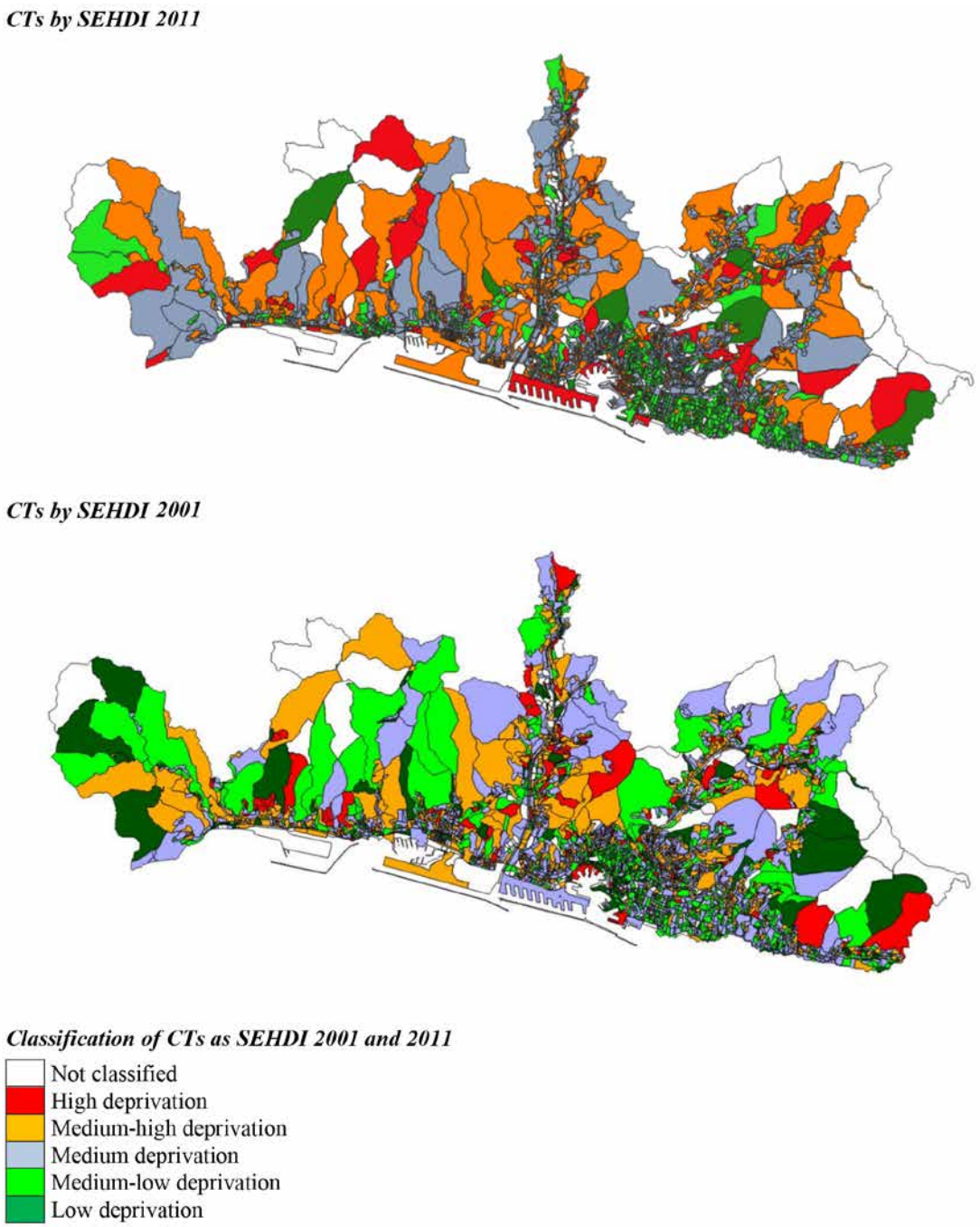
Maps of deprivation 2001 and 2011

In Figure 5 the changes in distribution of deprivation between the maps of 2001 and 2011 are displayed.
The differences between the maps are evident, seeing in 2011 the spreading of CTs at medium-high and high deprivation in some not expected parts of the city, as in the central parts and even in the eastern area of the city, previously richer than the rest of municipality.

Discussion

The temporal variations in the distribution by gender and age groups of population, described in Graph. 3, show the cross between the curves by age, which testifies the aging and the changed balance between age groups, making tangible the growing difficulties of society in keeping up with the deep social and economic changes. The curves of younger cross early with the one of elderly women. This testifies that the problem of aging emerged in Genoa sooner than in other Italian metropolitan areas [1, 2].
Moreover, the graph shows that the elderly in Genoa were mostly represented by women, who are at the same time "the strong sex", the one having more chances to survive [16], and "the weak link" of society, because often more subjected to disabling diseases [17] and to economic discriminations [18, 19]. At this purpose, the intersection between the curves of elderly and those of middle-age adults also becomes important, because it testifies the lack of support from the adults, which have decreased numerically over time. This aid is decisive when the aging growth, most of all in the case of illness. Furthermore, this lacking affects more the older women, due to their longer survival.
The "demographic fall" (Fig. 1) has given rise to a long-lasting debate on the "Genoese case", with the comparison of two theses. The first accentuates the "physiological" aspects of the population diminishing in large cities [20]. The second accentuates the more specific decline of Genoa city. Indeed, starting from the deindustrialization, this continued with a worsening of welfare independently from the national and international economic troubles (Fig. 2). This situation is still going on, even if, recently, the productive system attempted to re-start on a restructuring industrial path towards high-tech [3].
Figure 4 reinforces the problematic nature of the above results, displaying the decrease of Italian citizens and the modest, but evident, growth of the foreigners in the population. It underlines even that the shift towards poverty regards more the Italians, while the foreigners, starting from a poor situation in 2001, experienced an improvement, with a shift towards medium-deprived classes related to their increasing inclusion in the context. In this regard, it should also be considered that

Fig. 5. Distribution by deprivation groups in Genoa city by census sections classified on the basis of SEHDI 2001 and SEHDI 2011.



they often reside with those who are helping, who often live in the wealthiest areas.

The SEHDIs 2001 and 2011 (Tab. I) put in evidence the decline of welfare and health in Genoa city.

The difference between the two indices is relevant. The SEHDI 2001 pictured a city in economic growth, whose population, although it was decreasing and more aged than most of Italy, enjoyed a moderate widespread prosperity as regards education, labour market and characteristics of the family and housing structure. Instead, the SEHDI 2011 depicts aspects typical of an impoverished society, in aging, the lack of family support, the decreases of house property and of educational level. It describes a thinning of the population in average conditions and a shift towards poverty, which particularly affects women. In fact, Table II shows the decreasing population in the groups at medium deprivation and the increasing of those at medium-high deprivation.

As for the family structure, Table III shows the crisis of the traditional family. Between the two censuses the opposite tendencies of the share of unmarried, with the highest values in the poorest in 2001 and in the richest

in 2011, represent the increasingly widespread habit of living together outside of marriage, which reduces the costs of formation and dissolution of families. This, together with the greater diffusion of divorces and separations in all strata of society, testifies the spreading of unstable models of life, due mostly to the precarious prospects for work. Furthermore, this have favoured the increase of single-parent families, whose economic situation often become precarious and slip into poverty.
Likewise, the degree of education, which increases weakly in disadvantaged individuals in the first period, shows a significant weakening in the wealthiest in the second, bringing the population that has only the compulsory education qualification to almost 50%. This decrease is reinforced by aging, since the increase in the percentage of elderly people in the population also increases the number of individuals who in the past had been able to reach a lower level of education. Furthermore, the growing percentages of foreign immigrants, whose educational level is mostly very low, has contributing to a further lowering.
Finally, the differences between the maps, which are evident in Figure 5, testify that the loss of high-prestige appeal and residential tourist attraction is added to the other negative features previously highlighted, with a consequent decrease of the profitability of the real estate market. This consideration is confirmed by the specific aspects of the loss recorded by the real estate market in such areas in the last decade: for instance, the eastern part of the city (Quarto, Quinto and the well-known area of Nervi) remarked an average loss of value of 4.4%, although it is one of the most affluent part of the city in material terms, historically characterized by the highest values in real estates.

Conclusions

The results of this study reinforce the correlation between the impoverishment of population and the worsening of living conditions when they are related to the low level of education. The latter greatly influences the health aspects, since it determines the quality of life level, the level and the remuneration of one's own job, the lower availability of an own home and/or its location in disadvantaged areas, closer to polluting sources. Moreover, more often it is associated with unhealthier lifestyles (smoking habits, alcohol consumption, unbalanced diets) [21, 22] and determines how people deal with health in preventive aspects and in avoiding risky lifestyle habits [23, 24].
Furthermore, the strong aging, increasing the needs for social support and assistance [25, 26], is a difficult challenge for public welfare policies aimed at contrasting the contemporary effects of impoverishment and aging on the population.
The use of specific socio-health indices (such as SEHDI) is probably a useful tool for guiding local intervention policies. These results demonstrate that local deprivation indices should be used to specifically help the populations, as these allow identifying the subgroups that could benefit most from the investment of resources dedicated to correcting inequalities.

Ethical statement

No need of ethical approval was requested, because no personal sensitive information was used.

Acknowledgements

Funding sources: this research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Conflict of interest statement

The authors declare no conflict of interest.

Authors' contributions

Both authors equally contributed to define the theoretical framework and the methods, to perform the statistical analyses, to write the text and to the process of revision and editing. No funding was provided for this study.

References

[1] Arvati P, Ed. Novecento genovese. Genova attraverso i Censimenti 1951-2001. Genoa, Italy: Sistema Statistico Nazionale 2007. http://statistica.comune.genova.it/pubblicazioni/download/Novecento_genovese/novecentogenovese.pdf (Last access: 21st April 2021).

[2] Arvati P, Ed. Rapporto statistico Liguria. Analisi storica 1861-2011. Genoa, Italy: Sistema Statistico Nazionale 2007. https://www.istat.it/it/files/2011/11/analisi-storica-1861-2011.pdf (Last access: 21st April 2021).

[3] Banca d'Italia - Eurosistema. Economie regionali. L'economia della Liguria. No. 7 – June 2018. Rome, Italy: Banca d'Italia 2018. https://www.bancaditalia.it/pubblicazioni/economie-regionali/2018/2018-0007/1807-liguria.pdf (Last access: 21st April 2021).

[4] ISTAT. Population and households: XIV Italian National Census. Rome, Italy: ISTAT 2001. https://www.istat.it/it/censimenti-permanenti/censimenti-precedenti/popolazione-e-abitazioni/popolazione-2001 (Last access: 21st April 2021).

[5] ISTAT. Population and households: XV Italian National Census. Rome, Italy: ISTAT 2011. https://www.istat.it/it/censimenti-permanenti/censimenti-precedenti/popolazione-e-abitazioni/popolazione-2011 (Last access: 21st April 2021).

[6] Lillini R, Quaglia A, Vercelli M; Registro mortalità Regione Liguria. (Building of a local deprivation index to measure the health status in the Liguria Region). Epidemiol Prev 2012;36:180-7.

[7] Lillini R, Vercelli M. The local Socio-Economic Health Deprivation Index: methods and results. J Prev Med Hyg 2018;59:e3-10. https://doi.org/10.15167/2421-4248/jpmh2018.59.4s2.1170

[8] Tabachnick BG., Fidell LS. Using multivariate statistics. 4th ed. Boston, MA: Allyn and Bacon 2001.

[9] Agnelli JP, Cadeiras M, Tabak EG, Turner CV, Vanden-Eijnden E. Clustering and classification through normalizing flows in feature space. Multiscale Model Simul 2010;8:1784-802. https://doi.org/10.1137/100783522

[10] Neckerman K, Ed. Social inequality. New York, NY: Russell Sage Foundation 2004.

[11] Marmot MG, Smith GD. Socio-economic differentials in health. J Health Psychol 1997;2:283-96. https://doi.org/10.1177/135910539700200302

[12] Carstairs V. Deprivation indices: their interpretation and use in relation to health. J Epidemiol Community Health 1995;49(Suppl 2):S3-8. https://doi.org/10.1136/jech.49.suppl_2.s3

[13] Scarpa S. Immigration policy regimes, welfare states and urban inequality patterns: a comparison between Malmö and Genoa. European Urban and Regional Studies 2015;23:862-77. https://doi.org/10.1177/0969776415578199

[14] Palumbo M, Poli S. Aging in the contemporary urban context: the mortality rates of older residents in Genoa, Italy. City Networks 2017:157-75. https://doi.org/10.1007/978-3-319-65338-9_9

[15] Casanova G, Lamura G, Principi A. Valuing and integrating informal care as a core component of long-term care for older people: a comparison of recent developments in Italy and Spain. J Aging Soc Policy 2017;29:201-17. https://doi.org/10.1080/08959420.2016.1236640

[16] Conti S, Farchi G, Masocco M, Minelli G, Toccaceli V, Vichi M. Gender differentials in life expectancy in Italy. Eur J Epidemiol 2003;18:107-12. https://doi.org/10.1023/a:1023029618044

[17] von Strauss E, Agüero-Torres H, Kåreholt I, Winblad B, Fratiglioni L. Women are more disabled in basic activities of daily living than men only in very advanced ages: a study on disability, morbidity, and mortality from the Kungsholmen Project. J Clin Epidemiol 2003;56:669-77. https://doi.org/10.1016/s0895-4356(03)00089-1

[18] Betti E. Gender and precarious labor in a historical perspective: Italian women and precarious work between fordism and postfordism. Int Labor Work Class Hist 2016;89:64-83. https://doi.org/10.1017/S0147547915000356

[19] Busetta G, Fiorillo F, Palomba G. The impact of attractiveness on job opportunities in Italy: a gender field experiment. Economia Politica 2020;38:171-201. https://doi.org/10.1007/s40888-020-00194-5

[20] McKinsey Global Institute. Urban world: meeting the demographic challenge. McKinsey & Company 2016, pp. 1-48. https://www.mckinsey.com/featured-insights/urbanization/urban-world-meeting-the-demographic-challenge-in-cities# (Last access: 21st April 2021).

[21] Mattei G, De Vogli R, Ferrari S, Pingani L, Rigatelli M, Galeazzi GM. Impact of the economic crisis on health-related behaviors in Italy. Int J Soc Psychiatry 2017;63:649-56. https://doi.org/10.1177/0020764017726097

[22] Masters RK, Link BG, Phelan JC. Trends in education gradients of 'preventable' mortality: a test of fundamental cause theory. Soc Sci Med 2015;127:19-28. https://doi.org/10.1016/j.socscimed.2014.10.023

[23] Scafato E, Gandin C, Galluzzo L, Scipione R, Vichi M, Ghirini S; CSDA Working Group. Epidemiology and alcohol-related monitoring in Italy and in the Regions. Evaluation of the National Observatory on Alcohol on the impact of the alcohol consumption in support for the implementation of the activities of the National Alcohol and Health Plan. Report 2017. Rome, Italy: ISS 2017. http://old.iss.it/publ/?lang=1&id=3037&tipo=5 (Last access: 21st April 2021).

[24] Lantz PM, Golberstein E, House JS, Morenoff J. Socioeconomic and behavioral risk factors for mortality in a national 19-year prospective study of U.S. adults. Soc Sci Med 2010;70:1558-66. https://doi.org/10.1016/j.socscimed.2010.02.003

[25] Rondon Garcia LM, Aguirre Arizala BA, Garcia Garcia FJ, Gallego CC. Support and social contact as a decisive meta-variable in morbidity and social welfare of the older person. Curr Aging Sci 2017;10:282-90. https://doi.org/10.2174/1874609810666170413124209

[26] Olaya B, Domènech-Abella J, Moneta MV, Lara E4, Caballero FF, Rico-Uribe LA, Haro JM. All-cause mortality and multimorbidity in older adults: the role of social support and loneliness. Exp Gerontol 2017;99:120-6. https://doi.org/10.1016/j.exger.2017.10.001

Received on November 27, 2020. Accepted on April 20, 2021.

Correspondence: Roberto Lillini, Analytical Epidemiology & Health Impact, Fondazione IRCCS "Istituto Nazionale Tumori", Milan, Italy - Tel. +39 02 23903564 - E-mail: r.lillini@campus.unimib.it

How to cite this article: Vercelli M, Lillini R. Deindustrialisation, demographic decline, aging, economic crisis and social involution in a metropolitan area analysed by applying Socio-Economic and Health Deprivation Indices. J Prev Med Hyg 2021;62:E709-E717. https://doi.org/10.15167/2421-4248/jpmh2021.62.2.1889

RESEARCH ARTICLE

Application of Socio-Economic and Health Deprivation Indices to study the relationships between socio-economic status and disease onset and outcome in a metropolitan area subjected to aging, demographic fall and socio-economic crisis

MARINA VERCELLI[1], ROBERTO LILLINI[2]
[1] Department of Health Sciences (DISSAL), University of Genova, Genova, Italy;
[2] Analytical Epidemiology & Health Impact Unit, Fondazione IRCCS "Istituto Nazionale Tumori", Milan, Italy

Keywords

Metropolitan area • Socioeconomic crisis • Deprivation indices • Mortality by cause • Diseases onset • Diseases outcomes

Summary

Aims. *Genoa is a city affected by a deep economic, demographic and social involution. The association between disease onset and outcome and socioeconomic status (SES) was assessed in the mortality by cause in two periods, using indices referred to the distribution of deprivation in the population defined in a ten-years span (2001 to 2011).*

Material and Methods. *Two Socio-Economic and Health Deprivation Indices (SEHDIs), computed at census tract level (2001 and 2011 Censuses), were applied to analyse the SMRs by cause, age (0-64 and 65+ years) and gender of the five normalised groups of deprivation individuated in the two population distribution. The associations between SES and onset of disease was described in the mortality 2008-11 using the index referred to 2001 population. The second index, referred to 2011 population, described the associations between SES and disease outcomes in the mortality 2009-13. Two ANOVAs evaluated the statistical significance ($p < 0.05$) of differences in death distribution among groups.*

Results. *The population at medium-high deprivation increased in Genoa between 2001 and 2011. The mortality by age and gender showed different trends. Not significant trends (NS) in both periods regarded only the younger (respiratory diseases in both sexes, prostate cancer, diabetes in women). Linearly positives (L↑) trends in both periods were observed only in men (all cancers and lung cancers, overall mortality and cardiovascular diseases in younger, diabetes in older). Not linear trends (NL) in both periods interested both sexes for flu and pneumonia, women for lung cancer, old women for overall mortality and respiratory diseases, old men for colorectal cancers. Instead, L↑ trends in the final phases of disease interest all cancers in the elderly (NS trend at the disease onset), all cancers and breast cancer in young women, diabetes and colorectal cancers in young men (NL trends at the disease onset). On the contrary, L↑ trends at the disease onset and NL trends in the final phases regarded cardiovascular diseases in elderly, overall mortality, respiratory diseases and prostate cancer in old men, diabetes and colorectal cancers in old women. Finally, NL trends at the disease onset regarded colorectal cancers in young women (NS trend in the final phases) and breast cancer in the older (linearly negative trend, L↓, in the final phases).*

Discussion. *Deprivation trends confirmed the literature about populations shifting towards poverty. Aging-linked social risks were revealed, reflecting the weakening of social-health care, which worsened in elderly if alone. Serious problems in younger singles or in the single-parent families arose. Cardiovascular diseases, all cancers and colorectal cancers trends confirmed the advantage of less deprived when diseases are preventable and curable. Prostate and breast cancers trends reflected the rising incidence and increasing problems in care. The need of corrective interventions in social and health policies was emerging, aimed to support in a targeted way a population in an alarming condition of socio-economic deterioration.*

Introduction

This paper describes the relationships between health and Socio-Economic Status (SES) in the population of Genoa city, in order to illustrate the simultaneous effects of aging, demographic fall and socio-economic (SE) involution in a metropolitan area. In a previous article, the changes in demographic and SE situation of Genoa since the Second World War and the capacity of two deprivation indices in describing the evolution of demographic and SE situation in the more recent period were displayed.

The distributions by deprivation clusters of overall mortality and of mortality by cause in two partially overlapping periods, 2008-11 and 2009-13, were analysed. In the two periods the residents were distributed by deprivation clusters applying two Socio-Economic and Health Deprivation Indices (SEHDI) [1, 2]: the first referring to demographic and SE situation at 2001 Census, the second to that at 2011 Census. This allowed to compare the mortality of some pathologies in a population which moved from a state of relative well-being, such that at 2001, to a situation

https://doi.org/10.15167/2421-4248/jpmh2021.62.3.1890

of impoverishment, aging and social involution, such that at 2011.
Moreover, due to the long duration of survival of most of the considered diseases, some suggestions about the association between deprivation and disease occurrence determinants could be caught through the analyses by the first index, and some evidences about the association with disease outcomes determinants by the second, thus describing the influence of deprivation in different phases of disease course in the same population.

Materials and methods

The variables concurring to the SEHDIs 2001 and 2011 came from 2001 and 2011 Censuses, respectively [3-4]. The indices were built at Census Tract (CT) level with a methodology already published [1-2]. The CTs of Genoa were classified in five normalised groups at growing deprivation either by SEHDI 2001 and by SEHDI 2011. The choice of a normalised classification was made to respect the usual normal distribution of SE deprivation phenomena in the population [5].
The mortality data of the period 2008-2013 was derived from the ISTAT Database of mortality in Liguria. The data were geo-referred at CT level by the Liguria Region Statistics Office in collaboration with the Statistics Office of Genoa municipality.
The considered causes of death were overall mortality (ICD-10 A00-Y89), diabetes mellitus (E10-E14), cardiovascular diseases (I00-I99), respiratory diseases (J00-J99), overall cancers (C00-C43, C46-C95), colorectal cancer (C18-C21, C26.0), lung cancer (C33-C34), female breast cancer (C50), prostate cancer (C61). Flu and pneumonia (J10-J18) were added to these causes due to their interest in public health [6].
Most of the above causes are long-lasting, in fact the patient often survives on average nearly ten years. Therefore, the affected population should have been presented at both Censuses, residing mostly in the same CT either at the onset, or at the outcome of its disease. If the situation of deprivation of any CT (chosen as proxy of individual deprivation of its resident) changed between Censuses, the disease was associated to different clusters of deprivation in the two periods under analysis, even if the events were the same for three years on six (2009-2011). In this way, hints of the association of disease with deprivation under the same conditions of taken in charge was remarked, stressing the association with the deprivation status at the onset of disease in the first period, and with the outcome of disease in the second.
In a first step the standardised mortality rates (SMRs) by cause and deprivation groups were computed, using the SEHDI 2001 population distribution for the 2008-2011 period and the SEHDI 2011 population distribution for the 2009-2013.
In a second step the SMRs were calculated considering also gender and age (0-64 years and 65 years and more). In each step two ANOVAs with F-test and linear distribution test ($p < 0.05$) were performed to evaluate the statistical significance of differences in death distribution through the SE groups [7].
All the analyses were performed by the statistical software SPSS 19.0 and Stata 13.0.

Results

The changes in the population distribution by SEHDI clusters at 2001 and 2011 Censuses were wide and relevant. The clusters at medium and medium-low deprivation diminished (-7.4% and -2.1%), those at medium-high deprivation notably increased (+8.3%), while those in high deprivation and the ones at low deprivation increased imperceptibly (+0.1% and +0.2%).
Table I compares the general trends (all ages and both sexes) of each cause in the deprivation clusters defined according to SEHDI 2001 in the period 2008-2011, and those of period 2009-2013 in the deprivation clusters defined according to SEHDI 2011.
For each cause, the number of death (OBS) by deprivation group and in all population and the SMRs computed adopting the Liguria region as standard are shown. The statistically significant increase (*) and decrease (°) with respect to Liguria rates are also displayed.
The statistical significance of trend (or its not significance, NS) was calculated, stressing the linearity (L) or not linearity (NL) and the direction of trend (positive ↑, when mortality increased at deprivation growing; negative ↓, when mortality increased at deprivation decreasing).
The overall mortality trends were L↑ in both periods. In 2008-2011, the Genoa total mortality and those of groups from low to medium deprivation were significantly lower than the Liguria rates, while the more deprived groups showed mortality significantly higher.
In 2009-2013, the total mortality and that of deprived groups were significantly higher versus Liguria rates, while the one of richer groups was significantly lower.
Analogously, the trends were L↑ in both periods for diabetes, respiratory diseases and lung cancers. Instead, NL trends characterised flu and pneumonia.
Different behaviours by period were highlighted for cardiovascular diseases, all cancers and colorectal cancers, which trends were NL in the first period and L↑ in the second.
Prostate and breast cancers tendencies changed from L↓ to L↑ between periods.
The trends of mortality by cause, age groups (0-64 years and ≥ 65 years) and gender in the deprivation clusters defined by SEHDI 2001 for 2008-2011, and SEHDI 2011 for 2009-2013 are shown in Table II for the overall mortality and in Table III for the mortality by cause.
NS trends in both periods regarded the respiratory diseases in younger of both sexes, the prostate cancer in younger men, and the diabetes in younger women.
Instead, L↑ trends in both periods were observed for overall mortality and cardiovascular diseases in younger,

Tab. I. Mortality by cause and deprivation in Genoa city. Comparison of 2008-2011 and 2009-2013 trends. Number of death (OBS), Standard Mortality Ratios (SMR) and statistical significance (p).

Deprivation groups	Cause	2008-2011			2009-2013			Cause	2008-2011			2009-2013		
		OBS	SMR	p	OBS	SMR	p		OBS	SMR	p	OBS	SMR	p
High deprivation	OVERALL MORTALITY	1074	1.10	*	2327	1.99	*	ALL CANCERS	281	1.02		473	1.42	*
Medium-high deprivation		7164	1.08	*	12440	1.10	*		1822	0.98	°	3344	1.03	*
Medium deprivation		16595	0.91	°	18042	1.00			4885	0.95	°	4797	0.93	°
Medium-low deprivation		7012	0.91	°	7059	0.87	°		2001	0.92	°	1973	0.85	°
Low deprivation		569	0.92	°	601	0.77	°		164	0.96		155	0.69	°
Total		32414	0.98	°	40469	1.03	*		9153	0.99	°	10742	0.95	°
Trend:		p < 0.05 L↑			p < 0.05 L↑				p < 0.05 NL			p < 0.05 L↑		
High deprivation	DIABETES	52	1.66	*	91	2.43	*	COLORECTAL CANCERS	41	0.98		60	1.60	*
Medium-high deprivation		260	1.21	*	406	1.12	*		297	1.05	*	491	1.34	*
Medium deprivation		509	0.88	°	571	0.99			730	0.94	°	770	1.32	*
Medium-low deprivation		189	0.77	°	193	0.75	°		304	0.92	°	323	1.24	°
Low deprivation		14	0.71	°	25	1.01			21	0.80	°	24	0.95	
Total		1024	0.98	°	1286	1.02			1393	0.99		1668	1.31	*
Trend:		p < 0.05 L↑			p < 0.05 L↑				p < 0.05 NL			p < 0.05 L↑		
High deprivation	CARDIOVASCULAR DISEASES	351	0.99		869	1.99	*	LUNG CANCERS	71	1.31	*	103	1.67	*
Medium-high deprivation		2635	1.07	*	4495	1.07	*		361	0.90	°	748	1.22	*
Medium deprivation		6006	0.91	°	6495	0.97	°		1008	0.97	°	958	0.98	
Medium-low deprivation		2604	0.93	°	2543	0.85	°		386	0.94	°	390	0.88	°
Low deprivation		213	0.98		229	0.80	°		21	0.58	°	29	0.67	°
Total		11809	0.98	°	14631	1.00			1847	0.98	°	2228	1.04	*
Trend:		p < 0.05 NL			p < 0.05 L↑				p < 0.05 L↑			p < 0.05 L↑		
High deprivation	RESPIRATORY DISEASES	71	1.21	*	145	1.82	*	PROSTATE CANCER	8	0.67	°	14	1.14	
Medium-high deprivation		414	1.04	*	772	1.00			69	0.91	°	148	1.19	*
Medium deprivation		1013	0.92	°	1146	0.92	°		194	0.94	°	232	1.15	*
Medium-low deprivation		426	0.92	°	479	0.86	°		91	1.04	*	85	0.94	
Low deprivation		37	1.01		42	0.78			9	1.29	*	4	0.44	°
Total		1961	0.98	°	2584	0.96	°		371	0.99	°	483	1.10	*
Trend:		p < 0.05 L↑			p < 0.05 L↑				p < 0.05 L↓			p< 0.05 L↑		
High deprivation	FLU & PNEUMONIA	17	1.30	*	35	1.99	*	FEMALE BREAST CANCER	18	0.95	°	47	1.96	*
Medium-high deprivation		77	0.86	°	149	0.88			126	0.93	°	236	1.05	
Medium deprivation		227	0.92	°	287	1.06			356	0.95	°	388	1.09	
Medium-low deprivation		114	1.09	*	123	1.01			155	0.96	°	153	0.97	
Low deprivation		7	0.86	°	12	1.03			17	1.33	*	12	0.83	
Total		442	0.97	°	606	1.02			672	0.99	°	836	1.08	*
Trend:		p < 0.05 NL			p < 0.05 NL				p < 0.05 L↓			p < 0.05 L↑		

NOTE: Standardized Mortality Ratios on the Liguria rates. SEHDI: Socio-Economic and Health Deprivation Index (at 2001 and 2011 censuses).
p = test F, p < 0.05: * Significant increasing risk; ° Significant decreasing risk.
Trend: p < 0.05 L↑: linear positive; p < 0.05 L↓: linear negative; p < 0.05 NL: not linear; NS: not significant.

for all cancers and lung cancer in men of both ages, for the diabetes in old men.

NL trends in both periods are displayed by women for lung cancer, by old men for colorectal cancers, by old women for overall mortality and respiratory diseases.

On the contrary, the trends of all cancers in old women were NS at the disease onset but L↑ in the final phases.

NL trends at the disease onset but L↑ in the final phases characterized all cancers and breast cancer in younger women, and diabetes and colorectal cancers in younger men.

In elderly of both sexes the trends of cardiovascular diseases changed from L↑ at the disease onset to NL in the final phases.

Analogously, the total mortality, respiratory diseases and prostate cancer trends in old men, and the diabetes and colorectal cancers in old women changed.

Finally, the trends of colorectal cancers in younger women were NL at the disease onset and NS in the final phases, while the breast cancer trend in old women were NL at the disease onset and L↓ in the final phases.

Discussion

A general observation about results regarded the differences between deprivation trends of younger and older groups, because the younger showed a higher

Tab. II. Trends of overall mortality in Genoa city: comparison of 2008-2011 and 2009-2013 mortality by age, gender and deprivation groups. Number of death (OBS), Standard Mortality Ratios (SMR) and statistical significance (p).

Cause	Clusters	2008-2011 (SEHDI 2001)										2009-2013 (SEHDI 2011)									
		0-64 years - Males			0-64 years -Females			65+ years - Males			65+ years -Females	0-64 years - Males			0-64 years -Females			65+ years - Males			65+ years -Females	
		OBS	SMR	p	OBS	SMR	p	OBS	SMR	p	OBS	SMR	OBS	p	SMR	OBS	p	OBS	SMR	p	OBS	SMR	p
OVERALL MORTALITY	HD	148	2.27	*	74	2.46		391	1.38	*	461	1.21	*	133	2.28	*	113	3.20	*	681	1.22	*	1399	1.97	*
	MHD	524	1.31	*	330	1.53	*	2569	1.20	*	3741	1.37	*	777	1.28	*	443	1.26	*	5086	0.96	°	6131	1.03	*
	MD	1030	0.98		639	1.08	*	6709	1.00		8217	1.05	*	1096	1.07	*	698	1.19	*	7329	0.97	°	8916	1.06	*
	MLD	339	0.79	°	205	0.82	°	2841	0.93	°	3627	1.07	*	402	0.84	°	257	0.94		2837	0.95	°	3562	1.08	*
	LD	26	0.77		22	1.09		235	0.90		286	1.10		63	1.23		31	1.11		220	0.97		287	1.30	*
	Total	2067	1.04	*	1270	1.15	*	12745	1.02	*	16332	1.12	*	2471	1.12	*	1542	1.21	*	16153	0.97	°	20295	1.09	*
	Trend	p < 0.05 L↑			p < 0.05 L↑			p < 0.05 L↑			p < 0.05 NL	p < 0.05 L↑			p < 0.05 L↑			p < 0.05 NL			p < 0.05 NL		

NOTE: Standardized Mortality Ratios on the Liguria rates. SEHDI: Socio-Economic and Health Deprivation Index (at 2001 and 2011 censuses).
Clusters: HD: High Deprivation, MHD: Medium-High Deprivation, MD: Medium Deprivation, MLD: Medium-Low Deprivation, LD: Low Deprivation.
p= test F, p<0.05; *= significant increasing risk; °= significant decreasing risk.
Trend: p < 0.05 L↑: linear positive; p < 0.05 L↓: linear negative; p < 0.05 NL: not linear; NS: not significant.

number of positive trends, either in both periods and in the final phases of disease. Moreover, often old women's trends appeared to be worsened more than the men's ones.

The associations observed in the younger age group are interesting. In the latter the low frequency of competitive diseases makes easier to identify the risk determinants, also if SES linked factors.

The campaigns for prevention and early diagnosis in the past were directed more specifically towards the younger age groups and facilitated more timely diagnoses. They were associated with more efficacious treatments and less fatal outcomes, but their effects differed between the deprivation clusters.

The differences might be related to variations in intensity of exposure to the risk factors (like occupational exposure in men), or to different preventive or diagnostic-therapeutic strategies. Women, for example, are more attentive to some beneficial behaviour patterns, like health dietary habits and early prevention.

Furthermore, we must remember that the more lethal diseases, such as lung cancer, enjoy less effective preventive and therapeutic options, showing a more homogeneous distribution of survival among population groups. In fact the care options are limited in the same way for everyone, although exposure to the risk factors is not similar in all individuals. Conversely, when more preventive and therapeutic options at different costs are available, as in the case of prostatic and breast cancers, differences in timely diagnosis and survival duration increase among clusters of population at different deprivation level.

As regards overall mortality in Genoa, it is interesting to observe the change in the ratios of mortality with the Liguria rates between periods. In 2008-11, using the 2001 SEHDI distribution of population, the Genoa total mortality and those of clusters from low to medium deprivation were significantly lower than the Liguria one, while the more deprived groups showed mortalities significantly higher. This testified the welfare of the city with respect to the overall region, related to the presence of most major hospitals into the city and, likely, to the better organisation of taking in charge the patients, particularly the elderly. Moreover, in this period the number of foreigners called to provide aid and assistance at home was increasing [8].

In 2009-13, using the 2011 SEHDI distribution of population, the general mortality and that of the deprived groups resulted significantly higher versus the Liguria one, while the mortality of richer groups were significantly lower. This testified the worsening of general living conditions and of organisation of social and health system, which led to an increasing in the mortality of deprived with respect to the richer groups, the only ones able to utilise own resources to make up for the lacks of the health and welfare system.

Confirming the literature, the SMRs trends were linearly positive in both periods for a lot of diseases strongly associated with deprivation (diabetes, respiratory diseases, and lung cancers) and the worst living

Tab. III. Trends of mortality by cause in Genoa city: comparison of 2008-2011 and 2009-2013 mortality by age, gender and deprivation groups. Number of death (OBS), Standard Mortality Ratios (SMR) and statistical significance (p).

Cause	Clusters	2008-2011 (SEHDI 2001)												2009-2013 (SEHDI 2011)											
		0-64 years - Males			0-64 years -Females			65+ years - Males			65+ years -Females			0-64 years - Males			0-64 years -Females			65+ years - Males			65+ years -Females		
		OBS	SMR	p	OBS	SMR	p	OBS	SMR	p	OBS	SMR	p	OBS	SMR	p	OBS	SMR	p	OBS	SMR	p	OBS	SMR	p
DIABETES MELLITUS	HD	4	2.79		2	3.37		18	2.19	*	28	1.96	*	5	3.64		1	1.71		29	1.72	*	56	2.10	*
	MHD	11	1.26		4	0.94		83	1.33	*	162	1.59	*	17	1.20		10	1.71		162	1.01		217	0.97	
	MD	11	0.48	°	12	1.03		211	1.08		275	0.94		20	0.83		14	1.43		228	1.00		309	0.98	
	MLD	5	0.53	°	3	0.61		77	0.87		104	0.82	°	10	0.89		0	0.00	°	70	0.78	°	113	0.91	
	LD	0	0.00	°	0	0.00	°	6	0.79		8	0.82		0	0.00	°	0	0.00	°	8	1.17		17	2.05	*
	Total	31	0.71	°	21	0.96		395	1.09		577	1.06		52	1.00		25	1.18		497	0.99		712	1.02	
	Trend	p < 0.05 NL			NS			p < 0.05 L↑			p < 0.05 L↑			p < 0.05 L↑			NS			p < 0.05 L↑			p < 0.05 NL		
CARDIOVASCULAR DISEASES	HD	26	2.12	*	10	2.75	*	125	1.31	*	190	1.06		26	2.38	*	12	2.90	*	219	1.17	*	612	1.84	*
	MHD	86	1.15		50	1.92	*	865	1.20	*	1634	1.27	*	133	1.18		55	1.34		1708	0.96	°	2599	0.94	°
	MD	168	0.85	°	63	0.88		2289	1.01		3486	0.95	°	192	1.01		86	1.25		2508	0.99		3709	0.95	°
	MLD	57	0.70	°	27	0.89		1004	0.97		1516	0.94	°	58	0.65		24	0.75		966	0.97		1495	0.97	
	LD	4	0.63		0	0.00	°	97	1.10		112	0.91		11	1.15		2	0.61		75	0.99		141	1.37	*
	Total	341	0.92		150	1.12		4380	1.04	*	6938	1.01		420	1.01		179	1.20	*	5476	0.98		8556	0.99	
	Trend	p < 0.05 L↑			p < 0.05 L↑			p < 0.05 L↑			p < 0.05 L↑			p < 0.05 L↑			p < 0.05 L↑			p < 0.05 NL			p < 0.05 NL		
RESPIRATORY DISEASES	HD	7	4.17	*	1	1.23		31	1.31		32	1.36		2	1.43		3	3.08		55	1.15		85	1.81	*
	MHD	12	1.17		11	1.89		216	1.20	*	175	1.04		26	1.80	*	14	1.44		416	0.91	°	316	0.81	°
	MD	19	0.70		17	1.07		552	0.98		425	0.88	°	19	0.78		14	0.86		584	0.90	°	529	0.96	
	MLD	9	0.81		7	1.03		210	0.82	°	200	0.96		5	0.44	°	9	1.19		246	0.97		219	1.01	
	LD	0	0.00	°	0	0.00	°	17	0.77		20	1.25		2	1.64		0	0.00	°	24	1.24		16	1.10	
	Total	47	0.92		36	1.20		1026	0.98		852	0.95		54	1.02		40	1.14		1325	0.93	°	1165	0.95	
	Trend	NS			NS			p < 0.05 L↑			p < 0.05 NL			NS			NS			p < 0.05 NL			p < 0.05 NL		
OVERALL CANCERS	HD	48	1.75	*	33	1.97	*	110	1.23	*	90	1.01		43	1.77	*	43	2.19	*	193	1.09		194	1.16	*
	MHD	218	1.30	*	152	1.27	*	801	1.19	*	651	1.02		292	1.16	*	232	1.19	*	1584	0.94	°	1236	0.89	°
	MD	468	1.06		352	1.07		2236	1.06	*	1829	1.00		470	1.11	*	376	1.15	*	2128	0.89	°	1823	0.93	°
	MLD	150	0.83	°	123	0.88		931	0.96		797	1.00		173	0.87	°	155	1.02		884	0.94	°	761	0.98	
	LD	10	0.70		21	1.87	*	70	0.85		63	1.03		23	1.09		16	1.04		56	0.78	°	60	1.16	
	Total	894	1.07	*	681	1.11	*	4148	1.06	*	3430	1.00		1001	1.09	*	822	1.16	*	4845	0.92	°	4074	0.94	°
	Trend:	p < 0.05 L↑			p < 0.05 NL			p < 0.05 L↑			NS			p < 0.05 L↑			p < 0.05 L↑			p < 0.05 L↑			p < 0.05 L↑		
COLORECTAL CANCERS	HD	6	2.24		3	1.74		16	1.66		16	1.38		2	0.81		3	1.50		32	1.69	*	23	1.11	
	MHD	17	1.04		21	1.70		139	1.90	*	120	1.44	*	48	1.87	*	27	1.36		213	1.18	*	203	1.17	*
	MD	63	1.46	*	52	1.54	*	301	1.31	*	314	1.32	*	66	1.52	*	50	1.50	°	340	1.33	*	314	1.28	*
	MLD	20	1.13		19	1.32		138	1.32	*	127	1.22	*	21	1.03		30	1.94	*	151	1.50	*	121	1.26	*
	LD	0	0.00	°	4	3.44		9	1.00		8	1.01		2	0.92		3	1.91		11	1.44		8	1.24	
	Total	106	1.31	*	99	1.56	*	603	1.42	*	585	1.32	*	139	1.48	*	113	1.57	*	747	1.33	*	669	1.23	*
	Trend:	p < 0.05 NL			p < 0.05 NL			p < 0.05 NL			p < 0.05 L↑			p < 0.05 L↑			NS			p < 0.05 NL			p < 0.05 NL		
LUNG CANCERS	HD	14	1.89		12	4.92	*	37	1.63	*	8	0.84		13	2.11		10	3.64	*	57	1.28		23	1.26	
	MHD	61	1.35	*	23	1.31		222	1.29	*	55	0.81		82	1.28	*	43	1.57	*	468	1.11	*	155	1.02	
	MD	133	1.12		55	1.15		616	1.14	*	204	1.05		119	1.10		46	1.00		590	0.99		203	0.94	
	MLD	37	0.76	°	19	0.94		226	0.92		104	1.23	*	49	0.97		22	1.03		227	0.96		92	1.09	
	LD	2	0.52		1	0.61		14	0.67		4	0.61		6	1.11		4	1.85		12	0.67		7	1.23	
	Total	247	1.10		110	1.23	*	1115	1.12	*	375	1.03		269	1.15	*	125	1.26	*	1354	1.03		480	1.01	
	Trend:	p < 0.05 L↑			p < 0.05 L↑			p < 0.05 L↑			p < 0.05 NL			p < 0.05 L↑			p < 0.05 NL			p < 0.05 L↑			p < 0.05 NL		
PROSTATE & FEMALE BREAST CANCERS	HD	2	3.81		1	0.26	°	6	0.84		17	1.52		0	0.00		7	1.59		14	0.97		40	1.82	*
	MHD	2	0.62		33	1.20		67	1.23		93	1.16		4	0.90		47	1.07		144	1.05		189	1.03	
	MD	10	1.18		84	1.11		184	1.08		272	1.18	*	12	1.61		93	1.27	*	220	1.13		295	1.14	*
	MLD	2	0.58		29	0.91		89	1.15		126	1.26	*	1	0.29		33	0.97		84	1.10		120	1.18	
	LD	0	0.00	°	9	3.48	*	9	1.35		8	1.04		1	2.67		2	0.58		3	0.52		10	1.47	
	Total	16	1.01		156	1.10		355	1.12	*	516	1.20	*	18	1.11		182	1.15		465	1.09		654	1.14	*
	Trend:	NS			p < 0.05 NL			p < 0.05 L↓			p < 0.05 NL			NS			p < 0.05 L↑			p < 0.05 NL			p < 0.05 L↓		

NOTE: Standardized on Liguria Region rates. SEHDI: Socio-Economic and Health Deprivation Index (at 2001 and 2011 censuses). Clusters: HD: High Deprivation; MHD: Medium-High Deprivation; MD: Medium Deprivation; MLD:Medium-Low Deprivation; LD: Low Deprivation
p = test F, p < 0.05: * Significant increasing risk; ° Significant decreasing risk.
Trend: p < 0.05 L↑: linear positive; p < 0.05 L↓: linear negative; p < 0.05 NL: not linear; NS: not significant

conditions of people affected by these diseases in any social strata are well known in literature [9-16].

Instead, for cardiovascular diseases, all cancers and colorectal cancers the different behaviours by period (trends not linear when population was distributed as in 2001 context, and linearly positive in the second

when population was distributed as in the 2011 one) confirmed the better situation of the more affluent in case of diseases preventable and curable thanks to an anticipated diagnosis or a better taken in charge [13-23]. The growing prevalence of diabetes in populations with a western lifestyle [9-12] showed robust positive associations with the SES [9]. The main risk factors, i.e. overweight or obesity and the disease inheritance, have suggested a common environment or a gene-environment interaction and a possible SE segregation. A higher level of education might partially balance these aspects, particularly in who adopted preventive lifestyles, like mostly the women. Diabetes confers increased vulnerability to particles derived from traffic and industrial or domestic combustion [10, 11]. These effects in Genoa might have affected the population differentially across SE groups, as suggested by the positive trends in elderly, stressed by the population distribution on the basis of SEHDI 2011, but which were present also with the population distribution from SEHDI 2001. Furthermore, the young showed gender differences, suggesting more attention to prevention in women [12], while in men trends are worsened, changing from NL to L positive. This suggests the high risk in the less deprived, evidenced using SEHDI 2001 distribution of population, related to the association with hyper caloric diet and more sedentary lifestyles.

The mortality for cardiovascular diseases improved in time due to the adoption of healthier life styles and the better cares (changes in smoking habits, metabolic disorders control, physical activity promotion, overweight and obesity control, pressure control and so on) [13-18]. The risk dropped with corrective actions on diet suggested by physicians and health authorities. In Italy, after these actions great effects were observed, even if SES differences still disadvantaged the most deprived [19, 20]. Worldwide a great benefit has derived from smoking cessation in young male, but this has regarded to a lesser extent the most deprived [20]. Furthermore, the association between air pollution and low SES has proven to have a large impact on mortality outcomes [21, 22]. These data characterize mostly urban areas with an industrial past, as Genoa has been. Indeed, in the youngest, robust positive trends emerged for both population distributions, while in the elderly the advantage found in the less deprived at the onset of disease disappeared in the final stages.

Most of deaths for respiratory system disease was due to the COPDs [23, 24], which affected mainly the deprived [23-26].

In Genoa, the respiratory diseases showed NS trends in the younger and NL trends in elderly women, while in elderly men trends changed from L positive to NL. As regards the elderly, the changes in smoking habits in both sexes, and the decreasing in time of the past occupational exposures at high risk in men, could explicate these trends. In fact, in men a share of deaths has related to the effects of pneumoconiosis and silicosis, occupation-related and very frequent in asbestos and silica processing workers [27]. In the past, this kind of exposures largely have involved the Genoese workers, particularly those engaged in some harbour's activities (naval building and repair), and in an industry of steel, an oil refinery and a silica factory, all activities present and active in the western part of the city since the post-war period to the end of the 90s (and after for the steel factory). The more affected pertained to the most deprived groups, either directly employed in these activities, either subjected to environmental exposure. In fact, in Genoa, houses and industries are too close, due to the limited building space available in relation to the mountainous orography.

Flu and pneumonia were not considered in the analyses by gender due to the reduced numbers of deaths, but they were taken in consideration due their consequences. In fact, the more fragile segments of populations are hit from their late complications, mostly the elderly and the homeless [25-27]. In literature, the association between this kind of diseases and deprivation is controversial, because often not linear relationships emerged, due to their connection with the differences by SES in vaccination coverage [26,27]. The results in Genoa confirm these not linear behaviours of trends in both sexes. A study on the acceptance of vaccination, carried out in nine Italian areas including Genoa [6], used the same mortality data of the second period considered in these analyses (2009-2013), verifying the vaccination coverage on the elderly population classified by deprivation with SEHDI 2011. This study proved a not linear behaviour of vaccination acceptance: in synthesis, the deprivation clusters at the extremes of distribution presented a lower coverage. This is due likely for neglection or not comprehension of the preventive messages in the deprived, and for some negative behaviour against vaccination, which are spreading in the richer classes [26, 27].

The relationship between all cancers and the deprivation is controversial in literature, because varies on the base of the specific mix of cancer sites present in the populations. In fact, cancer sites as colon-rectum, breast and prostate, whose major risk factors are the same lifestyles predisposing to diabetes and cardiovascular diseases (excessive energetic intakes associated to sedentary behaviours) are more diffused into the richer strata of population. On the contrary, unhealthier life styles, such as smoking and alcohol drinking, to which the occupational exposures at risk are added, are more frequently associated to cancer sites as lung cancer, and more often hit the poorer groups of population [28-31]. Therefore, the different combination of cancer sites and the weight of each one in the population defines the type of association with deprivation observed for all cancers. Moreover, for any cancer site, in addition to risk factors that cause the onset, it is also necessary to consider the risk factors that determine the mortality. Among them, the comorbidities, the early or late diagnosis, the effectiveness of the care (also related to the efficiency of health system), the available familial and social support, are among the major determinants [31-34].

The trends of all cancers showed a shift towards deprivation between periods in younger and older women. The behaviours observed with the SEHDI 2001 distribution of population are NL, in coherence with the literature. They referred mostly to breast cancer trends, which regarded both, either the high risks of less deprived old women, either the increase of incidence in the deprived younger ones [35]. In men, the trends were mostly related to lung cancer trends, always linearly positive at any age and in both periods, and to colorectal cancers trends mostly in the younger.

For colorectal cancers, a Swedish study demonstrated that SE differences exist in diagnostic activity and management, which may affect survival [34]. Although rectal cancer has poorer prognosis than colon cancer, it has been noted that among the highly educated peoples rectal cancer patients had better survival than colon cancer patients. In Genoa, the not linear trends in elderly seemed to underline delay in diagnoses and problems in the care path, involving in the final course of disease phase also the less deprived, in particularly women. In the younger a great difference by gender was evident. The NL trends at the onset of disease revealed contemporarily higher incidences either at the lowest or at the highest deprivation in both sexes, which could be associated to unhealthier lifestyles (as hyper caloric diet, sedentary lifestyle, and smoking). Instead, the late course of disease presented large differences by gender. This could be related with the delay in diagnosis and treatment associated with less attention to preventive aspects in younger men [36], which could have been aggravated by the delay in the screening organization (stabilized at only 44% at the end of the 2017) and the insufficient rationalization and coordination of care (previously already suspected).

For lung cancer a wide part of social gradient seen in literature probably is mediated by the distribution of smoking habits, the risk factor which account for the most of the attributable fraction [37-39], while a minor fraction can be attributed to the differences in occupational exposure [39].

In Genoa, the occurrence of lung cancer showed increasing trends to increasing deprivation in the elderly of both sexes and the younger men. The not linear trends in younger women could testify the high risks of the richest due to the smoking habit [40].

Prostate cancer showed in Italy lower incidence risks among men having low educational level [38], consistent with data from other countries [41]. This is probably related to the PSA screening diffusion, more common habit among the more educated higher social classes [41, 42], while it is presumable that the deprived experienced also some delay in diagnosis [41, 42].

In the Genoese data, considering the analyses by age groups, the NL trends seemed to testify the presence of both the effects cited in literature.

As regards the breast cancer, the risks seem to be mostly related with reproductive, hormonal and dietary factors [43-45], which are cited as more spread in the higher social classes [43-45], while the obesity, strong predictor of cancers post-menopausal [45], is capable to explain the positive trends observed, related to the increase among the less educated women. Considering the analyses by age groups, the breast cancer trends, NL at the disease onset, were coherent with the literature data. As regards the disease outcomes, displayed by the second period, the opposite trends by age (positive in the younger and negative in the older) could be due to the different frequencies across deprivation groups related to the dietary and reproductive habits at higher risk among the less deprived in the elderly, while for the younger delayed diagnoses in the more deprived were suspected.

Not considering the differences by age, the overall trends of prostate and female breast cancers changed from the linear negative trends at the onset of disease to the linear positive trends of the final course of disease. This is not in contradiction with the findings by age, because by summing the two ages the higher number of cases in the elderly is enough to show a statistically significant changing of trends.

As regards the limits and strengths of these analyses, we must return to the methodological choose to apply two SEHDI's indices in describing the distribution of population by deprivation in the two periods.

The comparison between periods could be not valid if the populations at the two censuses were largely composed of different individuals, e.g. if the number of non-residents in the first period were too high, as in the case of a large increment in foreign migrants. The latter, in fact, could have determinants of their disease onset not dependent from the situation of Genoese deprivation.

This kind of limitation is certainly to be considered, given the integration of foreigners in the population happened between 2001 and 2011. In fact, they have created territorial aggregations of foreigners in specific areas of the city over time [46].

Nevertheless, the effects of their presence in the mortality should be reduced, given their younger average age compared to the natives, and the "healthy worker" effect [47-49], related to the fact that only the healthiest can have faced the inconveniences of emigration due to their need to find a job.

Conclusion

The findings of this study further strengthen the correlation between the impoverishment of a population and the worsening of its health condition. In Genoa, most of the not oncologic diseases show linear positive trends, well known in literature for the populations slipping towards poverty. The trends of oncologic diseases show mostly problems related to delayed diagnoses in the more deprived younger and in old women, problems likely correlated to some weakness in preventive measures and organisation of care [30, 38].

The trends of the main diseases support the hypotheses

of ageing-linked social risks and reflected poor social-health care, which worsen in elderly if alone [8,50].
Nevertheless, from this work emerges that among the most affected there are also the young if single, or householder of a single-parent families, which probably are at low or no social support, and often have a precarious or low remuneration employment. In fact, on the base of observed mortality outcomes, we have reason to suspect that some of these latter gave up prevention and treatment for economic and/or cultural reasons [51-53].
This situation becomes particularly relevant when the poorness is strongly tied to the worsening of the educational level of the population, considering how much this influences how individuals cope with prevention, assume lifestyles at risk, etc. [38, 54].
Moreover, the association with a strong ageing, increasing the needs of social support and care giving, is an "explosive mix" for a public health and a social system based on resources more and more reduced [8].
The use of the SEHDIs probably constitutes a useful tool to design targeted intervention policies at contrasting the effects of impoverishment on the population health.
The contemporary use of indices referring to the situation of SES of population in the periods of onset and outcome of a long term disease contributes to guide the organisation of the take in charge of patients, highlighting the different kind of relationships that bind deprivation and disease.
These results provide evidence that SES indices related to different time periods could be used, identifying in a more specific way the subpopulations that could benefit most from the investment of resources dedicated to disease management in its different stages, from the preventive aspects and the programs of health education to the taken in charge of the final phases of life.
These analyses of Genoese social evolution advise to choose the most appropriate SES indices for more effective health policies, targeted to reduce the social inequalities in health.

Conflicts of interest

Nothing to declare.

Authors' contribution

Authors equally contributed to realize this paper.

References

[1] Lillini R, Quaglia A, Vercelli M; Registro mortalità Regione Liguria. [Building of a local deprivation index to measure the health status in the Liguria Region]. Epidemiol Prev 2012;36:180-7.

[2] Lillini R, Vercelli M. The local Socio-Economic Health Deprivation Index: methods and results. J Prev Med Hyg 2018;59(4 Suppl 2):E3-10. https://doi.org/10.15167/2421-4248/jpmh2018.59.4s2.1170

[3] ISTAT. Population and households: XIV Italian National Census. Rome, Italy: ISTAT 2001. https://www.istat.it/it/censimenti-permanenti/censimenti-precedenti/popolazione-e-abitazioni/popolazione-2001 (last access: 02/08/2021).

[4] ISTAT. Population and households: XV Italian National Census. Rome, Italy: ISTAT 2011. https://www.istat.it/it/censimenti-permanenti/censimenti-precedenti/popolazione-e-abitazioni/popolazione-2011 (last access: 02/08/2021).

[5] Neckerman K, ed. Social Inequality. New York, NY: Russell Sage Foundation 2004.

[6] Vercelli M, Lillini R, Arata L, Zangrillo F, Bagnasco A, Sasso L, Magliani A, Gasparini R, Amicizia D, Panatto D. Analysis of influenza vaccination coverage among the elderly in Genoa (Italy) based on a deprivation index, 2009-2013. J Prev Med Hyg 2019;59(4 Suppl 2):E11-7. https://doi.org/10.15167/2421-4248/jpmh2018.59.4s2.1171

[7] Tabachnick BG., Fidell LS. Using Multivariate Statistics. 4th ed. Boston, MA: Allyn and Bacon 2001.

[8] Casanova G, Lamura G, Principi A. Valuing and Integrating Informal Care as a Core Component of Long-Term Care for Older People: A Comparison of Recent Developments in Italy and Spain. J Aging Soc Policy 2017;29:201-7. https://doi.org/10.1080/08959420.2016.1236640

[9] Smith JP. Nature and causes of trends in male diabetes prevalence, undiagnosed diabetes, and the socioeconomic status health gradient. Proc Natl Acad Sci USA 2007;104:13225-31. https://doi.org/10.1073/pnas.0611234104

[10] Dubowsky SD, Suh H, Schwartz J, Coull BA, Gold DR. Diabetes, obesity, and hypertension may enhance associations between air pollution and markers of systemic inflammation. Environ Health Perspect 2006;114:992-8. https://doi.org/10.1289/ehp.8469

[11] O'Neill MS, Veves A, Zanobetti A, Sarnat JA, Gold DR, Economides PA, Horton ES, Schwartz J. Diabetes enhances vulnerability to particulate air pollution-associated impairment in vascular reactivity and endothelial function. Circulation 2005;111:2913-20. https://doi.org/10.1161/CIRCULATIONAHA.104.517110

[12] Global Burden of Metabolic Risk Factors for Chronic Diseases Collaboration. Cardiovascular disease, chronic kidney disease, and diabetes mortality burden of cardiometabolic risk factors from 1980 to 2010: a comparative risk assessment. Lancet Diabetes Endocrinol 2014;2:634-47. https://doi.org/10.1016/S2213-8587(14)70102-0

[13] Lantz PM, Golberstein E, House JS, Morenoff J. Socioeconomic and behavioural risk factors for mortality in a national 19-year prospective study of U.S. adults. Soc Sci Med 2010;70:1558-66. https://doi.org/10.1016/j.socscimed.2010.02.003

[14] Hemingway A. Determinants of coronary heart disease risk for women on a low income: literature review. J Adv Nurs 2007;60:359-67. https://doi.org/10.1111/j.1365-2648.2007.04418.x

[15] Federico B, Kunst AE, Vannoni F, Damiani G, Costa G. Trends in educational inequalities in smoking in northern, mid and southern Italy, 1980-2000. Prev Med 2004;39:919-26. https://doi.org/10.1016/j.ypmed.2004.03.029

[16] Rees K, Hartley L, Flowers N, Clarke A, Hooper L, Thorogood M, Stranges S. 'Mediterranean' dietary pattern for the primary prevention of cardiovascular disease. Cochrane Database Syst Rev 2013;8:1-55. https://doi.org/10.1002/14651858.CD009825.pub2

[17] Marra M, Migliardi A, Costa G. Health inequalities and nutrition in Italy during crisis times. Epidemiol Prev 2015;39:322-31.

[18] Delfino RJ, Sioutas C, Malik S. Potential role of ultrafine particles in associations between airborne particle mass and cardiovascular health. Environ Health Perspect 2005;113:934-46. https://doi.org/10.1289/ehp.7938

[19] Zanobetti A, Schwartz J. Particulate air pollution, progression, and survival after myocardial infarction. Environ Health Per-

spect 2007;115:769-75. https://doi.org/10.1289/ehp.9201

[20] Wheeler A, Zanobetti A, Gold DR, Schwartz J, Stone P, Suh HH. The relationship between ambient air pollution and heart rate variability differs for individuals with heart and pulmonary disease. Environ Health Perspect 2006;114:560-6. https://doi.org/10.1289/ehp.8337

[21] Beelen R, Raaschou-Nielsen O, et al. Effects of long-term exposure to air pollution on natural-cause mortality: an analysis of 22 European cohorts within the multicentre ESCAPE project. Lancet 2014;383:785-95. https://doi.org/10.1016/S0140-6736(13)62158-3

[22] Benmarhnia T, Oulhote Y, Petit C, Lapostolle A, Chauvin P, Zmirou-Navier D, Deguen S. Chronic air pollution and social deprivation as modifiers of the association between high temperature and daily mortality. Environ Health 2014;13:53. https://doi.org/10.1186/1476-069X-13-53

[23] Lin HH, Ezzati M, Murray M. Tobacco smoke, indoor air pollution and tuberculosis: a systematic review and meta-analysis. PLoS Med 2007;4:e20. https://doi.org/10.1371/journal.pmed.0040020

[24] Coggon D, Harris EC, Brown T, Rice S, Palmer KT. Work-related mortality in England and Wales, 1979-2000. Occup Environ Med 2010;67:816-22. https://doi.org/10.1136/oem.2009.052670

[25] Rutter PD, Mytton OT, Mak M, Donaldson LJ. Socio-economic disparities in mortality due to pandemic influenza in England. Int J Public Health 2012;57:745-50. https://doi.org/10.1007/s00038-012-0337-1

[26] Vukovic V, Lillini R, Lupi S, Fortunato F, Cicconi M, Matteo G, Arata L, Amicizia D, Boccalini S, Bechini A, Prato R, Stefanati A, Panatto D, de Waure C. Identifying people at risk for influenza with low vaccine uptake based on deprivation status: a systematic review. Eur J Public Health 2020;30:132-41. https://doi.org/10.1093/eurpub/cky264

[27] Panatto D, Gasparini R, Amicizia D. Influenza vaccination coverage in the elderly and socio-economic inequalities in Italy. J Prev Med Hyg 2019;59(4 Suppl 2):E1-2. https://doi.org/10.15167/2421-4248/jpmh2018.59.4s2.1198

[28] Auvinen A, Karjalainen S. Possible explanations for social class differences in cancer patient survival. In: Kogevinas M, Pearce N, Susser,M, Boffetta P, eds. Social Inequalities and Cancer. IARC Scientific Publications No. 138:377-397. Lyon: International Agency for Research on Cancer 1997.

[29] Whitaker KL, Scott SE, Wardle J. Applying symptom appraisal models to understand sociodemographic differences in responses to possible cancer symptoms: a research agenda. Br J Cancer 2015;112:S27-34. https://doi.org/10.1038/bjc.2015.39

[30] Quaglia A, Lillini R, Mamo C, Ivaldi E, Vercelli M, SEIH (Socio-Economic Indicators and Health) Working Group. Socio-economic inequalities: a review of methodological issues and the relationships with cancer survival. Crit Rev Oncol Hematol 2013;85:266-77. https://doi.org/10.1016/j.critrevonc.2012.08.007

[31] Vercelli M, Quaglia A, Lillini R. Useful indicators to interpret the cancer burden in Italy. Tumori 2013;99:425-38. https://doi.org/10.1700/1334.14808

[32] Quaglia A, Lillini R, Casella C, Giachero G, Izzotti A, Vercelli M, Liguria Region Tumour Registry. The combined effect of age and socioeconomic status on breast cancer survival. Crit Rev Oncol Hematol 2011;77:210-20. https://doi.org/10.1016/j.critrevonc.2010.02.007

[33] Manzoli L, Villari P, M Pirone G, Boccia A. Marital status and mortality in the elderly: a systematic review and meta-analysis. Soc Sci Med 2007;64:77-94. https://doi.org/10.1016/j.socscimed.2006.08.031

[34] Cavalli-Björkman N, Lambe M, Eaker S, Sandin F, Glimelius B. Differences according to educational level in the management and survival of colorectal cancer in Sweden. Eur J Cancer 2011;47:1398-406. https://doi.org/10.1016/j.ejca.2010.12.013

[35] Heer EV, Harper AS, Sung H, Jemal A, Fidler-Benaoudia MM. Emerging cancer incidence trends in Canada: The growing burden of young adult cancers. Cancer 2020;126:4553-62. https://doi.org/10.1002/cncr.33050

[36] van Loon AJ, Brug J, Goldbohm RA, van den Brandt PA, Burg J [corrected to Brug J]. Differences in cancer incidence and mortality among socio-economic groups. Scand J Soc Med 1995;23:110-20. doi: 10.1177/140349489502300206. Erratum in: Scand J Soc Med 1995;23:155.

[37] Hovanec J, Siemiatycki J, Conway DI, et al. Lung cancer and socioeconomic status in a pooled analysis of case-control studies. PLoS One 2018;13:e0192999. https://doi.org/10.1371/journal.pone.0192999.

[38] Spadea T, D'Errico A, Demaria M, Faggiano F, Pasian S, Zanetti R, Rosso S, Vicari P, Costa G. Educational inequalities in cancer incidence in Turin, Italy. Eur J Cancer Prev 2009;18:169-78. https://doi.org/10.1097/CEJ.0b013e3283265bc9

[39] Kogevinas M, Porta M. Socioeconomic differences in cancer survival: a review of the evidence. IARC Sci Publ 1997;(138):177-206.

[40] Hansen MS, Licaj I, Braaten T, Lund E, Gram IT. The fraction of lung cancer attributable to smoking in the Norwegian Women and Cancer (NOWAC) Study. Br J Cancer 2021;124:658-62. https://doi.org/10.1038/s41416-020-01131-w

[41] Goovaerts P, Xiao H, Gwede CK, Tan F, Huang Y, Adunlin G, Ali A. Impact of Age, Race and Socio-economic Status on Temporal Trends in Late-Stage Prostate Cancer Diagnosis in Florida. Spat Stat 2015;14:321-37. https://doi.org/10.1016/j.spasta.2015.07.002

[42] Jan M, Bonn SE, Sjölander A, Wiklund F, Stattin P, Holmberg E, Grönberg H, Bälter K. The roles of stress and social support in prostate cancer mortality. Scand J Urol 2016;50:47-55. https://doi.org/10.3109/21681805.2015.1079796

[43] Kelsey JL, Gammon MD, John EM. Reproductive factors and breast cancer. Epidemiol Rev 1993;15:36-47. https://doi.org/10.1093/oxfordjournals.epirev.a036115

[44] Dieterich M, Stubert J, Reimer T, Erickson N, Berling A. Influence of Lifestyle Factors on Breast Cancer Risk. Breast Care 2014;9:407-14. https://doi.org/10.1159/000369571

[45] Kamińska M, Ciszewski T, Łopacka-Szatan K, Miotła P, Starosławska E. Breast Cancer Risk Factors. Prz Menopauzalny 2015 ;14:196-202. https://doi.org/10.5114/pm.2015.54346

[46] Scarpa S. Immigration policy regimes, welfare states and urban inequality patterns: A comparison between Malmö and Genoa. Eur Urban Reg Stud 2016;23:862-77. https://doi.org/10.1177/0969776415578199

[47] Li CY, Sung FC. A review of the healthy worker effect in occupational epidemiology. Occup Med (Lond) 1999;49:225-9. https://doi.org/10.1093/occmed/49.4.225.

[48] Shah D. Healthy worker effect phenomenon. Indian J Occup Environ Med 2009;13:77-9. https://doi.org/10.4103/0019-5278.55123

[49] Domnich A, Panatto D, Gasparini R, Amicizia D. The "healthy immigrant" effect: Does it exist in Europe today? Ital J Public Health 2012;9:e75321-7.

[50] Fleisch Marcus A, Illescas AH, Hohl BC, Llanos AA. Relationships between social isolation, neighborhood poverty, and cancer mortality in a population-based study of US adults. PLoS One 2017;12:e0173370. https://doi.org/10.1371/journal.pone.0173370

[51] de Belvis AG, Ferrè F, Specchia ML, Valerio L, Fattore G, Ricciardi W. The financial crisis in Italy: implications for the healthcare sector. Health Policy 2012;106:10-6. https://doi.org/10.1016/j.healthpol.2012.04.003

[52] Sarti S, Terraneo M, Tognetti Bordogna M. Poverty and private health expenditures in Italian households during the recent crisis. Health Policy 2017;121:307-14. https://doi.org/10.1016/j.healthpol.2016.12.008

[53] Tereanu C, Sampietro G, Sarnataro F, Mazzoleni G, Pesenti B, Sala LC, Cecchetti R, Arvati M, Brioschi D, Viscardi M, Prati C, Sala G, Barbaglio GG. Exploring patient safety culture in preventive medicine settings: an experience from Northern Italy. J Prev Med Hyg 2017;58:E121-9.

[54] Damiani G, Federico B, Bianchi CBNA, Ronconi A, Basso D, Fiorenza S, Sassi F. Socio-economic status and prevention of cardiovascular disease in Italy: evidence from a national health survey. Eur J Publ Health 2011;21:591-6. https://doi.org/10.1093/eurpub/ckq075

Received on November 27, 2020. Accepted on May 27, 2021.

Correspondence: Roberto Lillini. Analytical Epidemiology & Health Impact, Fondazione IRCCS "Istituto Nazionale Tumori", Milan, Italy - Tel: +390223903564 - E-mail: roberto.lillini@istitutotumori.mi.it.

How to cite this article: Vercelli M, Lillini R. Application of Socio-Economic and Health Deprivation Indices to study the relationships between socio-economic status and disease onset and outcome in a metropolitan area subjected to aging, demographic fall and socio-economic crisis. J Prev Med Hyg 2021;62:E718-E727. https://doi.org/10.15167/2421-4248/jpmh2021.62.2.1889

Review

Adverse Childhood Experiences & mental health – the urgent need for public health intervention in India

GUNJAN Y. TRIVEDI[1], NISHITHA PILLAI[2], RIRI G. TRIVEDI[1]
[1] Cofounder, Society for Energy & Emotions, Wellness Space, Ahmedabad, India;
[2] Interning Psychologist, Society for Energy & Emotions, Wellness Space, Ahmedabad, India

Keywords

Adverse Childhood Experiences (ACE) • Post Traumatic Stress Disorder (PTSD) • Physical abuse • Sexual abuse • Neglect • Mental health • Inner child

Summary

Global evidence has demonstrated that Adverse Childhood Experiences (ACEs) up to age 18 significantly increases the risk of mental and physical health for an adult. The research linking ACE with health and well-being has confirmed a dose-response relationship between the number of ACEs experienced and the extent of the impact on wellbeing. The source of ACE is the family, community, and the immediate environment, and it causes long-term risk for mental health with the potential to carry it over beyond the present generation. The findings are consistent across the developed and developing countries, and the evidence highlights the need for new elements beyond the 10 ACE elements in the path-breaking original study. India needs urgent intervention on ACE prevention and management with 0.4 billion children and adolescents, with one out of seven Indians with mental health issues. Firstly, this commentary reviews global research and summarizes the limited evidence available in India on ACE elements' impact on mental health. And, secondly, it proposes a multi-pronged approach to identify, manage and prevent the mental health implications of ACE in India to preempt a significant public health challenge.

Introduction

The last two decades of structured research, primarily in North America and Europe in Adverse Childhood Experiences (ACE), have articulated that exposure to ACEs is associated with an increased risk of mental illness and other chronic conditions, including cardiovascular, respiratory disease, and cancer. In addition, evidence has identified pathways that include neurological, hormonal, and immunological development and the association with increased biomarkers for inflammation and shortened telomeres [1]. The original study used 10 elements of ACE based on the categories of abuse, neglect, and household dysfunction and its role in overall health, well-being, and social function [2, 3]. Since then, accumulating evidence for the negative impact of ACEs on health outcomes in adulthood has highlighted this as a public health concern [4]. The article focuses on India's ACE and mental health implications based on the evidence that ACEs are associated with higher odds of mental disorders, risky behavior linked to poor quality of life, and chronic disease in adulthood after controlling for relevant demographic and socioeconomic factors.

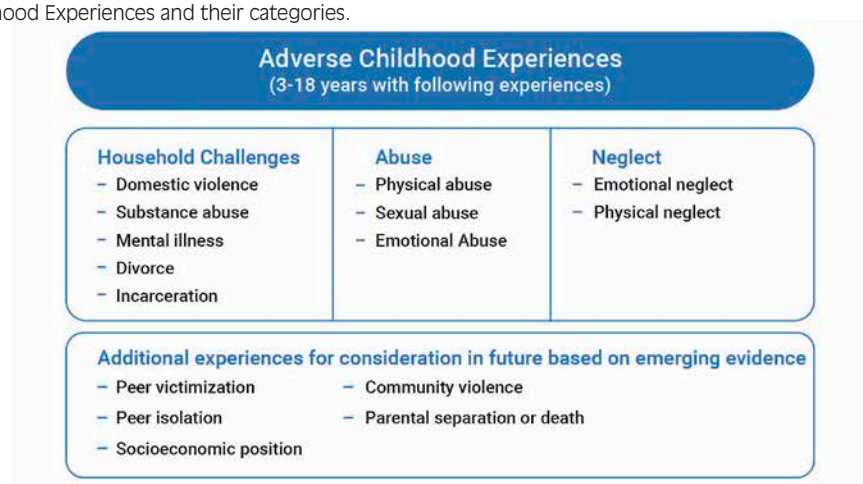
A 2017 study estimated that one in seven Indians was affected by mental disorders. The proportion of mental disorders to the total disease burden in India has almost doubled in 2017 as compared to 1990 and DALY (Disability-Adjusted-Life-Years) contribution due to mental disorders to total DALYs in India reaching 4.7% in 2017 *vs* 2.5% in 1990 [5]. Given the mental health implications of ACE, India's increasing share in global disease burden, and the high prevalence of mental health challenges in the population, there is an opportunity to identify critical drivers of mental health in India. With multiple healthcare challenges and limited research on ACE in India, a new approach focused on prevention is necessary in public health to avoid a disproportionate increase in mental disorders.

Global evidence on the impact of Adverse Childhood Experiences on health and wellbeing

The original work, using the 10-point questionnaire (Fig. 1) developed in collaboration with the Center for Disease Control & Prevention, United States, identified a strong graded relationship between the extent of ACE exposure during childhood and the presence of multiple risk factors for several of the leading causes of death in the United States [6]. This questionnaire is validated across several continents for the impact of these 10 experiences on mental and physical health [1, 7]. Since then, newer versions are explored by adding several more adverse experiences such as: (1) peer victimization; (2) peer isolation or rejection; and (3) socioeconomic position (SEP) [8, 9]. WHO has also propagated a new questionnaire by adding two more new elements: (1) community violence; and (2) parental separation or death [10-13]. For the purpose of this review, we recommend focusing on the original 10-point questionnaire based on the established

https://doi.org/10.15167/2421-4248/jpmh2021.62.3.1785

Fig. 1. Adverse Childhood Experiences and their categories.



processes and scientific evidence of over more than two decades.

Specific research findings highlighted in Figure 2 are captured below:

- *ACE and overall health consequences:* a review of > 250,000 subjects indicated that if the individual experienced 4 or more ACEs, he/she is more likely to experience multiple health outcomes compared to individuals with no ACE. The more ACE elements the individual reports, the higher the risk of health-harming behavior (e.g., smoking, sexual risk-taking) and the likelihood of infectious and non-communicable disease [1, 7, 14];
- *higher risk of developing mental disorder:* the evidence indicates that the dose-dependent risk based on the number of ACE experiences is highest for depression followed by PTSD, borderline personality disorder, and substance abuse [15-17];
- *ACE and physical health implications:* ACE is also associated with obesity, diabetes, inflammatory bowel disease (e.g., ulcerative colitis, Cohn disease), and abnormal pain perception with or without the related body pathology [18];
- *implications beyond the present generation:* Specific outcomes such as violence, mental illness, and problematic substance abuse (correlated with multiple ACEs) can represent ACEs for the next generation through exposure to parental domestic violence, mental illness, and substance abuse [19]. This evidence confirms that the implications of ACE go beyond the present generation into a cycle that includes adversity, deprivation, and ill-health;
- *across developed and developing world:* The work has been extended into some developing and low-income countries, and the findings confirm a similar dose-response relationship between ACE and health outcomes and risk behavior [11, 20, 21]. Evidence estimates that about 319 million adolescents and adults across Europe and 172 million across North America are carrying the legacy of ACE. In addition, about 142 million in Europe and 103 million in North America are estimated to have multiple ACEs, and these individuals could carry the health-harming behaviors and eventually chronic disease [1];
- *linked to criminal behavior:* A 2015 study on more than 22,000 delinquent youth referred to the Florida Dept of Juvenile Justice indicated that for each additional adverse experience, the child experiences increased risk of becoming a serious, violent, and chronic juvenile offender by 35, while controlling for other risk factors for criminal behavior [22];
- *opportunity to integrate the limitations of existing ACE questions:* While exploring the evidence, it is essential to note the limitations of the existing ACE model that primarily uses 10 questions. Specifically, the model excludes exposure to community violence, lower socio-economic status - the two variables that have out-performed some of the ACEs-10 items [8]. There is also an opportunity to integrate exposure to poverty in the ACE model [23]. While the simplicity

Fig. 2. Implications of Adverse Childhood Experiences on health and wellbeing.

of the ACE questionnaire has generated strong evidence, the experts also argue the need to integrate a more structured approach such as providing a preamble on sensitive questions, add a broader scale vs. just yes and no. However, as captured earlier, the recommendation is to focus on the original 10-questions.

Overall, the evidence confirms a clear dose-response linkage between ACE, adult health behavior, and outcome. The data also indicates that the outcomes extend beyond the present generation. These findings from the global research make a compelling reason to re-apply and create a more integrated approach for measuring and preventing adverse childhood experiences, specifically in mental health care management for India. In other words, the concept of the "inner child" phenomena (a psychosynthesis of all ages from childhood to old age) continues to impact human being's overall expressions of themselves in the world [24].

Evidence of the work done on ACE or related categories in India

About 19% of the world's children are in India, and these children constitute 42% of the Indian population (2011 census). 50% of these children are vulnerable and need care and protection [25]. The following points provide the context about the adverse childhood experiences research in India, with a specific focus on mental health:

Studies integrating all ACE elements to understand the impact on mental health

In India, very few studies integrate all the ACE parameters to understand its impact on health and well-being [25]. Expressly, the 2019 study in the state of Kerala indicated 91% prevalence amongst the youth who had experienced ≥ 1 ACE, and about 50% of them had experienced ≥ 3 ACEs [26]. Similar to the global studies, this study also found increased odds of having major depression in adulthood (4 times higher). In addition, the study also found that those individuals with family dysfunction had higher odds (2 times higher) of experiencing antipathy and sexual and psychological abuses confirming that the impact of ACE goes beyond the present generation.

Studies on individual elements of ACE

With limited studies on the impact of multiple ACEs on the individual, it is prudent to review the research about the impact of the ACE elements (Fig. 1) on mental health.

- *Physical abuse:* the first nationwide study in India in 2007 on Child abuse by the Ministry of Women and Child Development indicated a high prevalence among young children (5 to 12 years old). These children were at risk of abuse and exploitation. Specifically, 69% of the 55% abused individuals were boys, and the source of the abuse was parents in most cases. Juvenile justice institutions also have similar evidence [27]. Physical abuse is the most common form of early trauma experienced in both males and females, leading to suicidal ideation [28]. Another study found that physical abuse at home, sexual abuse, and alcohol abuse were independently associated with suicidal behavior [29]. A cross-sectional study across five states in India of more than 5,000 subjects indicated that adults' drinking is associated with physical abuse, psychological abuse, and neglect [30, 31]. Thus, physical abuse increases the risk of poor health outcomes and mental health challenges.
- *Childhood Sexual Abuse (CSA):* a study done in India on CAS indicates that it is significantly associated with mood, substance use, and anxiety disorders in both genders. CSA victims have increased risks for temperamental problems, poor social adjustment, lack of trust, and insecure relations with parents. The literature of the same study indicates that 4-41% of the girls and 10-55% of the boys in school and college students have experienced one form (contact, non-contact, forced) of CSA in India. It also suggests that CSA does not necessarily occur individually but may also co-occur with other ACEs in the same child [32]. Another study on women with serious mental illness reveals that 18 out of 50 respondents reported a history of sexual abuse in their childhood. These abuses ranged from fondling to actual penetration [33]. Evidence has also confirmed the impact of CSA on family and the social function of the individual.
- *Emotional abuse:* a study across different states in India on college students from three different strata, namely medical, engineering, and arts and science college, on 936 subjects found that: (a) 42% of the participants reported that they were referred to as 'idiot" during their childhood; (b) around 48% were mocked because of their physical appearance, around 35.8% being called foul names; and (c) 32.6% were blamed for things that were not their fault. Humiliation without any justified cause was reported by around 18.2% of the participants [34]. A study was done on childhood maltreatment among adolescents with child work history on 132 adolescents from different cities like Delhi, Varanasi, and Jaipur. The results indicated that there was a higher proportion of emotionally abused participants compared to non-abused participants who met the criteria for the oppositional defiant disorder (17.5%), panic attack (19%), major depression (9.5%), and dysthymia (25.4%) [27]. Some studies highlighted under physical abuse earlier also included emotional or psychological abuse and confirmed that it is associated with a higher risk of mental health challenges in adulthood.
- *Neglect:* in a state-wide survey in Gujarat, around 30% of the children reported feeling 'neglected' [35]. Another study by the Ministry of women and child development (2007) found that around 27% of girls were getting less food than their brothers. Half of

them experienced emotional abuse, but most girls (71%) experienced neglect from their families, and all these maltreatments were associated with poor mental health. The same study on childhood maltreatment among adolescents with child work history indicated that participants with general neglect showed more significant hyperactivity than those who had no such experience. It was also observed that neglect was significant for ADHD (Attention Deficit Hyperactivity Disorder), major depression, dysthymia, bipolar disorder, and eating problems [27].

- *Household substance abuse:* a study on maltreatment among adolescents with child work history from different cities like Delhi, Varanasi, and Jaipur found that parental substance abuse was present in 12.9% of the total sample. The effect of parental substance abuse is significant for generalized anxiety disorder, and dysthymia and it also exhibited a trend for major depression [27].

While the above studies are limited in terms of sample size and geography, the outcome provides sufficient evidence consistent with global findings of the role of several ACE elements and their implications on mental health. In addition, the evidence includes the increased probability of extending the impact of ACE elements in the family to the next generation. Finally, when an individual experiences multiple ACEs, it increases the odds of experiencing long-term mental health challenges.

Studies in the areas not covered under core ACE elements

The studies highlighted below explored the elements beyond the original 10-point ACE questionnaire to validate a strong linkage between these elements and mental health. These elements are also part of the familial environment or the community.

- *Bullying:* bullying is reported commonly (70%) and mainly in schools. A study in Gujarat on 2,182 subjects found 199 as bullies, 406 as victims, 924 as bully-victims, and 653 as non-involved. Bullying happened in the classroom while the teacher was away (18.9%), during recess (26.6%), during the prayer session (7%), just after school (21%), and on the way home (12.6%) [35]. Another study found that out of the bullied students, 60.7% of them had significant mental health problems. About 26.1% had some borderline level of mental health problems; significant emotional problems (10.5%), conduct issues (20.3%), hyperactivity-inattention (6.2%), peer problems (16.9%), and low prosocial behaviors (5.7%) [31].
- *Post-Traumatic-Stress-Disorder (PTSD):* PTSD is a likely outcome based on the ACE elements. A study on the prevalence of PTSD in the Indian context indicated that abuse scored the second highest in average prevalence, around 28%. Along with that, 15 other studies were additionally identified and compared to the prevalence rates of other trauma-related disorders. The most commonly reported prevalence rates of other disorders following exposure to traumatic events other than PTSD include depression, anxiety disorder, adjustment disorder, and panic disorder [36]. In addition, a study in the northern region of Kashmir in India highlighted that depression and anxiety disorder are major co-morbid psychiatric disorders associated with PTSD [37].
- *Community violence:* despite the history of communal violence across India, there is not much work done in this area [37]. Based on insights from the global study, this area needs further work since community violence contributes significantly towards health outcomes as per the global research findings.
- *Other:* additional findings indicate that childhood maltreatment was linked to likely diagnosis of specific phobia (41.66%), conduct disorder (33.33%), social phobia (30.30%), dysthymia, obsession, compulsion, and so on. Generalized Anxiety, panic attack, and PTSD have been linked to childhood maltreatment.

Overall, the evidence reveals a significant impact on an individual's mental health based on the ACE elements and categories linked to family and the community. Childhood maltreatment or ACEs include physical abuse, sexual abuse, emotional abuse, neglect, and experiences like bullying, community violence, and post-traumatic stress disorder, which harm an individual's mental health.

The challenge for ACE and mental health in India

The evidence highlighted above captures most of the ACE elements from Figure 1. The global and Indian evidence discussed above confirms the significant increase in the odds ratio of health risk behavior and mental health implications as the number of ACE elements increases in the individual regardless of their demographics and geography. For India, while we have evidence on individual ACE elements, there is an opportunity to study the combined impact of multiple ACE elements on an individual's mental health. Several additional insights captured below provide the extent of challenge India is likely to face:

- India has less than 1% of the national healthcare budget allocated to mental health. According to recently published data, about 12% with depression (six states data) and only 40-50% with schizophrenia in India receive care [38].
- Individuals experiencing social and economic adversities have a high prevalence and risk for mental health issues, which adds to India's complexity and risk [39]. Thus, India does not have sufficient funds and professionals to reach out to individuals facing mental health issues today.
- The National Mental Health Survey (2016), the largest survey of mental morbidity in India, estimated that nearly 150 million individuals suffer from one or the other mental morbidity in the country [40]. As captured earlier, the proportional contribution of mental disorders to the total disease burden in India has almost doubled in 2017 compared to 1990 [5].

Despite improvements in various health metrics, India still contributes disproportionately to the global disease burden. For example, considering specific data for suicide rate, India, with 15.7 per 0.1 million population, stacks up higher than the regional average of 12.9 and the global average of 10.6 [41].

- About 10 million Indians aged 13-17 years suffer from severe mental illness, and this number could increase if the entire age spectrum of childhood and adulthood is considered [42]. With the implications of ACE on mental health and the fact that India has the highest number of children and adolescents (0.4 billion together), there is an opportunity to focus on primary prevention of ACE in such a large population [43]. In addition, the environment (family, community) that facilitates the creation of ACE also needs to be identified and addressed.
- Finally, as per the year 2017 data, mental disorders are one of the leading contributors in India to YLDs (Years Lived with Disability) at 14.5%, and its contribution to DALYs (Disability-Adjusted-Life-Years) has increased to 4.7% in 2017 *vs* 2.5% in 1990 [5, 44].

Together, the above points present a gloomy picture for India and its mounting mental health challenge linked to ACE.

The urgent need for prevention-focused approach

The high prevalence of individual ACE elements and their association with a broad-based negative impact on mental health, family, the social function of the individual, and finally, the DALYs indicate that India needs an aggressive prevention plan [45]. In addition, several factors in the Indian context, such as: (1) strong linkage between childhood adversities and mental health; (2) the increasing proportional burden of mental health; and (3) the complex interconnections between the individual, the family, the community, and the society, highlight a need for a multi-pronged, multi-level (i.e., across social, healthcare, and political levels) intervention focused on prevention.

The prevention approach must include: (a) primary prevention that attempts to prevent all possible ACEs so that children are less exposed to the adversity and are less likely to have their children experience the ACEs; (b) secondary prevention that aims to reduce the immediate and short-term consequences of the experiences; and finally (c) tertiary prevention that treats and reduces the long-term consequences of ACEs [46]. Amongst these ideas, primary prevention will have the most significant individual, and social impact and hence must be the focus for India [47].

Discussions and recommendations

India has a National Mental Health Program since 1982, and the National Mental Health Policy was introduced in 2014, followed by the rights-based Mental Health Care Act in 2017. Specific programs such as Rashtriya Bal Swasthya Karyakram (RBSK) focusing on adolescent groups and Rashtriya Kishor Swasthya Karyakram (RKSK) covering children from birth to age 18 by the Ministry of Health & Family Welfare have identified mental health as one of the objectives. These platforms are presently available for mental health issues. India also has a strong presence of non-governmental organizations (NGOs) such as Childline, community-based setups, civic forums, etc. While these organizations can help, given many children needing help and the need to prioritize early childhood challenges such as mortality, quality nutrition, etc., there is an opportunity to have a more integrated approach specifically focused on prevention. The program must also include awareness at the grassroots level, education of the child, family, community, and research to drive prioritization and effectiveness. While there is a legal framework supporting the idea, the implementation and enforcement need to be strengthened. For example, a comparison of the number of child marriages in India (43% women aged 20-24 were married before they were 18) and the number of people prosecuted for anti-child marriage law (a few hundred per year, at best), it shows that the law is not enforced [48]. The extent of existing prevalence, inadequate coverage of mental health services, low awareness, and stigma attached to "mental" health conditions further complicate the challenges in ACE prevention. Despite these challenges, it is evident that this work needs to be integrated with existing programs in a multi-pronged manner, focusing on prevention across all levels.

The suggestions below highlight the key recommendations for India (vital elements captured in Fig. 3) to increase the probability of success in controlling the potential escalation in mental health disorders over the next few decades in India:

- *prevention focus*: at each stage of ACE, from occurrence to its implications, the focus must be on prevention as described below [49]:
  - primary prevention: focusing on prevention of the occurrence of ACE through parenting and community efforts,
  - secondary prevention: reducing the severity and acute outcomes of ACE through immediate intervention to prevent short term implications and finally,
  - tertiary prevention: preventing the long-term consequences through programs that can address chronic health implications;
- *public awareness campaign*: the three categories of household challenges, abuse and neglect (Fig. 1) and their implications need broad-based awareness and recall across the family and community level for actionability. Few specific suggestions are captured below [49]:
  - this needs to follow the branding model where the focus is: (a) awareness; (b) recall; and eventually (c) action. This will ensure each person, regardless of his/her role, is empowered to act for prevention. The awareness and recall could include several

celebrity endorsements, and the action could be coordinated by NGO related social framework,
  - the closest contact of the child, i.e., parents, school teachers, and primary health professionals, must be trained to identify and act on the potential subject through this campaign. Education across the cross-functional teams (see below), specifically for parents and teachers driving action, to prevent ACE, must be made mandatory through social media, celebrity, print campaigns, and inclusion in school textbooks. Research has also indicated that efforts to mobilize the men and boys as allies in prevention can help,
  - a team consisting of health professionals, political leadership, and social health experts must lead this work, and we recommend enrollment of political leadership.

Given the limited funding for mental health in India and the perception of taboo for mental health, the effort needs to also focus on changing society's perception and belief systems. Despite these challenges, public awareness must form the core backbone of the intervention spanning the healthcare experts, social workers or scientists, the critical population, i.e., family/caregiver, the subject, and the political leadership. Needless to add, public awareness must happen in parallel to activities instead of waiting to get all the answers from the outcomes of other elements. Insights from successful public healthcare campaigns such as polio eradication or Childline could be incorporated into this program [50];

- *cross-functional teams*: the work in this area is complex, and the impact sometimes takes decades or generations to manifest. This complexity requires a holistic intervention involving several healthcare professionals, individuals, families, and communities. Figure 3 captures the list of professionals or individuals needed in the team that includes: (a) Mental Health Professionals; (b) Public Health Professionals; (c) Social Workers; (d) Parents and Caregivers; and finally (e) Primary Health Clinic. These teams must incorporate the primary, secondary and tertiary ACE prevention mindset and work together as one organization;
- *Govt policies and plan*: National Mental Health Policy must propagate the identification and prevention of ACE as a key element for the mental health prevention strategy. RBSK and RBSK frameworks should be modified to include ACE prevention as a core strategy with implementation plans;
- *research linking ACE and mental health*: this work needs to focus on ACE identification and highlight critical elements of the original 10 ACE elements (Fig. 1) with maximum impact on scale and intensity of mental health challenges. A multifunctional team involving public health professionals, mental health professionals, social health experts, and epidemiologists must drive this work. Similarly, learnings from region-specific programs linking poverty or socioeconomic health and mental health also need to be weaved in [51].

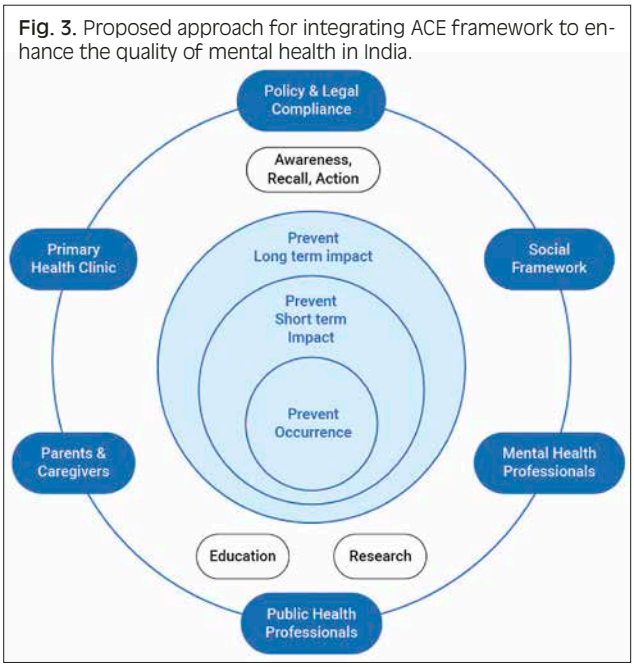


Fig. 3. Proposed approach for integrating ACE framework to enhance the quality of mental health in India.

The above points provide a set of ideas to begin a multi-pronged approach to understanding, identifying, managing, and preventing mental health linked with ACE. With more evidence and knowledge, this work could become the core foundation to transform India's mental healthcare scenarios significantly. ACE Prevention is not only essential for the mental well-being of future generations, but it also is critical for India's economic growth [52].

Conclusions

Identifying, addressing, and preventing the combined impact of multiple categories of adverse childhood experiences is a critical driver for reducing the mental health burden India is facing. Extensive global research and early findings from India on the dose-response relationship between ACE and mental health confirm this. With this background and mounting scientific evidence, the review has identified the urgent need for ACE prevention and highlighted the need to expedite the research in this area. India needs to prioritize ACE prevention and management and re-apply insights from work done across developing and developed nations. The recommendation includes a multi-pronged approach driving research, awareness, prevention, education, and management with strong collaboration among mental health, public health, and social health professionals.

Acknowledgements

Funding sources: this research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.
Dr Vikas Kokare, Sub Regional Team Coordinator, WHO,

Gujarat, India for his guidance on the recommendations We thank Dr Vikas Kokare, Sub Regional Team Coordinate, WHO, Gujarat, India for his guidance on the recommendations. Authors also acknowledge the review by Dr Anita Verma (Physiologist). Finally, a special thanks to Tana Trivedi, PhD, for her constructive comments to modify the overall flow of the article

Conflict of interest statement

The authors declare no conflict of interest.

Authors' contributions

Idea generation, structure, global research and recommendations (GYT).
India specific research (NP).
Subject expertise, identification of additional 5 ACE elements, revision to integrate practical aspects.(RGT).

References

[1] Bellis MA, Hughes K, Ford K, Rodriguez GR, Sethi D, Passmore J. Life course health consequences and associated annual costs of adverse childhood experiences across Europe and North America: a systematic review and meta-analysis. Lancet Public Health 2019;4:e517-28. https://doi.org/10.1016/S2468-2667(19)30145-8

[2] Felitti VJ, Anda RF, Nordenberg D, Williamson DF, Spitz AM, Edwards V, Marks JS. Relationship of childhood abuse and household dysfunction to many of the leading causes of death in adults: the Adverse Childhood Experiences (ACE) Study. Am J Prev Med 1998;14:245-58. https://doi.org/10.1016/s0749-3797(98)00017-8

[3] Larkin H, Felitti VJ, Anda RF. Social work and adverse childhood experiences research: implications for practice and health policy. Soc Work Public Health 2014;29:1-6. https://doi.org/10.1080/19371918.2011.619433

[4] Wade Jr R, Cronholm PF, Fein JA, Forke CM, Davis MB, Harkins-Schwarz M, Pachter LM, Bair-Merritt MH. Household and community-level adverse childhood experiences and adult health outcomes in a diverse urban population. Child Abuse & Neglect 2016;52:135-45.

[5] Sagar R, Dandona R, Gururaj G, Dhaliwal RS, Singh A, Ferrari A, Dua T, Ganguli A, Varghese M, Chakma JK, Kumar GA. The burden of mental disorders across the states of India: the Global Burden of Disease Study 1990–2017. Lancet Psychiatry 2020;7:148-61. https://doi.org/10.1016/j.chiabu.2015.11.021

[6]Center for Disease Control & Prevention Website. https://www.cdc.gov/vitalsigns/aces/index.html (last accessed: Aug 24, 2020).

[7] Struck S, Stewart-Tufescu A, Asmundson AJ, Asmundson GG, Afifi TO. Adverse childhood experiences (ACEs) research: a bibliometric analysis of publication trends over the first 20 years. Child Abuse & Neglect 2021;112:104895. https://doi.org/10.1016/j.chiabu.2020.104895

[8] Finkelhor D, Shattuck A, Turner H, Hamby S. A revised inventory of adverse childhood experiences. Child Abuse & Neglect 2015;48:13-21. https://doi.org/10.1016/j.chiabu.2015.07.011

[9] Walsh D, McCartney G, Smith M, Armour G. Relationship between childhood socioeconomic position and adverse childhood experiences (ACEs): a systematic review. J Epidemiol Community Health 2019;73:1087-93. http://dx.doi.org/10.1136/jech-2019-212738

[10] Organization WHO. Adverse Childhood Experiences International Questionnaire (ACE-IQ) 2012. Available from: http://www.who.int/violence_injury_prevention/violence/activities/adverse_childhood_experiences/en

[11] Chang X, Jiang X, Mkandarwire T, Shen M. Associations between adverse childhood experiences and health outcomes in adults aged 18–59 years. PloS One 2019;14:e0211850. https://doi.org/10.1371/journal.pone.0211850

[12] Lee H, Kim Y, Terry J. Adverse childhood experiences (ACEs) on mental disorders in young adulthood: latent classes and community violence exposure. Prev Med 2020:106039. https://doi.org/10.1016/j.ypmed.2020.106039

[13] Adverse Childhood Experiences International Questionnaire (ACE-IQ). https://www.who.int/violence_injury_prevention/violence/activities/adverse_childhood_experiences/guidance_for_analysing.pdf?ua=1 (last accessed: Aug 31, 2020).

[14] Choi NG, DiNitto DM, Marti CN, Choi BY. Association of adverse childhood experiences with lifetime mental and substance use disorders among men and women aged 50+ years. Int Psychogeriatr 2017;29:359-72. https://doi.org/10.1017/S1041610216001800

[15] Herzog JI, Schmahl C. Adverse childhood experiences and the consequences on neurobiological, psychosocial, and somatic conditions across the lifespan. Front Psychiatry 2018;9:420. https://doi.org/10.3389/fpsyt.2018.00420

[16] Ege MA, Messias E, Thapa PB, Krain LP. Adverse childhood experiences and geriatric depression: results from the 2010 BRFSS. Am J Geriatr Psychiatry 2015;23:110-4. https://doi.org/10.1016/j.jagp.2014.08.014

[17] Von Cheong E, Sinnott C, Dahly D, Kearney PM. Adverse childhood experiences (ACEs) and later-life depression: perceived social support as a potential protective factor. BMJ Open 2017;7(9). https://doi.org/10.1136/bmjopen-2016-013228

[18] Herzog JI, Schmahl C. Adverse childhood experiences and the consequences on neurobiological, psychosocial, and somatic conditions across the lifespan. Front Psychiatry 2018;9:420. https://doi.org/10.3389/fpsyt.2018.00420

[19] Metzler M, Merrick MT, Klevens J, Ports KA, Ford DC. Adverse childhood experiences and life opportunities: shifting the narrative. Child Youth Serv Rev 2017;72:141-9. https://doi.org/10.1016/j.childyouth.2016.10.021

[20] Ramiro LS, Madrid BJ, Brown DW. Adverse childhood experiences (ACE) and health-risk behaviors among adults in a developing country setting. Child Abuse & Neglect 2010;34:842-55. https://doi.org/10.1016/j.chiabu.2010.02.012

[21] Almuneef M, Qayad M, Aleissa M, Albuhairan F. Adverse childhood experiences, chronic diseases, and risky health behaviors in Saudi Arabian adults: a pilot study. Child Abuse & Neglect 2014;38:1787-93. https://doi.org/10.1016/j.chiabu.2014.06.003

[22] Fox BH, Perez N, Cass E, Baglivio MT, Epps N. Trauma changes everything: examining the relationship between adverse childhood experiences and serious, violent and chronic juvenile offenders. Child Abuse & Neglect 2015;46:163-73. https://doi.org/10.1016/j.chiabu.2015.01.011

[23] McLennan JD, MacMillan HL, Afifi TO. Questioning the use of adverse childhood experiences (ACEs) questionnaires. Child Abuse & Neglect 2020;101:104331. https://doi.org/10.1016/j.chiabu.2019.104331

[24] Sjöblom M, Öhrling K, Prellwitz M, & Kostenius C. Health throughout the lifespan: The phenomenon of the inner child reflected in events during childhood experienced by older persons. Int J Qual Stud Health Well-being 2016;11:31486. https://doi.org/10.3402/qhw.v11.31486

[25] Damodaran KD, Rapheal J, Paul V. Child maltreatment in the Indian context. Int J Humanit Soc Sci 2014;4:333-9. https://www.researchgate.net/publication/281061036_Child_Maltreatment_in_the_Indian_Context

[26] Damodaran D,Varghese K. The unveiled Indian picture of Ad-

verse Childhood Experiences: socio-demographic correlates among youth in Kerala. Int Soc Sci Rev 2019;6:1248-1257. https://doi.org/10.2139/ssrn.3322512

[27] Pandey R, Gupta S, Upadhyay A, Gupta RP, Shukla M, Mishra RC, Arya YK, Singh T, Niraula S, Lau JY, Kumari V. Childhood maltreatment and its mental health consequences among Indian adolescents with a history of child work. Aust N Z J 2020;54:496-508. https://doi.org/10.1177/0004867420909524

[28] Singh S, Manjula M, Philip M. Suicidal risk and childhood adversity: a study of Indian college students. Asian J Psychiatr 2012;5:154-9. https://doi.org/10.1016/j.ajp.2012.02.024

[29] Pillai A, Andrews T, Patel V. Violence, psychological distress and the risk of suicidal behaviour in young people in India. Int J Epidemiol 2009;38:459-69. https://doi.org/10.1093/ije/dyn166

[30] Esser MB, Rao GN, Gururaj G, Murthy P, Jayarajan D, Sethu L, Jernigan DH, Benegal V; Collaborators Group on Epidemiological Study of Patterns and Consequences of Alcohol Misuse in India. Physical abuse, psychological abuse and neglect: Evidence of alcohol-related harm to children in five states of India. Drug Alcohol Rev 2016;35:530-8. https://doi.org/10.1111/dar.12377

[31] Mishra K, Ransing R, Khairkar P, Gajanan S. Association between childhood abuse and psychiatric morbidities among hospitalized patients. Int J Soc Psychiatry 2016;32(1). https://doi.org/10.4103/0971-9962.176769

[32] Choudhry V, Dayal R, Pillai D, Kalokhe AS, Beier K, Patel V. Child sexual abuse in India: A systematic review. PloS One 2018;13:e0205086. https://doi.org/10.1371/journal.pone.0205086

[33] Chandra PS, Carey MP, Carey KB, Shalinianant A, Thomas T. Sexual coercion and abuse among women with a severe mental illness in India: an exploratory investigation. Compr Psychiatry 2003;44:205-12. https://doi.org/10.1016/S0010-440X(03)00004-X

[34] Bhilwar M, Upadhyay RP, Rajavel S, Singh SK, Vasudevan K, Chinnakali P. Childhood experiences of physical, emotional and sexual abuse among college students in South India. J Trop Pediatr 2015;61:329-38. https://doi.org/10.1093/tropej/fmv037

[35] Patel V, Varma J, Nimbalkar S, Shah S, Phatak A. Prevalence and profile of bullying involvement among students of rural schools of anand, Gujarat, India. Indian J Psychol Med 2020;42:268-73. https://doi.org/10.4103/IJPSYM.IJPSYM_172_19

[36] Gilmoor AR, Adithy A, Regeer B. The cross-cultural validity of post-traumatic stress disorder and post-traumatic stress symptoms in the Indian context: a systematic search and review. Front Psychiatry 2019;10:439. https://doi.org/10.3389/fpsyt.2019.00439

[37] Mushtaq R, Shah T, Mushtaq S. Post-Traumatic stress disorder (PTSD) in children of conflict region of Kashmir (India): a review. J Clin Diagn Res 2016;10(1):VE01. https://doi.org/10.7860/JCDR/2016/11766.7152

[38] Patel V, Xiao S, Chen H, Hanna F, Jotheeswaran AT, Luo D, Parikh R, Sharma E, Usmani S, Yu Y, Druss BG. The magnitude of and health system responses to the mental health treatment gap in adults in India and China. Lancet 2016;388:3074-84. https://doi.org/10.1016/S0140-6736(16)00160-4

[39] Narasimhan L, Gopikumar V, Jayakumar V, Bunders J, Regeer B. Responsive mental health systems to address the poverty, homelessness and mental illness nexus: the Banyan experience from India. Int J Ment Health Syst 2019;13:1-0. https://doi.org/10.1186/s13033-019-0313-8

[40] Gautham MS, Gururaj G, Varghese M, Benegal V, Rao GN, Kokane A, Chavan BS, Dalal PK, Ram D, Pathak K, Lenin Singh RK. The National Mental Health Survey of India (2016): prevalence, socio-demographic correlates and treatment gap of mental morbidity. Int J Soc Psychiatry 2020:0020764020907941. https://doi.org/10.1177/0020764020907941

[41] Srivastava K, Chatterjee K, Bhat PS. Mental health awareness: the Indian scenario. Ind Psychiatry J 2016;25:131. https://doi.org/10.4103/ipj.ipj_45_17

[42] Ministry of Health and Family Welfare, Government of India. National Mental Health Survey of India. 2016. Available from: http://www.indianmhs.nimhans.ac.in/Docs/Summary.pdf (last accessed on 2020 Aug 06).

[43] Hossain MM, Purohit N. Improving child and adolescent mental health in India: status, services, policies, and way forward. Indian J Psychiatry 2019;61:415. https://doi.org/10.4103/psychiatry.IndianJPsychiatry_217_18

[44] Release of GBD India Mental Disorders Paper, Press Release, Indian Council of Medical Research (ICMR/PR Unit/IIFO/2019/50, 23/12/2019).

[45] Carson DK, Foster JM, Tripathi N. Child sexual abuse in India: Current issues and research. Psychological Studies 2013;58:318-25. https://doi.org/10.1007/s12646-013-0198-6

[46] Oral R, Ramirez M, Coohey C, Nakada S, Walz A, Kuntz A, Benoit J, Peek-Asa C. Adverse childhood experiences and trauma informed care: the future of health care. Pediatr.Res 2016;79:227-33. https://doi.org/10.1038/pr.2015.197

[47] Poole MK, Seal DW, Taylor CA. A systematic review of universal campaigns targeting child physical abuse prevention. Health Educ Res 2014;29:388-432. https://doi.org/10.1093/her/cyu012

[48] Seth R. Protection of children from abuse and neglect in India. Japan Med Assoc J 2013;56:292-97 (last accessed on Jun 14, 2021).

[49] Centers for Disease Control and Prevention. Preventing Adverse Childhood Experiences: leveraging the best available evidence. Atlanta, GA: National Center for Injury Prevention and Control, Centers for Disease Control and Prevention 2019 (last accessed, Jun 11, 2021).

[50] John TJ, Vashishtha VM. Eradicating poliomyelitis: India's journey from hyperendemic to polio-free status. Indian J Med Res 2013;137:881.

[51] Narasimhan L, Gopikumar V, Jayakumar V, Bunders J, Regeer B. Responsive mental health systems to address the poverty, homelessness and mental illness nexus: the Banyan experience from India. Int J Ment Health Syst 2019;13:1-0. https://doi.org/10.1186/s13033-019-0313-8

[52] Sethi D, Yon Y, Parekh N, Anderson T, Huber J, Rakovac I, Meinck F. European status report on preventing child maltreatment. World Health Organization 2018.

Received on September 21, 2020. Accepted on June 8, 2021.

Correspondence: Gunjan Y. Trivedi, Society for Energy & Emotions, Wellness Space, 119-C Swastik Society, Navrangpura, Ahmedabad 380009, India - Tel.: +91.9574742288 - E-mail: gunjan@wellness-space.net

How to cite this article: Trivedi GY, Pillai N, Trivedi RG. Adverse Childhood Experiences & mental health – the urgent need for public health intervention in India. J Prev Med Hyg 2021;62:E728-E735. https://doi.org/10.15167/2421-4248/jpmh2021.62.3.1785

OPEN ACCESS J PREV MED HYG 2021; 62: E736-E741

RESEARCH ARTICLE

Investigating the predictors of breast cancer screening behaviors (breast self-examination, clinical examination or examination by physician/midwife and mammography) based on protection motivation theory (PMT) in women

MAHIN NAZARI, FAHIMEH MAHBOOBI GHAZAANI, MOHAMMAD HOSSEIN KAVEH, MASOUD KARIMI, LEILA GHAHREMANI
Department of Health Education and Health Promotion, School of Health, Shiraz University of Medical Sciences, Shiraz, Iran

Keywords

Screening • Breast Cancer • Protection Motivation Theory • Behaviors

Summary

Background. *Breast cancer is one of the most common health problems worldwide. The mortality rate of this disease is due to the lack of knowledge about screening methods and late diagnosis of cancer.*
Objective. *The purpose of this study is to determine the predictors of breast cancer screening behaviors using protection motivation theory.*
Methods and materials. *The conduction of study was cross-sectional and on 400 women aged 30-59 in Kashan. The data collection instrument was a researcher-made questionnaire based on protection motivation theory. Sampling was performed from all community health service centers in Kashan and the proportional to size sampling method was used as available sampling. The statistical tests were Pearson correlation and linear regression. The software used was version 22 SPSS and the significance level was 0.05.*
Results. *The results showed that the average age of women was 39.7 ± 7.9 years. There is a direct and statistically significant relationship between perceived breast cancer screening behaviors and perceived self-efficacy ($P < 0.05$) and there is an inverse statistically significant relationship between breast cancer screening behaviors and perceived cost ($P < 0.05$). There is also a direct and significant statistical relationship between motivation of protection and perceived sensitivity, intensity, self-efficacy, cost, and perceived response efficiency ($P < 0.05$). Perceived self-efficacy, cost, and response efficiency are the predictors of breast cancer screening behaviors. The perceived cost is the negative predictor.*
Conclusion. *Overall, health care providers can view PMT as a framework for developing educational interventions aimed at improving behaviors related to breast cancer screening of women.*

Introduction

Breast cancer is the most common cancer in developed and developing countries. Breast cancer is one of the most important health problems in Iran [1, 2] and according to the latest national data base, the standard age for breast cancer is 33.21 per 100,000 [2]. A recent study on breast cancer reported that the average age of breast cancer in Iranian women was 5 years earlier than that in developed countries [3] and the National Cancer Registration Program reported an increase in the incidence rate. Also, breast cancer is the fifth leading cause of cancer death and is estimated to have 14.2% mortality [2].
Previous researches in Iran have shown that breast cancer has a significant impact on women's lives [4]. Lack of awareness of risk factors, breast cancer screening methods, cultural taboos, feelings of shame about talking about breast cancer, lead to late diagnosis and progression of breast cancer and death. Screening involves breast self-examination, examination by a physician, and mammography; self-examination is the easiest way for the initial diagnosis [5].
Among the methods of breast cancer screening, breast self-examination by women is a simple, effective and useful method for breast cancer screening that is suitable for all women and increases self-awareness [6]. Although there is no evidence of the effect of breast self-examination on early detection of breast cancer, according to the Kotka pilot project [7] breast self-examination among early detection methods leads to better diagnosis and reduction of mortality, but studies in Sweden, Russia and Shanghai show no progress in the reduction of mortality [8-10]. However, it has been shown that breast self-examination may be of particular importance in countries where breast cancer is on the rise, but mammography services are not much available [11].
Due to the lack of population-based mammography screening program in Iran, it appears that breast self-examination and subsequent examination by a physician may be appropriate methods in empowering women to diagnose breast cancer early. Breast self-examination and then a doctor's examination are helpful for women who do not have access to another screening method, such as a mammography. Despite the benefits of breast

 https://doi.org/10.15167/2421-4248/jpmh2021.62.3.1857

self-examination, many women are inactive, and various studies have reported insufficient breast self-examination [12].

The Protection Motivation Theory (PMT) is a useful and social cognitive model for motivating the use of protective behaviors and is often used in breast cancer screening [13]. According to the PMT model, women who are more aware of the risk and are prone to breast cancer, and those who consider themselves at risk for serious illness, are more likely to affect the screening-related behaviors. Numerous studies have shown the effectiveness of PMT in breast cancer screening [14-18].

Although breast cancer is one of the few cancers identified in the early stages, this level is very low in Iran [19]. The aim of this study was to determine the predictors of breast cancer screening behaviors (breast self-examination, clinical examination or examination by physician /midwife and mammography) using the Protection Motivation Theory (PMT).

Methods and materials

Study plan

This analytical research was performed as a cross-sectional study on 400 women aged 30-59 years referring to community health service centers and health centers in Kashan (Iran) from March 2019 to April 2020.

Study participants and sampling environment

This study was conducted in Kashan, in central Iran. The target population of the study was all women (single and married) aged 30-59 years, who were selected from 14 health centers and 14 community health centers in Kashan. The criteria for entering the study included: women aged 30-59, consent to participate in the study, lack of breast disease, having a health record in health centers and data bases, and lack of neurological and mental illness. Dependent variables included: protection motivation theory structure including perceived vulnerability, perceived severity, perceived self-efficacy, perceived response costs, perceived response efficiency, and breast cancer screening behaviors, and independent variables included: age, women's level of education, social and job positions.

Sampling

In this study, Cochran's formula was used to estimate the best sample size. In the present study, with $p = 0.05$ and the value of $q = 0.05$, the sample size was considered to be $n = 385$, which, taking into account the fall, the sample number of 400 people was selected. Sampling was done from all community health service centers and health centers in Kashan (14 centers + 14 bases) and the proportional to size sampling method was used (sample size of each center and base, based on the ratio of the population of women aged 30-59 in that center or base was determined). Then, from the women who referred to the relevant centers and bases, the information was collected using the available (easy) data collection method until we reached the desired sample size.

Questionnaire or measurement tool

The method of collecting information in this study was to present a questionnaire to the subjects in person and complete it in a report. In this study, two questionnaires were used to collect data: 1) demographic profile questionnaire with 18 options containing questions related to individual characteristics including: age, level of education, marital status, family history of cancer and household income; and 2) researcher-made questionnaire based on the protection motivation theory structure in breast cancer screening behaviors and women's knowledge in this field with 31 and 18 questions, respectively, due to the lack of a standard questionnaire in this field, it was codified using sources and reference books and the results of other studies [20, 21]. Questions related to theoretical structures separately included: 4 questions related to perceived vulnerability, 5 questions related to perceived intensity, 8 questions related to perceived self-efficacy, 7 questions related to perceived response costs, 4 questions related to perceived efficacy of the response and 3 questions about breast cancer screening behaviors (breast self-examination, clinical examination or examination by physician /midwife and mammography) and 18 knowledge questions related to women's information about breast cancer, its signs and symptoms and screening behaviors available in this regard. Each question of the protection motivation theory structure was scored using the Likert 5 scale, from a completely opposed option for some items to a completely agreed item for some items. For scoring questions related to behavior, yes and no, code 1 was given to answer yes and code 0 to answer no as their scores. To rate the knowledge questions, answer yes got code 1 and answer no and I don't know got code 0.

Investigating the validity and reliability of the questionnaire

After finalizing the initial draft of the researcher-made questionnaire, its face validity, content validity and structure validity were examined. To evaluate the content validity, the designed questionnaire was provided to 9 specialists and professors of education and health promotion and 2 experts of the non-communicable diseases unit of Kashan Health Department who work in the field of cancer. Experts were asked to evaluate the questionnaire in terms of difficulty level, ambiguity level, observance of Persian grammar, use of appropriate words and placement of words in their proper place. In the next step, to calculate the content validity ratio, they were asked to classify each of the questions based on the three-part Likert spectrum, "it is necessary," "it is useful but not necessary," and "it is not necessary." To calculate the content validity index, they were also asked to identify the relevance, simplicity and clarity of each item based on a 4-part Likert spectrum. By calculating this index, test items were retained in the test, which based on the minimum acceptable in this index, gave a score above 79%. Accordingly, the ratio of content validity for knowledge, perceived vulnerability, perceived intensity, perceived self-efficacy, perceived response

costs, and perceived response efficiency, was respectively; 0.91, 0.9, 0.85, 0.95, 0.95 and 0.95. Content validity index for knowledge, perceived vulnerability, perceived intensity, perceived self-efficacy, perceived response costs, and perceived response efficiency was respectively; 0.92, 0.91, 0.91, 0.95, 0.92 and 0.91. The reliability of the questionnaire was assessed by internal consistency method and Cronbach's alpha coefficient and values equal to or higher than 0.7 were considered acceptable. For this purpose, questionnaires were distributed during the pilot study among 30 women who met the same entry criteria as the present study. Cronbach's alpha value for knowledge, perceived vulnerability, perceived intensity, perceived self-efficacy, perceived response costs, and perceived response efficiency, was obtained 0.7, 0.74, 0.72, 0.82, 0.7, 0.82 respectively. After reviewing the validity and reliability, the questionnaire was explained to 400 women in the target group according to the sampling method and was assigned according to the criteria for entering the study. The questionnaire was completed by the samples with the guidance of health care providers in centers and bases.

Analysis of results

The collected data was encoded and entered into (IBM SPSS version 22). A statistically significant level of less than 0.05 and equal to it was considered. Data analysis was performed using Pearson T independent correlation coefficient and linear regression.

Results

400 participants answered the questions in this study (answering percentage 97.5%), ten questionnaires were removed (four questionnaires due to non-participation, three questionnaires due to disease, three questionnaires due to breast problems). Average age of women was 39.7 ± 7.9 years. Most of the women surveyed were married (92.1%), housewives (65.4%) and had secondary education (47.4%) (Tab. I).

The knowledge score of the subjects was 9.2 ± 2.5 out of 18, which was at an average level.

45.6% of people had poor knowledge about breast cancer and half of the people performed breast self-examination.

There is a direct and statistically significant relationship between the breast cancer screening behaviors (breast self-examination, clinical examination or examination by physician/midwife and mammography) and perceived self-efficacy, efficiency of perceived response ($P < 0.05$) and there is an inverse and significant relationship between breast cancer screening behaviors (breast self-examination, clinical examination or examination by physician/midwife and mammography) and the perceived cost ($P < 0.05$).

There is also a direct and significant statistical relationship between perceived motivation and perceived sensitivity, perceived intensity, perceived self-efficacy, perceived cost, and perceived response efficiency ($P < 0.05$).

Perceived self-efficacy, perceived cost, and perceived response efficiency are predictors of breast cancer screening behaviors (breast self-examination, clinical examination or examination by physician /midwife and mammography). Perceived cost is a negative predictor of these behaviors. According to Table II, there is a direct and statistically significant relationship between people's knowledge about breast cancer and protection motivation theory structures ($P < 0.05$). (Tab. II).

According to Table III, the mean score of perceived self-efficacy and perceived cost was significantly different between the group performing breast screening behaviors (breast self-examination, clinical examination or examination by physician /midwife and mammography) and the group not who did not. ($P < 0.05$). (Tab. III).

Tab. I. Demographic characteristics of women.

Variables		Mean ± SD or N (%)
Age		39.7 ± 7.9
Marital status	Married	359 (92.1%)
	Single	16 (4.4%)
	Widow	8 (2.2%)
	Divorced	7 (1.3%)
Women occupation	Housewives	255 (65.4%)
	Working	135 (34.6%)
Education level	Primary	74 (19)%
	Secondary	185 (47.4%)
	More than high school	131 (33.6%)

Tab. II. Correlation between knowledge about breast cancer and sub-scale of PMT.

Scale	Knowledge on breast cancer	
	r	P-value
Perceived vulnerability	0.35	< 0.001
Perceived severity	0.15	0.004
Perceived self-efficacy	0.24	< 0.001
Perceived cost	-0.28	< 0.001
Perceived response efficacy	-0.22	< 0.001
Response efficacy	0.22	< 0.001
Protection motivation	0.16	0.006

PMT: Protection Motivation Theory.

Tab.III. The mean of the PMT subscale on screening practice.

Scale	Mean±SD		P-value
	Screening practice (100)	Non screening practice (290)	
Perceived vulnerability	21.9 ± 2.7	21.4 ± 3.1	0. 61
Perceived severity	21.9 ± 2.7	21.4 ± 3.1	0.08
Perceived self-efficacy	36.4 ± 3.7	35.1 ± 3.9	0.004
Perceived cost	15.4 ± 5.5	17.2 ± 6.1	0.01
Perceived response efficacy	18.4 ± 2.1	18 ± 2.1	0. 2
Protection motivation	108.7 ± 8.9	108.4 ± 9.7	0.79

PMT: Protection Motivation Theory.

Discussion

In Kashan, breast cancer is on the rise and is the most common cancer in women, occurring mainly in the 4th and 5th decades of life, so there is a need to implement prevention and screening programs in high-risk populations [22]. The present study is one of the studies conducted on the application of the protection motivation theory to predict the performance of breast cancer screening behaviors by women. The findings of this study regarding the protection motivation theory structures can predict the conduct of breast cancer screening behaviors. The main aim of the present study was to determine the predictive behaviors of breast screening (breast self-examination, clinical examination or examination by physician /midwife and mammography) using PMT theory. In our example, women's knowledge of breast cancer was low, leading to late visits to health centers. In our study, 45.6% of people had poor knowledge about breast cancer and half of the people performed breast self-examination, which is consistent with the study of Ghofranipour et al. [19]. According to the World Health Organization, 55.7% of women worldwide have poor knowledge about breast cancer [23].

In many studies, a significant relationship has been found between breast self-examination and women's knowledge of diagnostic methods for this cancer [24-27]. Our study also found a significant relationship between women's knowledge about breast cancer and the behavior of breast self-examination. Given that breast cancer occurs earlier in Iranian women [28], increasing awareness about breast cancer screening can reduce mortality from the disease. In this study, the most important source of information about breast cancer screening was health staff, because the scope of primary health services and the completeness and comprehensiveness of primary health care, including health education. which is consistent with the study of Ghofranipour et al. [19]. this study, approximately 25% of people performed behaviors related to breast cancer screening (breast self-examination, clinical examination or examination by physician/midwife and mammography), which is consistent with a study by Ghofranipour et al. [16] and the study by Ager B et al. [29]. In this study, the perceived sensitivity and severity in explaining the function of breast cancer screening behaviors on a regular basis were not significant, but increased self-efficacy and reduced cost were accompanied by the behaviors associated with breast cancer screening. This result is in line with the results of the study by Ghofranifard et al. and other studies conducted in this field [19].

In our study, self-efficacy was an important factor in performing breast cancer screening behaviors (women who had regular breast self-examinations, if necessary, went to a doctor for a breast examination or had mammography test, if prescribed by the doctor). Their basic level of self-efficacy was higher than other people. Other studies have linked varying degrees of self-efficacy and breast cancer screening behaviors [30-38].

Conclusions

In general, the findings of our study show that health care providers should use PMT as a program to create educational interventions aimed at improving behaviors related to breast cancer screening in women.

The strengths

This research is a theoretical study that examines breast cancer and its screening behaviors. Our findings provide evidence of the use of PMT as a framework for educational interventions in breast cancer and screening behaviors in breast cancer.

The limitations

This study had many limitations. First, it was a cross-sectional study, so no causal conclusion can be drawn. The example of this research was middle-aged women in a region in the city of Kashan, which does not necessarily indicate what is happening among women in rural areas. Therefore, the results of this study cannot be generalized to a larger population in Iran. In addition, the data were collected by a self-report questionnaire, which may have biases. Further studies are recommended including sufficient confirmation of the information reported in the researches.

Research involving human participants

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed Consent

Informed consent was obtained from all individual participants included in the study.

Ethics approval

Ethics approval for the study was received from the Ethics Committee, Shiraz University of Medical Sciences with Ethic code IR.SUMS.REC.1398.1207.

Acknowledgements

This research was extracted from a research project (Ethic code IR.SUMS.REC.1398.1207) financially supported by Shiraz University of Medical Sciences, Shiraz, Iran.
Hereby, the authors would like to thank Kashan

University of Medical Sciences and Comprehensive health service center for their cooperation in conduct this study.

Conflict of interest statement

The authors declare no conflict of interest.

Authors' contributions

MN: Article writing and tool making (questionnaire).
FMG: Article writing, tool making (questionnaire), Collecting data, data analysis.
MHK: Article editing and tool making (questionnaire).
MK: Article editing and tool making (questionnaire).
LG: Article writing and tool making (questionnaire).

References

[1] Ahmadi A, Ramazani R, Rezagholi T,Yavari P. Incidence pattern and spatial analysis of breast cancer in Iranian women: Geographical Information System applications. East Mediterr Health J 2018;24:360-7. https://doi.org/10.26719/2018.24.4.360

[2] Nafissi N, Khayamzadeh M, Zeinali Z, Pazooki D, Hosseini M, Akbari ME. Epidemiology and histopathology of breast cancer in Iran versus other Middle Eastern countries. Middle East J Cancer 2018;9:243-51. https://doi.org/10.30476/MEJC.2018.42130

[3] Akbari A, Razzaghi Z, Homaee F, Khayamzadeh M, Movahedi M, Akbari ME. Parity and breastfeeding are preventive measures against breast cancer in Iranian women. Breast Cancer 2011;18:51-5. https://doi.org/10.1007/s12282-010-0203-z.

[4] Pourhaji F, Ghofranipour F. Designing and psychometric evaluation of Breast Self-Examination Behavior Predicting Scale (BSEBPS). Int J Cancer Manag 2018;11:e74266. https://doi.org/10.5812/ijcm.74266

[5] Zare N, Haem E, Lankarani K, Heydari ST, Barooti E.. Breast cancer risk factors in a defined population: weighted logistic regression approach for rare events. J Breast Cancer 2013;16:214. https://doi.org/10.4048/jbc.2013.16.2.214

[6] Coleman C. Early detection and screening for breast cancer. Semin Oncol Nurs 2017;33:141-55. https://doi.org/10.1016/j.soncn.2017.02.009

[7] Hakama M, Pukkala E, Kallio M. Effectiveness of screening for breast cancer in women under 50 years at entry: the Kotka pilot project in Finland. Int J Cancer 1995;63:55-7. https://doi.org/10.1002/ijc.2910630111

[8] Semiglazov V, Moiseyenko V, Protsenko C. Russia (St.-Petersburg)/WHO randomized prospective study of the role of BSE in reduction of breast cancer mortality. Eur J Cancer 1998;34:S92.

[9] Thomas DB, Gao DL, Self SG, Allison CJ, Tao Y, Mahloch J, Ray R, Qin Q, Presley R, Porter P. Randomized trial of breast self-examination in Shanghai: methodology and preliminary results. J Natl Cancer Inst 1997;89:355-65. https://doi.org/10.1093/jnci/89.5.355

[10] Holmberg L, Ekbom A, Calle E, Mokdad A. Breast cancer mortality in relation to self-reported use of breast self-examination. A cohort study of 450,000 women. Breast Cancer Res Treat 1997;43:137-40. https://doi.org/10.1023/a:1005788729145

[11] Miller AB, To T, Baines CJ.Canadian National Breast Screening Study-2: 13-year results of a randomized trial in women aged 50-59 years. J Natl Cancer Inst 2000;92:1490-9. https://doi.org/10.1093/jnci/92.18.1490

[12] Asghari E, Nahamin M, Khoshtarash M, Ghanbari A, Parizad N, MahdavI N, Asgarlo Z. The relationship between health belief and breast self-examination among Iranian university students. Int J Wom Health Reprod Sci 2016;4:110-3. https://doi.org/10.15296/ijwhr.2016.26

[13] Meyerowitz BE, Chaiken S. The effect of message framing on breast self-examination attitudes, intentions, and behavior. J Pers Soc Psychol 1987;52:500. https://doi.org/10.1037/0022-3514.52.3.500

[14] Rahaei Z, Ghofranipour F, Morovatisharifabad M, Mohammad E. Determinants of cancer early detection behaviors: application of protection motivation theory. Health Promot Perspect 2015;5:138. https://doi.org/10.15171/hpp.2015.016

[15] Vahedian Shahroodi M, Pourhaje F, Esmaily H. Investigating the effectiveness of protection motivation, perceived self-efficacy and perceived response costs by behavior of breast self-examination. Iran J Obstet Gynecol Infertil 2013;15:1-9.

[16] Helmes AW. Application of the protection motivation theory to genetic testing for breast cancer risk. Prev Med 2002;35:453-62. https://doi.org/10.1006/pmed.2002.1110

[17] Karmakar M, Pinto SH L, Jordan T R, Mohamed I, Holiday-Goodman M. Predicting adherence to aromatase inhibitor therapy among breast cancer survivors: an application of the protection motivation theory. Breast Cancer: Basic Clin Res 2017;11:1178223417694520. https://doi.org/10.1177/1178223417694520.

[18] Fry RB, Prentice-Dunn S. Effects of a psychosocial intervention on breast self-examination attitudes and behaviors. Health Educ Res 2006;21:287-95. https://doi.org/10.1093/her/cyh066

[19] Ghofranipour F, Pourhaji F, Delshad MH. Determinants of breast cancer screening: application of protection motivation theory. Int J Cancer Manag 2020;13:1-7. https://doi.org/10.5812/ijcm.100535

[20] Khodayarian M, Peyghambari F, Mazloomy Mahmoodabad S, Morowatisharifabad MA, Lamyian M. Development and psychometric evaluation of a protection motivation theory–based scale assessing the adherence of Iranian women breast cancer prevention behaviors. Iran J Breast Dis 2019;12:8-18. https://doi.org/10.30699/acadpub.ijbd.12.01.8

[21] Khiyali Z, Ghahremani l, Kaveh MH, Keshavarzi S. The effect of an educational program based on protection motivation theory on pap smear screening behavior among women referring to health centers in Fasa. J Educ Community Health 2017;3:31-7. https://doi.org/10.18869/acadpub.JECH.3.4.31

[22] Asgarian F, Mirzaei M, Asgarian S, Jazayeri M. Epidemiology of breast cancer and the age distribution of patients over a period of ten years. Iran J Breast Dis 2016;9:31-6. http://ijbd.ir/article-1-507-en.html

[23] Tesson S, Richards L, Porter D, PHilips K, Rankin N, Musiello T, Marven M, Butow PH. Women's preferences for contralateral prophylactic mastectomy: An investigation using protection motivation theory. Patient Educ Couns 2016;99:814-22. https://doi.org/10.1016/j.pec.2015.11.012

[24] Bashirian S, Barati M, Mohammadi Y, Moaddabshoar L, Dogonchi M. An application of the protection motivation theory to predict breast self-examination behavior among female healthcare workers. Eur J Breast Health 2019;15:90. https://doi.org/10.5152/ejbh.2019.4537

[25] Irani M, Nosrati SF, GHaffari F. Knowledge, attitude, and practice of women regarding breast cancer screening behaviors in Mashhad, Iran. J Midwifery Womens Health 2021;9:2715-24. https://doi.org/10.22038/JMRH.2020.44788.1539

[26] Alivand A, Doulah A, Ziagham S. The knowledge and practice of women referred to the health centers affiliated to Ahvaz'university of medical sciences on breast cancer and its screening methods. J Midwifery Womens Health 2016;4:757-63. https://doi.org/10.22038/jmrh.2016.7568

[27] Dadzi R, Adam A. Assessment of knowledge and practice of breast self-examination among reproductive age wom-

en in Akatsi South district of Volta region of Ghana. PloS One 2019;14:e0226925. http://doi.org/10.1371/journal.pone.0226925

[28] Gutnik L, Lee C, Msosa V, Moses A, Stanley CH, Mzumara S, Liomba NG, Gopal S. Clinical breast examination screening by trained laywomen in Malawi integrated with other health services. J Surg Res 2016;204:61-7. https://doi.org/10.1016/j.jss.2016.04.017

[29] Ralph AF, Ager B, Bell ML, Collins LM, Andrews L, Tucker K, PHillips KA, Butow PH. Women's preferences for selective estrogen reuptake modulators: an investigation using protection motivation theory. Patient Educ Couns 2014;96:106-12. http://doi.org/10.1016/j.pec.2014.04.011

[30] Petro-Nustus W, Mikhail BI. Factors associated with breast self-examination among Jordanian women. Public Health Nurs 2002;19:263-71. http://doi.org/10.1046/j.1525-1446.2002.19406.x

[31] Dündar PE, Ozmen D, Ozturk B, Haspolat G, Akhildiz F, Coban S, Cakiroglu G. The knowledge and attitudes of breast self-examination and mammography in a group of women in a rural area in western Turkey. BMC Cancer 2006;6:1-9. http://doi.org/10.1186/1471-2407-6-43

[32] Lu Z-yJ. Variables associated with breast self-examination among Chinese women. Cancer Nurs 1995;18:29-34.

[33] Zolfaghari M, Yekta ZP, Nejad FB, Nejad AK. Knowledge about seven warning signs of cancer and protective measures of cancer among people in Tehran, Iran. Payesh Health Mon 2010;9:317-24. https://doi.org/20.1001.1.16807626.1389.9.3.9.1

[34] Rutledge D, Davis G. Breast self-examination compliance and the health belief model. Oncol Nurs Forum 1988;15:175-9.

[35] Ayala GX. Differences in the practice of breast self-examination by Latina & caucasian-American women: the role of acculturation, group orientation, locus of control and health beliefs. Data: 2015-09-21. http://hdl.handle.net/10211.3/147620. Last access: November 01, 2020.

[36] Milne S, Sheeran P, Orbell S. Prediction and intervention in health-related behavior: a meta-analytic review of protection motivation theory. J Appl Soc Psychol 2000;30:106-43. https://doi.org/10.1111/j.1559-1816.2000.tb02308.x

[37] Luszczynska A, Schwarzer R. Planning and self-efficacy in the adoption and maintenance of breast self-examination: a longitudinal study on self-regulatory cognitions. Psychol Health 2003;18:93-108. https://doi.org/10.1080/0887044021000019358

[38] Garcia K, Mann T. From 'I wish'to 'I will': Social-cognitive predictors of behavioral intentions. J Health Psychol 2003;8:347-60. .https://doi.org/10.1177/13591053030083005

Received on November 10, 2020. Accepted on June 3, 2021.

Correspondence: Leila Ghahremani, Department of Health Promotion, 3rd Floor, School of Health, Shiraz University of Medical Science, Razi Ave., Shiraz, Iran; Research Center for Health Science, Institute of Health, Shiraz University of Medical Sciences, Shiraz, Iran - Tel.: +989177923542 - Fax: +98 713-7260225 - E-mail: ghahramanl@sums.ac.ir

How to cite this article: Nazari M, Ghazaani FM, Kaveh MH, Karimi M, Ghahremani L. Investigating the predictors of breast cancer screening behaviors (breast self-examination, clinical examination or examination by physician/midwife and mammography) based on protection motivation theory (PMT) in women. J Prev Med Hyg 2021;62:E736-E741. https://doi.org/10.15167/2421-4248/jpmh2021.62.3.1857

RESEARCH ARTICLE

Health warning messages on cigarette packs: how young smokers process it

FATEMEH SHAHI[1], SARA POURRAZAVI[1], KAMIAR KOUZEKANANI[2], MOHAMMAD ASGHARI JAFARABADI[3], HAMID ALLAHVERDIPOUR[1,4]
[1] Department of Health Education & Promotion, Tabriz University of Medical Sciences, Tabriz, Iran;
[2] Department of Educational Leadership, College of Education & Human Development,TAMUCC, Corpus Christi, Texas, USA;
[3] Department of Statistics and Epidemiology, Tabriz University of Medical Sciences, Tabriz, Iran;
[4] Research Center of Psychiatry and Behavioral Sciences, Tabriz University of Medical Sciences, Tabriz, Iran

Keywords

Elaboration likelihood model • Health warning messages • Smoking • Processing route

Summary

One of the major smoking prevention strategies has been to educate the public and increase people's awareness, using health-warning messages. However, many young people continue smoking without paying attention to health risk messages on cigarette packets in Iran. Hence, this study was conducted to examine the processing route of anti-smoking messages and influencing cognitive factors based on the Elaboration Likelihood Model. This cross-sectional study was correlational in nature. The non-probability sample consisted of 387 tobacco smokers in the age range of 18 to 30 years old. The study was conducted between July and November of 2018 in Tabriz, Iran. A researcher-designed questionnaire was used for the purpose of data collection. No causal inferences were drawn due to the non-experimental nature of the investigation. It was found that tobacco smokers often processed the health warning messages through the central route. Perceived severity, smoking abstinence self-efficacy, and psychological dependence were predictors of message processing through the central route. The results supported the conceptual model of cognitional predictors of the processing route. To design and execute effective health warning messages to quit smoking, it is recommended to consider cognitive factors as a means to enhance critical thinking about the content of the health-warning message.

Introduction

Most smokers begin smoking at an early age, when they think there is no need to worry about the adverse consequences of cigarette smoking, for example, vascular diseases, lung cancer, chronic pulmonary disease, and other head-to-toe side effects [1]. According to the literature, smokers tend to underestimate the harmful effects of smoking [2-4]; consequently, health policy makers try to persuade smokers to quit smoking by providing appropriate information through effective communication channels [2].

Health warning messages are known to be effective in positively affecting the attitudes of people towards health-related issues [5], for instance, on cigarette packages to inform the users of negative consequences of smoking, focusing on dangers of tobacco use [2]. In fact, pictorial health warning labels are regarded as a cost-effective medium and an effective communication method for providing health information among vulnerable groups, increasing awareness, and motivating smokers to quit cigarette smoking [2, 5].

According to avoidance-oriented approach, emotions such as fear influence people's decision-making process. Therefore, an effective warning message may motivate people to engage in behaviors that protect them from the potential threat [6]. In addition to fear, the credibility of the message and its source may influence its overall effectiveness [7]. According to the Elaboration Likelihood Model (ELM), there are two pathways to influence the creditability and usefulness of the message [8-10].

The ELM, developed by Petty and Cacioppo, is a dual process theory, describing the change of attitudes through two major routes to persuasion, namely central and peripheral routes [8-10]. Sometimes people tend to think carefully about the content of a message based on their knowledge. On the other hand, there are people who are either unwilling or unable to analyze the message in a logical manner; thus, peripheral factors, such as how and where the message is delivered and its visual impact play a prominent role in the emotional pathway [8-10]. In addition, Petty and Cacioppo assumed that motivation and ability are two influential factors affecting the acceptance of a message. In fact, attitudinal changes through the central route require the motivation to cognitively process the persuasive message, the ability to process the message, and a predominance of favorable cognitive responses on peripheral factors. On the other hand, such changes through the peripheral route may result if motivation, ability, or positive thinking are not present [10]. Peripheral route change requires that the topic of persuasive communication be associated with favorable cues. According to the ELM, message recipients have various levels of ability, personal interest, and motivation to elaborate the presented content [10]. Therefore, those who are highly motivated

https://doi.org/10.15167/2421-4248/jpmh2021.62.3.2111

to quit smoking and have sufficient ability to process the information follow the central route by relying on their knowledge and perceived personal relevance with a message. Whereas, people with lower motivation to quit or lower ability to process the information are likely to process the received message through the peripheral route by relying on superficial cues and less thoughtful evaluation of the information [8].

According to the available literature, there is a strong correlation between information processing and risk perception [11]. In this regard, researchers suggest people who believe in low health risk are expected to process risk reduction messages differently than people who feel threatened by threat [12]. For example, Pointer and Rogers (1993) found that perceived severity and vulnerability increase the likelihood of processing through the central route in persuasive communication that recommended moderate alcohol consumption. In fact, they stated that high protection motivation is more likely to lead to central message processing, because it increases the perceived personal relevance of the threat [12]. Alternatively, low protection motivation, because of decreased perceived personal relevance, would process the message in accordance with peripheral cues [12]. In addition, issue involvement, temporal busyness, or self-efficacy on the given subject [13, 14] may result in a different elaboration likelihood among individuals. Yoo (2017) examined the importance of self-efficacy in determining the message-processing route and reported its positive moderating impact on a central route but negative moderating influence on three peripheral routes. High self-efficacy helps people focus their energy on message processing. Familiarity through knowing the relevant subject allows individuals not to be distracted; thus, leading their engagement to deep thinking [15].

Young people believe that the unpleasant consequences of substance abuse only affects older people [16]. On the other hand, Te'eni-Harari et al. (2007) found that, contrary to adults, young people are a less intellectually oriented population, who mostly enact based on peripheral route to process information and are less influenced by motivation and ability variables [17]. In this regard, in spite of the presence of warning images on cigarette packets about the physical threats of smoking in Iran, many young people continue smoking without paying attention to health risk messages. Therefore, it may be concluded that message processing is different for young people than older ones. There is a lack of evidence in Iran about how the youth process the tobacco-related risk messages. The primary purpose of the study was to evaluate the information processing of health warning messages on cigarette packs in a sample of Iranian youths. The following research questions guided the study: How do smokers process health warnings on cigarette packs? What role do cognitive factors play in determining processing routes?

Methods

Participants

The cross-sectional study was conducted between July and November of 2018 in Tabriz, Iran with 387 current smokers. To recruit the participants, 10 parks and coffee shops in Tabriz's 10 districts were randomly selected. The sample consisted of young people who ranged in age from 18 to 30 years, reported being smokers, were not taking any medications for psychiatric disorder, voluntarily agreed to participate in the study, and signed the consent form, representing a non-random sample. Data were collected through a self-administered questionnaire. Cigarette packs with health warning messages, which had been prepared by the research team, were presented to the participants before completing the questionnaires. The Ethics Committee of Tabriz University of Medical Sciences had approved the study.

Measures

A panel of Seven (7) health psychologists and eight (8) health education and promotion experts examined the content validity of the instrument by rating each questionnaire item for relevance, clarity, representativeness, and essentiality. The means of the content validity index (CVI) and the content validity ratio (CVR) were 0.87 and 0.95, respectively, attesting to the content validity of the instrument. The instrument was pilot-tested with 50 young smokers to examine its utility.

Demographics

The demographic variables included age, gender, living arrangement (with parents, personal home, dormitory), marital status (single or married), employment status (full-time, part-time, unemployed), and the highest level of education. Additionally, history of hookah use, alcohol use, drug abuse, smoking among friends and family members, the number of cigarettes smoked per day, smoking behavior after waking up, and the first bidder of cigarette smoking were measured.

Message processing route

For evaluating processing routes of peripheral and central, based on the ELM, we included two most influential factors of "motivation" and "ability." The extent of motivation was determined by the attitude towards the message, personal relevance, and the need for cognition. Additionally, individuals' ability for elaboration was operationalized by "distractions" and "knowledge." In our study, the midpoint of the sum of motivation and ability was used to categorize the processing route into the peripheral (less than 2016.65) or central (greater than 2016.65).

The attitude towards the message was measured by 12 items developed by the researchers; for example, "pictures motivated me to reduce my daily number of

cigarettes smoked." Additionally, we developed a 3-item scale to assess perceived relevance; for example, "in my opinion, the pictures on the cigarette packet talked about my health conditions." The need for cognition was measured by the 6-item version of Cacioppo and Petty's (1982) scale that was proposed by Lins de Holanda in 2018 [18, 19]; for example, "I would prefer complex to simple problems." A 5-point Likert-type scaling (1 = extremely uncharacteristic of me, 5 = extremely characteristic of me) was used. Reliability coefficients for the attitude towards the message ($\alpha = 0.92$), perceived relevance ($\alpha = 0.82$), and need for cognition ($\alpha = 0.71$), attested to the internal consistency of the scale scores.

Additionally, ability was measured by knowledge and distractions, utilizing two scales that had been developed by the research team. Specifically, an 8-item scale was used to measure the knowledge about the potential negative consequences of smoking cigarettes; for example, "smoking can cause lung cancer." Responses were coded as 0 = no/don't know or 1 = yes. A 4-item scale was used to gauge distractions, utilizing a 4-point Likert-type scaling (1 = never, 4 = always); for example, "presence of people around me caused to lose my focus on pictures and smoking outcomes." The reliability coefficients for the knowledge and distractions were 0.67 and 0.62, respectively.

Cognitive variables

Perceived severity. To measure the seriousness of smoking risks, Harris's 4-item scale of perceptions of personal risk about smoking and health was employed[20]; for example, "smokers live shorter lives than non-smokers" and "smoking increases your chance of getting lung cancer." The reliability coefficient for the scale was 0.75.

Sensation-seeking. A published 8-item questionnaire was used to assess sensation-seeking behavior [21]; for example, "I would like to explore strange places." The reliability coefficient was 0.82.

Psychological dependence. A 4-item scale, derived from Autonomy Over Smoking scale [22] was used to measure psychological dependence; for example, "I rely on smoking to focus my attention" and "I rely on smoking to take my mind off being bored." The reliability coefficient for the scale was 0.80.

Smoking abstinence self-efficacy. A 12-item instrument (SASEQ) was used to assess self-efficacy [23]; for example, ''you feel very sad, are you confident that you will not smoke?'' The reliability coefficient for this scale was 0.80.

Positive attitude toward smoking. A 9-item researcher-made instrument was used to gauge participants' attitude toward smoking; for example, "smoking makes me look attractive" and "smoking makes me feel independent." The reliability coefficient for the scale was 0.67.

Cognition reaction. A 5-item researcher-made scale, which was based on a published study [5], was used to gauge the cognitive response that participants felt after seeing the images; for example, "I felt scared after seeing my pictures." The reliability coefficient for the scale was 0.76.

With the exception of ability, we used a 5-point Likert-type scaling (1 = the lowest, 5 = the highest) to measure the abovementioned scales. For the purpose of the data analysis, all were standardized, ranging from 0 to 100.

Health warning messages on cigarette packs

The research team developed four (4) health-warning messages to stick on cigarette packs that were pictorial in nature, because they are known to be more effective than are the text warnings [5]. Given that health warning messages that emphasize the physical consequences of a threat are helpful in informing and encouraging people to engage in preventive health behavior [24], we used images related to smoking-related diseases (e.g., cancers of the respiratory system, mouth, and teeth, Buerger's disease).

Statistical analysis

To analyze the data, the Statistical Package for the Social Sciences (SPSS), version 23, and Mplus software, version 6, were used. Descriptive statistics, mean (SD) and frequency (%), were used to summarize the data. The respondents' responses to the questionnaire items were used to measure each scale score. The normality of all distributions was examined by skew and kurtosis indices. A series of Chi-square Test of Independence was performed to examine the simple associations between the processing route and demographic characteristics. To compare the cognitive constructs scores in processing routes, a series of independent sample t-tests was applied. The significance level for all analyses was set, a priori, at 0.05.

Applying the Mplus software, we performed Structural Equation Modeling (SEM), with maximum likelihood estimation, to test the hypothesized model for cognitive predictors of the processing route in full sample (Model A) and gender groups (Model B). The SEM included model specification, identification, estimation, testing, and modification. The first step focused on the conceptual model regarding the hypotheses. The second step consisted of the model fit process, wherein the number of input and output parameters was suitably chosen. The maximum likelihood estimation was performed in the third step. The fit indices were assessed in the fourth step. In the fifth step, the modification indices were used to modify the model. Model fit measures were attained to judge how well the proposed model captured the covariances between all measures. Since the quality of fitted models is influenced by the sample size, multiple model fit indices were estimated, which were as follows: χ^2 ($p > 0.05$), χ^2/degrees of freedom < 5, the Root Mean Square Error of Approximation (RMSEA ≤ 0.08), the Standardized Root Mean Square Residual (SRMR ≤ 0.05), the Comparative Fit Index (CFI ≥ 0.90), and Tucker-Lewis index (TLI ≥ 0.90) [25].

Results

The majority of the participants (66.70%) processed the message through the central route, of which, 59.70%

were male, 62.00% lived with their families, 52.30% smoked one cigarette per day, and 69.70% had received the first cigarette from friends. On the other hand, 79.80% of the participants who processed the message with peripheral route were male, 42.60% lived in a dormitory, 35.70% smoked more than 15 cigarettes per day, and 51.90% reported friends had offered the first cigarette to them. As shown in Table I, a series of the Chi-square Test of Independence showed a statistically significant difference in processing route by gender, residency status, smoking rate, and the first bidder of using a cigarette.

As can be seen in Table II, mean differences between the central and peripheral routes were statistically significant based on the positive attitudes towards smoking (favoring the peripheral route), while central route scored higher on smoking abstinence self-efficacy, perceived severity, and psychological dependence. Sensation seeking did not distinguish between the two routes.

The respondents were provided with four distraction items: (1) presence of other people at their side distracting their attention to warning images; (2) not paying attention to risk message images on cigarette packs when doing other things; (3) becoming worried by the pictures on the cigarette packets; and (4) the severity of the desire for smoking. As shown in Table III, "frequently" was the option endorsed the most by all subjects in general and those employing the central route in particular. In addition, the respondents were provided with five cognition reaction items: (1) thinking to quit smoking after seeing picture on cigarette packets; (2) thinking to reduce smoking after seeing pictures on cigarette packets; (3) being attracted by picture on cigarette packets; (4) being reminded of the dangers of

Tab. I. A Profile of subjects by message processing routes (n = 387).

	Processing Rout		
	Peripheral (n = 129) N (%)	Central (n = 258) N (%)	
Gender			
Female	26 (20.20)	104 (40.30)	χ^2: 15.61, p < 0.05
Male	103 (79.80)	154 (59.70)	
Marital status			
Married	97 (75.20)	176 (68.30)	χ^2=2.01, p = 0.19
Single	32 (24.80)	82 (31.70)	
Residency status			
With family	59 (45.70)	160 (62.00)	
Alone	15 (11.70)	36 (14.00)	χ^2:14.26, p < 0.05
In dormitory	55 (42.60)	62 (24.00)	
Education level			
Elementary education	12 (9.30)	18 (7.00)	χ^2:0.67, p = 0.71
High school education	28 (21.70)	56 (21.70)	
University education	89 (69.00)	184 (71.30)	
Employment status			
Full time	36 (27.90)	78 (30.20)	χ^2: 0.23, p = 0.89
Part time	29 (22.50)	57 (22.10)	
Unemployed	64 (49.60)	123 (47.70)	
History of hookah use	105 (81.40)	204 (79.10)	χ^2: 0.29, p = 0.69
History of alcohol use	74 (57.40)	133 (51.60)	χ^2:1.17, p = 0.33
History of drugs abuse	31 (24.00)	41 (15.90)	χ^2: 3.76, p = 0.07
History of smoking in parents	66 (51.20)	120 (46.50)	χ^2: 0.74, p = 0.39
History of smoking in siblings	48 (37.20)	124 (48.10)	χ^2: 4.10, p = 0.05
History of smoking in friends	114 (88.40)	203 (78.70)	χ^2:5.45, p < 0.05
The first bidder of using cigarette			
Friends	67 (51.90)	180 (69.70)	
Colleagues	12 (9.30)	25 (9.70)	χ^2: 21.55, p < 0.05
Relatives	13 (10.10)	26 (10.10)	
Nobody	37 (28.70)	27 (10.50)	
Smoking consumption			
1 cigarette per day	33 (25.60)	135 (52.30)	
2-15 cigarettes per day	50 (38.70)	86 (33.30)	χ^2: 16.19, p < 0.05
More than 15 cigarettes per day	46 (35.70)	37 (14.40)	
Earliest time to smoke			
Immediate after waking up	53 (41.10)	96 (37.20)	
More than 60 minute after waking up	76 (58.90)	162 (62.80)	χ^2: 1.58, p = 0.21

Tab. II. Comparison of message processing routs based on cognitive variables.

Variable	Mean (SD)		Mean difference (95% CI), p-value
	Central route	Peripheral route	
Smoking abstinence self-efficacy	40.56 (8.46)	33.29 (7.96)	-7.27 (-8.92, -5.61) , < 0.05
Positive attitude toward smoking	22.67 (6.89)	25.04 (6.13)	2.36 (1.05, 3.67) , < 0.05
Perceived severity	16.28 (2.84)	13.01 (3.17)	-3.26 (-3.87, -2.66), < 0.05
Sensation-seeking	18.34 (6.51)	18.92 (5.96)	0.57 (-0.68, 1.83), 0.37
Psychological dependence	21.44 (5.57)	20.02 (5.55)	-1.42 (-2.54, -0.29), < 0.05

smoking after seeing pictures on cigarette packets; and (5) being scared by seeing pictures of self. The majority of those who processed the messages via the peripheral route disagreed or strongly disagreed with all items. On the other hand, central route processors agreed or strongly agreed with all items.

A series of SEM was performed to test the hypothesized model for cognitive predictors of the processing route. Model A is depicted in Figure 1 and shows the predictors among young smokers. The measurement model resulted in a good model fit (χ^2 = 71.78, n = 387, df = 5, p < 0.05, CFI = 1.00,

Tab. III. Comparison of message processing routs based on distraction and cognition reaction items.

Items	Answer choice	Processing route	
		Peripheral = 129 N (%)	Central = 258 N (%)
The presence of people around me caused to lose my focus on pictures and smoking outcomes	Never	37 (28.70)	54 (20.90)
	Frequently	69 (53.50)	179 (69.40)
	Always	23 (17.80)	25 (9.70)
When I do something, I cannot focus on pictures and smoking outcomes	Never	35 (27.10)	43 (16.60)
	Frequently	71 (55.10)	188 (72.90)
	Always	23 (17.80)	27 (10.50)
The pictures on the cigarette packets make me worried and I try to ignore it	Never	58 (45.00)	43 (16.60)
	Frequently	60 (46.50)	187 (72.50)
	Always	11 (8.50)	28 (10.90)
The desire for smoking is so severe in me, so that I ignore the picture on cigarettes packs and the smoking consequences	Never	39 (30.20)	56 (21.70)
	Frequently	68 (52.70)	164 (63.60)
	Always	22 (17.10)	38 (14.70)
I think to quit smoking after seeing pictures on cigarette packets	Strongly agree	4 (3.10)	61 (23.60)
	Agree	11 (8.50)	107 (41.50)
	Undecided	31 (24.10)	42 (16.30)
	Disagree	59 (45.70)	39 (15.10)
	Strongly disagree	24 (18.60)	9 (3.50)
I think to reduce smoking after seeing pictures on cigarette packets	Strongly agree	1(0.78)	41 (15.90)
	Agree	26 (20.16)	133 (51.50)
	Undecided	28 (21.70)	39 (15.10)
	Disagree	55 (42.60)	34 (13.20)
	Strongly disagree	19 (14.70)	11 (4.30)
The pictures on the packages attracted my attention	Strongly agree	3 (2.30)	44 (17.00)
	Agree	31 (24.00)	139 (53.90)
	Undecided	36 (27.90)	47 (18.20)
	Disagree	43 (33.30)	21 (8.10)
	Strongly disagree	16 (12.40)	7 (2.70)
After seeing pictures, I remember the dangers of smoking with every time you see a cigar pack	Strongly agree	1 (0.78)	37 (14.30)
	Agree	20 (15.50)	117 (45.30)
	Undecided	32 (24.80)	55 (21.30)
	Disagree	56 (43.40)	41 (15.90)
	Strongly disagree	20 (15.50)	8 (3.10)
I felt scared after seeing my pictures	Strongly agree	2 (1.60)	45 (17.40)
	Agree	12 (9.30)	104 (40.30)
	Undecided	34 (26.40)	67 (26.00)
	Disagree	59 (45.70)	36 (14.00)
	Strongly disagree	22 (17.00)	6 (2.30)

Fig. 1. Structural equation model for the full sample: CFI = 1.00, RMSEA = 0 (90% Confidence Interval: 0.00, 0.05). Parameter values are expressed as maximum likelihood estimates (standardized solution). Numbers in parentheses indicate values for parameter estimates. Message processing route coded as 0 = peripheral route, 1 = central route.

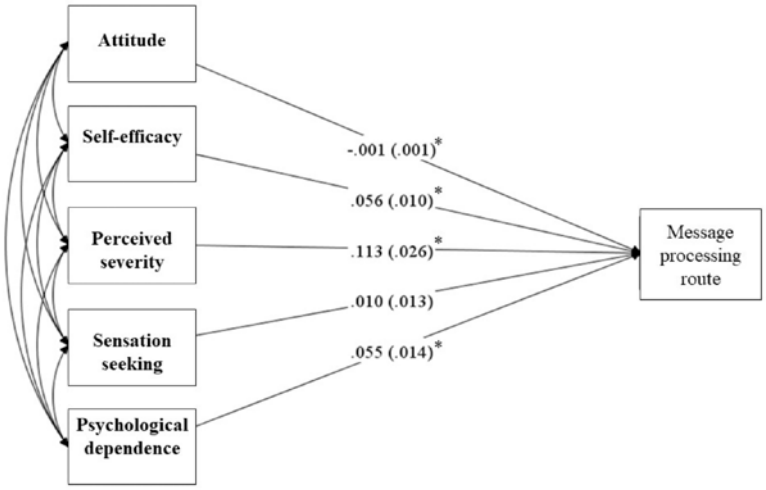
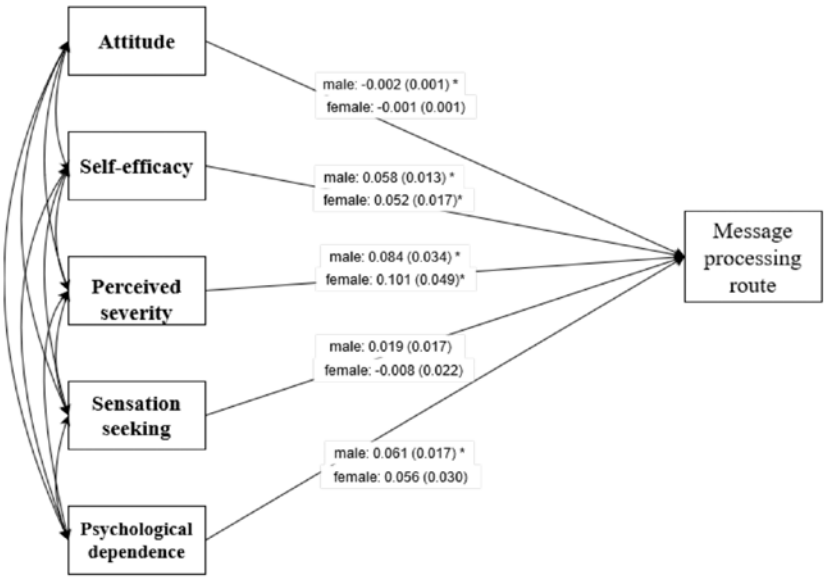


Fig. 2. Structural Equation Model B for the male and female sub-samples: CFI = 1.00, RMSEA= 0 (90% Confidence Interval: 0.00, 0.05). Parameter values are expressed as maximum likelihood estimates (standardized solution). Numbers in parentheses indicate values for parameter estimates. Message processing route coded as 0 = peripheral route, 1 = central route.



TLI = 1.00, RMSEA = 0.00, CI: 0.00, 0.05). The direct associations between self-efficacy, perceived severity, psychological dependence as predictor of the central route were statistically significant. The association between sensation seeking and the central route was not statistically significant. Moreover, results indicated a statistically significant relation between attitude toward smoking and peripheral route. 1-unit increase in attitude results in 0.001 decrease in message processing route. Additionally, 1-unit increase in self-efficacy, perceived severity, sensation seeing, and psychological dependence resulted in 0.056, 0.113, 0.010, and 0.055 increase in message processing route, respectively.

Next, we evaluated Model B for males and females separately and found that the conceptual model obtained from testing the goodness of fit causal structure of the hypothesized model fit the data well (χ^2 = 0.00, n = 387, df = 0, $p < 0.05$, CFI = 1.00, TLI = 1.00, RMSEA = 0.00 (CI: 0.00, 0.05). Among males and with respect to central route, the negative association with the attitude toward smoking and positive relations with self-efficacy, perceived severity, and psychological dependence were statistically significant. Among females, the positive associations between self-efficacy and perceived severity as predictors of the central route were statistically significant. Results are depicted in Figure 2.

Discussion

The young smokers in our study often processed warning messages through the central route. According to the ELM, message processing depends on one's motivation and ability [8]; thus, if people have high motivation and ability, they process messages centrally, if not, it is probably accomplished peripherally or sensationally [9, 10] Since motivation depends on factors such as the attitude, need for cognition, personal relevance to the subject, and the ability of being conscious and focused [7], it can be concluded that observing images was instrumental in raising awareness/knowledge and creating a sense of concern among the study's participants. In fact, they were thinking that these consequences were relevant to their smoking behavior. Consequently, despite the tendency to smoke, it was assumed that the study subjects processed messages through central route, based on the ELM. Our review of the literature also showed that warning images in cigarette packages increase people's awareness about the negative impact of smoking, which eventually raises individuals' concerns about their health, thereby, provoking the attention to the importance of quitting tobacco smoking [5]. Additionally, warning images may increase the attention and remind smokers of adverse effects of tobacco smoking.

We found that perceived severity, smoking abstinence self-efficacy, and psychological dependence were strong predictors of message processing through the central route. It is postulated that the perceived severity refers to one's belief that smoking can have serious and unpleasant consequences for his or her health [26] and numerous studies have shown that anti-tobacco warning images may increase people's fear perception and improve awareness of smokers about the side effects of tobacco use. Thereby, being exposed to these messages may motivate smokers to quit smoking [25]. In addition, Muñoz, Chebat, and Borges (2013) believed that graphic warnings have the potential to increase the sense of being worried about adverse consequences and influence individuals' attention and intention toward stopping cigarette smoking [27]. Muñoz and colleagues also found that these warnings messages can lead to an in-depth information processing and that focusing on graphic warning messages may provoke people to not engage in this high risk behavior [6, 27]. Moreover, it seems that due to the visual clarity of illustrations about the seriousness of the damages caused by smoking, smokers may relate the health risk messages to themselves and perhaps process the message through central route, which was reported in a study about AIDS warning messages [12].

Another factor that was found to be associated with processing via central manner is psychological dependence, which postulates that an addicted person, for example, drinks or smokes to fulfill a need [28]. In other words, psychological dependence arises when someone is emotionally tied to tobacco use based on her or his mental desire for it. Our findings showed that cigarette smokers, who were psychologically dependent on cigarettes and were exposed to fear appeals images, processed the scary images in a logical manner. In fact, challenges about the side effects of cigarette smoking in the mind of a smoker on one hand and psychological dependence, caused by consistent and frequent exposure to smoking and smoking-related behaviors and dependency [29], on the other hand, may explain why one does not try to quit smoking. It seems that although addicted people process the warning messages via central route, because of psychological dependence, they are unable to quit smoking. This paradox may be explained by the ELM and other theoretical frameworks that why someone who processes the messages correctly via a central route, still continues smoking. Thus, future studies must be conducted to explore deeply message processing routs. Moreover, it seems that the ELM works better in persuasive programs, where there is no psychological dependence for quitting behavior. Thus, future studies must be conducted to provide an answer. Moreover, it seems that the ELM works better in persuasive programs, where there is no psychological dependence for quitting behavior.

Although it is assumed that high sensation-seeking people process messages through peripheral or emotional route, we found no support for it in our study. Sensation-seeking is a personal condition; for example, wanting to experience a new thing, but without thinking about its consequences [30]. This feeling increases at the age range of 10 to 15 years and declines or remains stable thereafter [31]. Young people with high levels of sensation-seeking have a high risk-taking ability to experience physical, social, and legal risks, exhibit less protective beliefs about risky behaviors, and underestimate the severity of the risks [30]. High sensation seekers typically do not perceive the fear of threatening situations. As a result, they do not perceive high-risk behaviors, such as, smoking, alcohol drinking, and drug abuse as threatening behaviors [28, 30]. It has also been reported that sensation-seeking could act as a predictor of response to a fearful condition, which may provoke a response to "fear control" that ultimately results in a defensive avoidance behavior in case of being exposed to fearful messages [32]. Therefore, it seems that people with high levels of sensation-seeking are not attentive to the negative consequences of smoking presented in the delivered messages. In addition, they do not try to process the messages, because they find them irrelevant to themselves. Furthermore, in accordance with the extended parallel process model, maybe these individuals enter the fear control process and reject the message with a defensive avoidance response.

Some studies have suggested that females pay more attention to warning messages than do males [33]. However, others have found the same result in males [34]. We found that females and males process warning messages about cigarette smoking differently but in a logical manner. For example, females are more likely to process messages through the central route than do males. The structural equation modelling of the

data showed that psychological dependence predicts the processing of warning messages through central route only among men. It seems psychological dependence on cigarette smoking shifts females toward peripheral route. Thus, gender differences must be taken into consideration in designing and implementing relevant messages.

Repetition of message could be one of the factors that is related to the ability to think and enables more people to think in a logical manner. Hence in case of presenting a strong argument, repetition of message probably leads to more change in beliefs. Additionally, quality of argument may have an influential role in interventional studies conducted within the framework of the Elaboration Likelihood Model [35].

Moreover, it is postulated that individuals distinguish between strong and weak arguments only if they are able to process the message in a systematic manner. In other words, reading a message containing strong arguments will be accepted easily in comparison to messages containing weak arguments. As a result, if someone does not process the message systematically, it may not be able to distinguish strong and weak arguments; thus, the argument would be unqualified. Based on this reasoning, the presence or absence of an effect of argument quality on acceptance of the message indicates how people process the message systematically or not [8].

Limitations

The investigation was non-experimental in nature; thus, no causal inferences were drawn. Due to non-probability nature of the sampling technique, the generalizability/external validity of the study was limited to its participants. As in any survey research, providing socially acceptable responses could have been a threat to the internal validity of the results. To mitigate this possibility, respondents were assured at the start of the survey that all responses would be kept confidential.

Conclusions

Our non-probability sample of young Iranian tobacco smokers showed that they tend to process health warning messages through the central route, and that pictorial health warning labels have the potential to encourage people to reduce or quit smoking with a logical approach. It seems that people who are addicted to smoking are insightful and understand the side effects of tobacco use but because of their dependency on nicotine, they cannot cease it. In other words, despite understanding the consequences of tobacco use and processing the message through the central route, they cannot cease it. However, non-smokers probably process the health warning messages through a different route. Therefore, it is necessary to consider the quality of the arguments, the individuals' awareness of the consequences of smoking, and the repetition of the message in designing the messages in order to change people's attitudes towards smoking. Health officials should pay special attention to the demographic characteristics of smokers in designing health-warning messages related to smoking to increase their effectiveness. In addition, we suggest concerned individuals pay attention to messages that may positively impact people's attitudes toward quitting smoking by emphasizing the severity of the damage caused by smoking.

Ethical considerations

The ethics committee of Tabriz University of Medical Sciences (TBZMED) approved the study protocol (Approval ID: IR.TBZMED.REC.1397.210). The study's aim and process were explained to the participants, and written informed consent was obtained. The interviews were recorded anonymously using code numbers.

Acknowledgements

Funding sources: this article is part of a Master of Science thesis in health education and promotion, which was supported and approved by Tabriz University of Medical Sciences, Tabriz, Iran. The funders had no role in study design, data collection and analysis, decision to publish, or preparation of the manuscript.

Conflict of interest statement

The authors declare no conflict of interest.

Authors' contributions

FS, SP, HA designed the study. FS collected survey data. SP. MAJ, HA analyzed and present statistical results. For preparing this paper, KK, SP, HA were major contributors in writing the manuscript and in the final step KK edited the manuscript. All authors read and approved the final manuscript.

References

[1] Petrescu D, Vasiljevic M, Pepper J, Ribisl K, Marteau T. What is the impact of e-cigarette adverts on children's perceptions of tobacco smoking? A randomised control trial. Tob Control 2017;26:421-7. https://doi.org/10.1136/tobaccocontrol-2016-052940

[2] Hammond D. Health warning messages on tobacco products: a review. Tob Control 2011;20:327-37. https://doi.org/10.1136/tc.2010.037630

[3] Morgan JC, Byron MJ, Baig SA, Stepanov I, Brewer NT. How people think about the chemicals in cigarette smoke: a systematic review. J Behav Med 2017;40:553-64. https://doi.org/10.1007/s10865-017-9823-5

[4] Oncken C, McKee S, Krishnan-Sarin S, O'Malley S, Mazure CM. Knowledge and perceived risk of smoking-related conditions: a survey of cigarette smokers. Prev Med 2005;40:779-84. https://doi.org/10.1016/j.ypmed.2004.09.024

[5] Noar SM, Hall MG, Francis DB, Ribisl KM, Pepper JK, Brewer NT. Pictorial cigarette pack warnings: a meta-analysis of ex-

perimental studies. Tob Control 2016;25:341-54. https://doi.org/10.1136/tobaccocontrol-2014-051978

[6] Mutti-Packer S, Collyer B, Hodgins DC. Perceptions of plain packaging and health warning labels for cannabis among young adults: findings from an experimental study. BMC Public Health 2018;18:1361. https://doi.org/10.1186/s12889-018-6247-2

[7] Petty RE, Kasmer JA, Haugtvedt CP, Cacioppo JT. Source and message factors in persuasion: a reply to Stiff's critique of the Elaboration Likelihood Model. Commun Monogr 1987;54:233-49. https://doi.org/10.1080/03637758709390229

[8] Petty RE, Cacioppo JT, Schumann D. Central and peripheral routes to advertising effectiveness: the moderating role of involvement. J Consum Res 1983;10:135-46. https://doi.org/10.1086/208954

[9] Petty RE, Cacioppo JT. Communication and persuasion: Central and peripheral routes to attitude change. Springer Science & Business Media 2012.

[10] Petty RE, Cacioppo JT. The elaboration likelihood model of persuasion. Adv Exp Soc Psychol 1986;19:123-205. https://doi.org/10.1007/978-1-4612-4964-1_1

[11] Trumbo CW. Information processing and risk perception: an adaptation of the heuristic-systematic model. J Commun 2002;52:367-82. https://doi.org/10.1111/j.1460-2466.2002.tb02550.x

[12] Dinoff BL, Kowalski RM. Reducing AIDS risk behavior: the combined efficacy of protection motivation theory and the elaboration likelihood model. J Soc Clin Psychol 1999;18:223-39. https://doi.org/10.1521/jscp.1999.18.2.223

[13] Angst CM, Agarwal R. Adoption of electronic health records in the presence of privacy concerns: the elaboration likelihood model and individual persuasion. Mis Q 2009;33:339-70. https://doi.org/10.2307/20650295

[14] Zhou T. Understanding users' initial trust in mobile banking: An elaboration likelihood perspective. Comput Human Behav 2012;28:1518-25. https://doi.org/10.1016/j.chb.2012.03.021

[15] Yoo CW, Goo J, Huang CD, Nam K, Woo M. Improving travel decision support satisfaction with smart tourism technologies: a framework of tourist elaboration likelihood and self-efficacy. Technol Forecast Soc Change 2017;123:330-41. https://doi.org/10.1016/j.techfore.2016.10.071

[16] Kosmidou K, Zopounidis C. The determinants of banks' profits in Greece during the period of EU financial integration. Manage Financ 2008;34:146-59. https://doi.org/10.1108/03074350810848036

[17] Te'eni-Harari T, Lampert SI, Lehman-Wilzig S. Information processing of advertising among young people: the elaboration likelihood model as applied to youth. J Advert Res 2007;47:326-40. https://doi.org/10.2501/S0021849907070341

[18] Lins de Holanda Coelho G, Hanel HPP, Wolf LJ. The very efficient assessment of need for cognition: developing a six-item version. Assessment 2018;27:1870-85. https://doi.org/10.1177/1073191118793208

[19] Cacioppo JT, Petty RE. The need for cognition. J Pers Soc Psychol 1982;42:116-31. https://doi.org/10.1037/0022.3514.42.1.116

[20] Harris JK, Karamehic-Muratovic A, Herbers SH, Moreland-Russell S, Cheskin R, Lindberg KA. Perceptions of personal risk about smoking and health among Bosnian refugees living in the United States. J Immigr Minor Health 2012;14:413-9. https://doi.org/10.1007/s10903-011-9511-4

[21] Hoyle RH, Stephenson MT, Palmgreen P, Lorch EP, Donohew RL. Reliability and validity of a brief measure of sensation seeking. Pers Individ Dif 2002;32:401-14. https://doi.org/10.1016/s0191-8869(01)00032-0

[22] DiFranza JR, Wellman RJ, Ursprung W, Sabiston C. The autonomy over smoking scale. Psychol Addict Behav 2009;23:656. https://doi.org/10.1037/a0017439

[23] Spek V, Lemmens F, Chatrou M, van Kempen S, Pouwer F, Pop V. Development of a smoking abstinence self-efficacy questionnaire. Int J Behav Med 2013;20:444-9. https://doi.org/10.1007/s12529-012-9229-2

[24] Witte K, Meyer G, Martell D. Effective health risk messages: A step-by-step guide. Thousand Oaks, CA: Sage 2001.

[25] Weston R, Gore Jr PA. A brief guide to structural equation modeling. Couns Psychol 2006;34:719-51. https://doi.org/10.1177/0011000006286345

[26] Glanz K, Rimer BK, Viswanath K. Health behavior and health education: theory, research, and practice. 4th Edition. Jossey-Bass publisher 2008.

[27] Munoz Y, Chebat J-C, Borges A. Graphic gambling warnings: how they affect emotions, cognitive responses and attitude change. J Gambl Stud 2013;29:507-24. https://doi.org/10.1007/s10899-012-9319-8

[28] Kopp M, Wolf M, Ruedl G, Burtscher M. Differences in Sensation Seeking Between Alpine Skiers, Snowboarders and Ski Tourers. J Sports Sci Med 2016;15:11-6.

[29] Guillaumin C, Urban T. The fight against smoking. The need to consider behavioral dependence. Rev Pneumol Clin 2017;73:294-8. https://doi.org/10.1016/j.pneumo.2017.09.005

[30] Zuckerman M. Sensation seeking and risky behavior. Washington, DC: American Psychological Association 2007.

[31] Steinberg L, Albert D, Cauffman E, Banich M, Graham S, Woolard J. Age differences in sensation seeking and impulsivity as indexed by behavior and self-report: evidence for a dual systems model. Dev Psychol 2008; 44:1764. https://doi.org/10.1037/a0012955

[32] Blanton H, Snyder LB, Strauts E, Larson JG. Effect of graphic cigarette warnings on smoking intentions in young adults. PloS One 2014;9:e96315. https://doi.org/10.1371/journal.pone.0096315

[33] Koval JJ, Aubut J-AL, Pederson LL, O'Hegarty M, Chan SS. The potential effectiveness of warning labels on cigarette packages. Can J Public Health 2005;96:353-6. https://doi.org/10.1007/BF03404031

[34] Omar M, Lajis R, Foong K, Sirirassamee B, Sethaput C, Borland R, Fong GT, Hammond D, Thompson ME, Driezen P, Elton-Marshall T Proceedings of the 13th World Conference on Tobacco OR Health. Washington DC, USA: 2006.

[35] Eagly AH, Chaiken S. The psychology of attitudes. Fort Worth TX: Harcourt Brace Jovanovich 1993.

Received on April 19, 2021. Accepted on July 14, 2021.

Correspondence: Hamid Allahverdipour, Research Center of Psychiatry and Behavioral Sciences Department of Health Education & Promotion, Tabriz University of Medical Sciences, Tabriz 14711, Iran - E-mail: allahverdipourh@tbzmed.ac.ir

How to cite this article: Shahi F, Pourrazavi S, Kouzekanani K, Jafarabadi MA, Allahverdipour H. Health warning messages on cigarette packs: how young smokers process it. J Prev Med Hyg 2021;62:E742-E750. https://doi.org/10.15167/2421-4248/jpmh2021.62.3.2111

Research article

Legionella contamination of a cold-water supplying system in a German university hospital – assessment of the superheat and flush method for disinfection

MATTHIAS UNTERBERG[1], TIM RAHMEL[1], THOMAS KISSINGER[2], CHRISTIAN PETERMICHL[1, 3], MICHAEL BOSMANNS[3], MARTIN NIEBIUS[3], CHRISTINA SCHULZE[3], HANS-PETER JOCHUM[4], NINA PAROHL[5], MICHAEL ADAMZIK[1], HARTMUTH NOWAK[1]

[1] Department of Anesthesiology, Intensive Care and Pain Medicine, University Hospital Knappschaftskrankenhaus Bochum, Bochum, Germany; [2] Nursing Service Management, University Hospital Knappschaftskrankenhaus Bochum, Bochum, Germany; [3] Department of Hygiene, University Hospital Knappschaftskrankenhaus Bochum, Bochum, Germany; [4] Management, University Hospital Knappschaftskrankenhaus Bochum, Bochum, Germany; [5] HyKoMed GmbH, Lünen, Germany

Keywords

Legionella • Hospital-acquired Legionnaires' disease • Superheat and flush • Water-supplying system

Summary

Introduction. *In case of a contamination of water-supplying systems in hospitals with legionella, usually chemical disinfection measures are used for remediation. Unfortunately, it is reported, that these methods may not be sustainable, have an impact on water quality, and can even fail. As an alternative, the superheat and flush method does not need any special equipment, can be initiated in a short lead of time and does not affect the water quality. However, evidence on this disinfection measurement against legionella is lacking. We therefore investigated and report on the effectiveness and long-term results of the superheat and flush disinfection method.*

Methods. *During routine periodical examinations, a rising count of legionella was detected in the cold-water supplying system at a German university hospital. Adapted to an analysis of risks, effort and benefit, the superheat and flush procedure was applied twice within 6 months.*

Results. *While 33 out of 70 samples had a higher legionella count than the legal threshold of 100 CFU/100 mL (CFU - Colony Forming Units) before the first disinfection was carried out, this number could be reduced to 1 out of 202 samples after the first intervention. Additionally, in contrast to previously published studies, the effect was long-lasting, as no relevant limit exceedance occurred during the following observation period of more than two years.*

Conclusion. *The superheat and flush disinfection can provide an economic and highly effective measure in case of legionella contamination and should be shortlisted for an eradication attempt of affected water-supplying systems in hospitals.*

Introduction

The contamination of water-supplying systems in hospitals with *Legionella spp.* can be a major challenge due to outbreaks of nosocomial legionnaires' disease and economic issues, as well. Over the last decades, authors have regularly reported on this topic, especially for facilities with old building substance [1-4]. In the majority of cases, different chemical disinfection measures, especially hyperchlorination, are used to control the presence of legionella [2-5]. These measures often do not have a sustainable effect and need to be applied regularly, or even continuously [6], which may have also an impact on the water quality [4]. Other options for controlling a legionella infestation include *inter alia* the installation of sterile water filters, irradiation with ultraviolet (UV) light, and copper/silver-ionization. Sterile water filters need to be mounted at each point-of-use water fixture, have to be changed regularly, and are therefore very complex in installation and maintenance [7]. UV irradiation can either be applied at the main water supply, or near/at the water tapping points [8]. Again, special equipment is required for the application of this method. It has been evaluated in only few clinical studies and the results were varying, in some cases not long-lasting, and depending on the structural conditions of the building [9-11]. Thus, the current evidence describes UV irradiation as one possibility among many, with no clear debate for or against [12]. Silver and/or copper ionization can provide an effective measure to reduce legionella contamination and the risk of legionnaires' disease [12]. However, strict limits must be met, and the use of copper as a biocide in Europe is strictly regulated by the European Commission [13]. Despite all possibilities of disinfection measures, in some cases it is still not possible to achieve a sufficient reduction in the load of legionella [3, 14, 15]. As a last resort, only an entire reconstruction of the water-supplying system can eliminate the problem [16]. Beneath the effects of negative publicity due to reports in the local and/or national press [17, 18], these measures can essentially harm the economic base of a hospital [19-21].

In addition to the measures described above, other methods are also the subject of current discussions [6]. A physical disinfection approach is the superheat and flush method, which is based on the principle that water-carrying pipes are flushed for a short time with hot water at a temperature of approximately 70°C [22]. There is only few information in the current literature regarding the effectiveness and sustainability of this disinfection method, with even contradictory results. While early studies found this method to be as effective as hyperchlorination [23], other studies were found to be of only incomplete [24] or short-lasting success (60% efficacy and reoccurrence after 4-5 months) [25]. Therefore, this procedure deemed to be of lower interest during the last twenty years and was mainly used in a combination to other procedures [25]. However, this method has the advantage that it can be initiated without any special equipment in a short lead of time and does not negatively affect the water quality. Due to a currently only poor evidence base, further investigations are urgently needed to evaluate this disinfection control measure, since it may help to avoid the chemical methods and the difficulties associated with them.

Within the scope of this study, we therefore investigated and report on the effectiveness and long-term results of the superheat and flush disinfection method on the contamination of the cold-water system with legionella in a German university hospital.

Methods

Local legislations (Ordinance on the Quality of Water intended for Human Consumption – *"Trinkwasserverordnung, TrinkwV"*) prescribe a periodic testing of all water-supplying systems of hospitals regarding the appearance of *Legionella spp.* [26]. In 2014/2015, during a routine periodical examination, we detected rising counts of colony forming units (CFU) of legionella in the cold-water supplying system at the University Hospital Knappschaftskrankenhaus Bochum (UKB) in Bochum, Germany. In the hot water supply, there was no increased number of *Legionella spp.* detected. Fortunately, cases of nosocomial Legionnaires' disease were not observed.

According to recommendations of the Federal Environment Agency of Germany ("Umweltbundesamt", UBA) a detailed risk assessment was performed [26, 27]. According to these results in March 2014, a structural renovation and renewal of parts of the water pipe system was performed until May 2015, accompanied by health protection measures, *e.g.* assembly of sterile water filters at distal sites. Pipe sections with a low frequency of use of the tapping points were considered as a risk factor regarding the appearance and growth of *Legionella spp.* These pipe sections were identified by architectural drawings and local inspection and according to this detection all water tap installations were included in a flushing schedule. This measure required a sufficient water flow of at least five minutes every 72 hours.

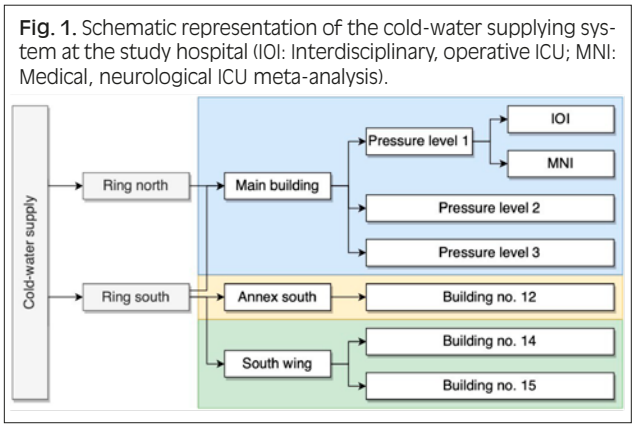


Fig. 1. Schematic representation of the cold-water supplying system at the study hospital (IOI: Interdisciplinary, operative ICU; MNI: Medical, neurological ICU meta-analysis).

The flushing schedule was continued until the present day and was set as a standard procedure. In addition, dismantling of unused pipes was performed, when possible. Re-evaluating these measures, we still found increased numbers of *Legionella spp.* CFUs exceeding the technical threshold of 100 CFU/100 mL. A total dismantling of the affected pipe systems would have meant a very high effort including a disruption of the daily business of the hospital. Thus, different measures of disinfection of the cold-water supplying system were evaluated under consideration of the applicability within the branched pipe-system as well as the feasibility during the regular daily business.

Hospital buildings' water supply

Two independent pipe strands build the basic structure of the water supplying system (ring north and ring south). The main hospital building, a fifteen-floor high tower built in 1972, is supplied by both of these rings and the water distribution is divided into three pressure levels to maintain a sufficient water pressure up to the highest floor. The first pressure level *inter alia* provides water for the two intensive care units (ICU), on the second floor of the building. The second pressure level feeds the patient-wards up to the seventh floor, and the third pressure level serves the floors eight to fifteen. The southern water distribution ring serves to the annex south (two patient wards and an outpatient department, four floors, built in 2011) and the south wing of the main building (four patient wards, four floors, built in 1963). A schematic representation of the hospitals cold-water supplying system is provided in Figure 1.

Superheat-and-flush measure

In a first superheat and flush procedure in March 2017, the entire cold-water supplying system was flushed with hot water section by section, including all distal sites. The entire measure covered a period of 14 days. In a first preparatory step, it had to be determined, which devices were sensitive to heat and might take damage from this process. These devices (like coffee machines and drinking fountains) were temporarily disconnected from the water pipes. To maintain an effective elimination of *Legionella spp.*, a water

temperature of at least 70°C had to be maintained for at least three minutes at all distal sites. A big challenge during this measure was to avoid scalding of patients and hospital staff. Therefore, each cold-water tap had to be blocked and observed by hospital staff during the disinfection measure. Moreover, the observers proofed the achievement and maintenance of the target temperature, as well as the regression to a value below 20°C afterwards for protection against accidental scalding. The water temperature before and after flushing, as well as the duration of flushing was documented. After the disinfection measure, periodical follow-up examinations were taken out. As a result of an expected short impact of success according to literature, in November 2017 a second superheat and flush disinfection following the same scheme was carried out. Furthermore, periodical testing was continued until the present day without another disinfection measure.

Sample collection, process and analysis

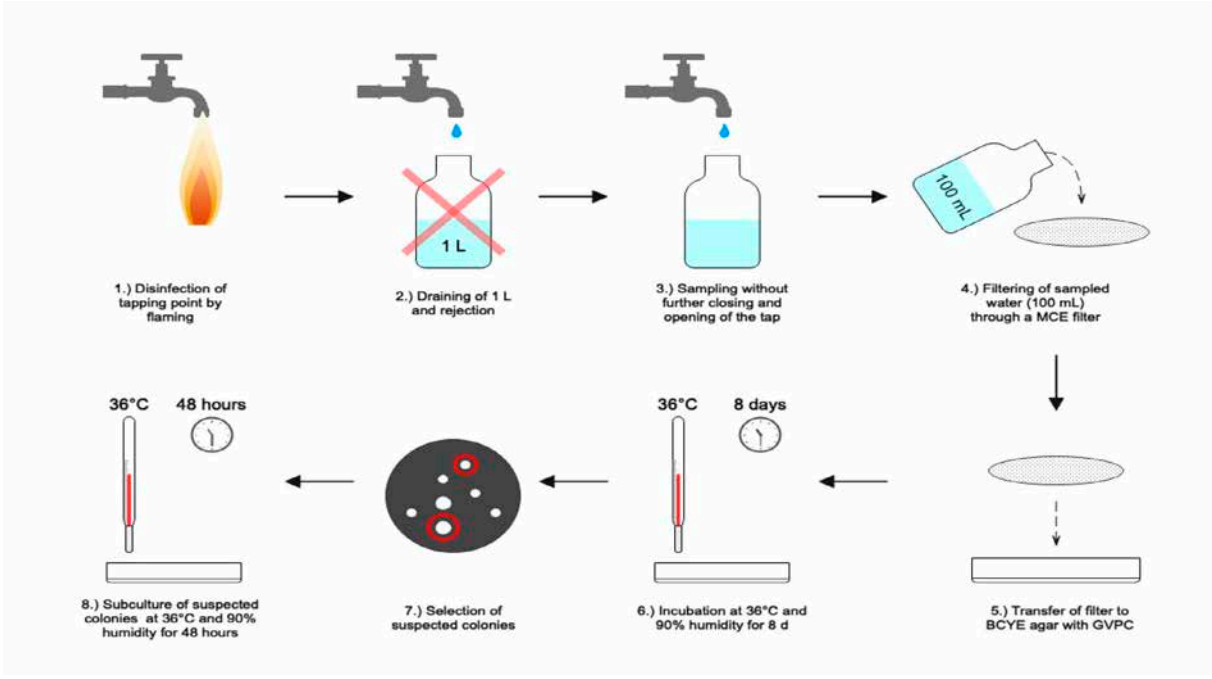
Sampling sites were selected randomly. All samples were taken in accordance with DIN EN ISO 19458 and DIN EN ISO 11731 (DIN EN ISO – German standard which has also been adopted as a European standard). The sampling technique is visualized in Figure 2. After an initial disinfection of the water tapping point by flaming, one liter of water was drained and discarded. Afterwards, without further closing and opening of the water tap, a sample container was filled, and the temperature of the sample was documented [26]. For determination of legionella count 100 mL of sampled water was filtered with a sterile mixed cellulose ester (MCE) membrane filter (Millipore EZ-Pak, Merck KGaA, Darmstadt, Germany), 47 mm in diameter with a pore size of 0.45 µm. Each membrane filter was transferred to a Buffered Charcoal Yeast Extract (BCYE) agar with glycine, vancomycin, polymyxin and cycloheximide (GVPC), incubated at 36 ± 1°C in a humid atmosphere (90% humidity), and examined after 8 days of incubation. Afterwards, suspected colonies were subcultured on BCYE agar with GVPC and Columbia blood agar. After another incubation period of 48 hours at 36 ± 1°C, only colonies grown on GVPC agar were included in the results. These were reported in colony forming units (CFU) per 100 mL.

Statistical analyses

Baseline characteristic and outcomes were analyzed as follows: Continuous, not normally distributed variables are presented as median and interquartile range (IQR), categorical variables are expressed as frequency and percentage. The normality of distribution of continuous variables was tested by one-sample Kolmogorov-Smirnov test. Comparison of CFUs before and after disinfection measures was performed using the Mann-Whitney U test. For this purpose, all sampling points of each water supply line were pooled according to time point of sampling (before and after superheat and flush disinfection). To a certain extent, samples were taken before and after superheat and flush disinfection at the same sampling point. These related samples were additionally compared with a one-sided Wilcoxon signed-rank test.

Statistical analysis was performed with GraphPad Prism 8 (GraphPad Software Inc., San Diego, CA, USA) and The R Project for Statistical Computing 4.0 (The R Foundation for Statistical Computing, Vienna,

Fig. 2. Visualization of the sampling technique for determination of legionella colony forming units per 100 mL (MCE: mixed cellulose ester; BCYE: buffered charcoal yeast extract; GVPC: glycine, vancomycin, polymyxin and cycloheximide).



Austria). A p-value of less than 0.05 was considered to be statistically significant.

Results

The count of CFU's before and after superheat and flush procedure are shown in Table I and Figure 3.

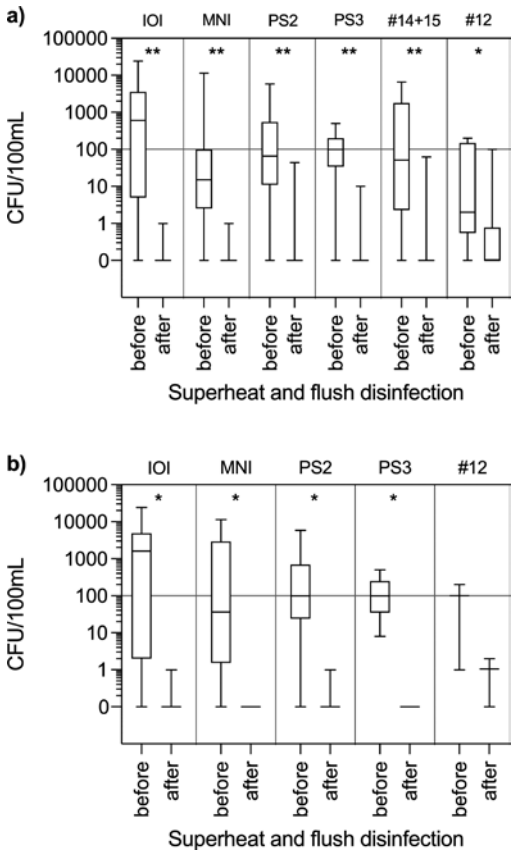
The frequency of exceeding the limit value of 100 CFU/100 mL pre- and post-disinfection is also presented in Table I.

Independently of localization of testing, before thermal disinfection the bacterial load of legionella exceeded by far the legal limits of 100 CFU/100 mL. Especially at the interdisciplinary, operative ICU (IOI), 73% of all samples surpassed this cutoff value up to 30 times. Also, at other sampling points (medical, neurological ICU (MNI), pressure stage 2 and 3, building 12, 14 and 15) 29 to 54% of all samples presented an exuberant load of *Legionella spp.* None of the mentioned sampling sites showed acceptable CFU counts at that time.

After superheat and flush disinfection, CFUs of legionella at nearly all sampling sites, except for one, were found below the cutoff level of 100 CFU/100 mL, while even no proof of *Legionella spp.* could be found at some sites. Statistical analysis of all sampling sites showed a highly significant reduction of legionella load in the cold-water supplying system after the measure, shown in Figure 3a. This was also observed in matched samples of identical locations before and after disinfection, although not all differences were statistically significant due to only a small size of matched samples as it is shown in Figure 3b.

The one sampling site still showing elevated legionella levels after the first intervention was attributed to a

Fig. 3. Distribution of Colony Forming Units (CFU) per 100 mL of *Legionella spp.* within the cold-water supplying system for a) all sampling points or b) only matched, identical sampling points, before/after superheat and flush disinfection. Horizontal line indicating the limit value of 100 CFU / 100 mL (IOI: interdisciplinary, operative ICU; MNI: medical, neurological ICU; PS2: pressure stage 2; PS3: pressure stage 3; #14+15: building no. 14 and 15; #12: building no. 12; * p-value < 0.05.; ** p-value < 0.001.



Tab. I. Colony forming units of Legionella spp. before and after first superheat and flush disinfection of the cold-water supplying system.

	Before disinfection			After disinfection			P-value
Sample location	CFUa [median (IQR)] / 100 mL	N	N above TLVb (%)	CFUa [median (IQR)] / 100 mL	N	N above TLVb (%)	
All sampling points							
Total	61 (3-100)	70	33 (47.1)	0 (0-0)	202	1 (0.5)	< 0.001
IOI[c]	600 (103-2,600)	11	8 (72.7)	0 (0-0)	36	0 (0.0)	< 0.001
MNI[d]	15 (3-100)	17	5 (29.4)	0 (0-0)	26	0 (0.0)	< 0.001
PS2[e]	66 (11-450)	16	7 (43.8)	0 (0-0)	43	0 (0.0)	< 0.001
PS3[f]	100 (35-200)	15	8 (53.3)	0 (0-0)	42	0 (0.0)	< 0.001
#14+15[g]	52 (3-175)	6	3 (50.0)	0 (0-0)	27	0 (0.0)	< 0.001
#12[h]	2 (1-100)	5	2 (40.0)	0 (0-0)	28	1 (3.6)	0.014
Matched sampling points[i]							
Total	100 (11-400)	33	18 (54.5)	0 (0-0)	33	0 (0.0)	< 0.001
IOI[c]	1,600 (4-4250)	7	4 (57.1)	0 (0-0)	7	0 (0.0)	0.018
MNI[d]	37 (10-85)	6	2 (33.3)	0 (0-0)	6	0 (0.0)	0.030
PS2[e]	100 (37-400)	9	5 (55.6)	0 (0-0)	9	0 (0.0)	0.007
PS3[f]	100 (36-200)	9	6 (66.7)	0 (0-0)	9	0 (0.0)	0.005
#14+15[g]	No matched sampling points						
#12[h]	101 (51-150)	2	1 (50.0)	1 (0-2)	2	0 (0.0)	0.500

[a] CFU: colony forming units; [b] TLV: threshold limit value of 100 CFU/100 mL; [c] IOI: interdisciplinary, operative ICU; [d] MNI: medical, neurological ICU; [e] PS2: pressure stage 2; [f] PS3: pressure stage 3; [g] #14+15: building no. 14 and 15; [h] #12: building no. 12. [i] identical sampling points before and after measure.

local contamination, and therefore an exchange of the tapping point was performed. Afterwards no increased loads of *Legionella spp.* were observed at this site. Until the second episode of disinfection in November 2017, follow-up samples showed no increase of CFUs of legionella. Over the further course of time, until the present day, the periodical assessment of bacterial load of *Legionella spp.* detected no sampling site passing the intervention threshold of 100 CFU/100 mL. Only at one sampling site in December 2019 (toilet flush) the limit value was exceeded, which was again attributable to a local contamination from an external origin (feces).

Discussion

We evaluated the effects of the superheat and flush method on the bacterial load of legionella in the cold-water supplying system at the UKB and we could show that this measure was highly effective. While 33 out of 70 samples had a legionella load of more than 100 CFU/100 mL before the first disinfection was carried out, this number could be reduced to 1 out of 202 samples. Additionally, the effect was long-lasting, as no relevant limit exceedance occurred until the present day (June 2020).

Since the 1980s, multiple studies have been carried out to analyze methods controlling legionellae populations in water-conducting systems of hospitals. Often the focus was set on hot water-supplying systems, but it has also been shown that cold water supply systems can be contaminated with legionella [28]. The investigation of used methods differs widely though. In early studies, both chemical disinfection processes using chlorine, and thermal disinfection processes were deemed as effective [23]. Additionally, further chemical methods *e.g.* ozone, copper or silver came up. Nevertheless, beside reports of successful implementations of these chemical measures [29-31], there were also examples of failure [32]. All chemical methods have in common, that they need to be carried out continuously. Alternatively, an intermittent chemical disinfection of the pipes can be carried out. In this case, a ban on the use of all water intakes for the duration of the measure is required. It must also be ensured that a target concentration of the substance in the water is reached and subsequently rinsed out to a harmless level [33]. However, due to these measures, damage to piping systems was observed in the past. In addition, they involve a great deal of effort and are difficult to implement in medical supply buildings during the clinical workflow [34].

Therefore, other feasible and effective disinfection methods were evaluated in the past, including physical measures for eradication. Irradiation with ultra-violet (UV) light (wavelength 253.7 nm) reliably kills legionella [35]. Despite that, irradiation units must be operated permanently and maintained regularly in accordance with the water flow rate and the systems have to be replaced annually. Moreover, disinfection by UV irradiation is locally limited and thus, if used centrally, contamination in the piping system is likely to remain [36]. There are no toxic by-products, but a decentralized use is very cost intensive.

A different approach is the superheat and flush procedure, which was the first disinfection measure used for eradication of legionella-colonized water distribution systems in hospitals [22]. This measure is based on a physical principle. Hot water is flushed through contaminated pipe sections for a sufficient period of time and kills legionella through a high temperature. However, there are older reports on only a short duration of effect with a recolonization of the water-supplying system within a short time after disinfection [25, 37-39]. But there is no need for special equipment and therefore the superheat and flush method can be initiated in a short period of time. These were the main reasons, why we chose this method for eradication in our hospital. Nevertheless, we were also aware to repeat this measure if a recolonization would have been occurred and thus, we scheduled two episodes of disinfection in advance, which represents a typical approach according to literature [40].

With regard to implementation of the superheat and flush method, there are also important things to consider. Some failures in the past were most likely attributable to non-systematic and simultaneous flushing of distal sites in a short period of time [40]. Moreover, it has to be ensured, that all pipe sections are included in the procedure. Therefore, we performed the superheat and flush disinfection section by section in only 14 days, where one structural section was disinfected at once within a few hours and repeated this intervention after 6 months. This meant a great deal of effort, as each tapping point had to be secured by personnel for prevention of accidental scalding. However, this ensured that no recontamination from areas that had not been disinfected yet could occur, which may be possibly one of the main reasons why the superheat and flush disinfection has shown such a great and long-lasting effect in our hospital. Legal thresholds were easily met and by far exceeded. The absolute legionella count could be reduced to almost 0 CFU/100 ml at all sampling points and no damage to pipelines or thermal damage to users occurred. Contrary to past studies, the effect was shown to be long-lasting after an observation period after more than two years. It remains speculative whether this result could have also been obtained with other disinfection methods. However, chemical disinfection might have required an interruption of the clinical workflow and environmental aspects can also not to be neglected. Drawback of superheat and flush method is an increased expenditure, which could be estimated at approximately 250 working hours for each implementation at the UKB. In contrast it has also to be taken into account, that other methods would have to be carried out by specialized companies.

The retrospective approach of the investigation and

the lack of comparison with other methods on the same object may limit our findings. However, several studies show that restrictions such as a development of tolerances and insufficient effectiveness may occur in chemical disinfection processes. Moreover, it remains speculative to what extent the removal of unused pipeline sections and the introduction of a flushing plan for less-used parts of the pipeline system influenced the effectiveness and long-term effect of the measure.

Despite the promising results of our study, a transferability into other hospitals or buildings is only limited. First of all, water supplying systems differ widely between hospitals as they represent grown structures which were extended and adjusted throughout the past during construction works and building expansions. Moreover, the location of contamination with legionella within the water system (*e.g.* pipes *vs* distal sites) may have an impact on effectiveness. Therefore, our measures cannot be transferred one-to-one to other hospitals with similar problems. Thus, it is essential to carry out an individual risk assessment and to choose and adapt disinfection measures according to local conditions. Nevertheless, our experience may encourage others to put the superheat and flush method on the shortlist of possible disinfection procedures.

Conclusions

The superheat and flush disinfection can provide an economic and highly effective measure in case of legionella contamination of water supplying systems, especially in hospitals with an older building structure. Nevertheless, according to local conditions, no general statement can be made for or against this disinfection measure. Affected hospitals have to carry out an individual risk assessment and selection of method for eradication. However, as there is no need for special equipment and it can be initiated in a short period of time, the superheat and flush procedure should be shortlisted for an eradication attempt.

Acknowledgements

Funding sources: this research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

We would like to thank all people who were involved in performance of the superheat and flush method by supervising distal sites, performing measurement of temperatures, obtaining water samples and avoiding accidental scalding of patients and hospital staff. Special thanks also go to Dr. Ulrich Maier of Umweltlabor ACB GmbH, Muenster, Germany, who supported us in the description of methods for measurement of legionella load in water samples.

Conflict of interest statement

The authors declare no conflict of interest.

Authors' contributions

MU: writing the manuscript; Data analysis. TR: review the manuscript. TK: planning the work. CP: data collection. MB: data collection. MN: data collection. CS: data analysis. H-P J: planning the work. NP: review the manuscript; analyze literature. MA: planning the work; review the manuscript. HN: writing the manuscript; statistics.

References

[1] Soda EA, Barskey AE, Shah PP, Schrag S, Whitney CG, Arduino MJ, Reddy SC, Kunz JM, Hunter CM, Raphael BH, Cooley LA. Vital signs: health care-associated legionnaires' disease surveillance data from 20 states and a large metropolitan area - United States, 2015. MMWR Morb Mortal Wkly Rep 2017;66:584-9. https://doi.org/10.15585/mmwr.mm6622e1

[2] Vincenti S, de Waure C, Raponi M, Teleman AA, Boninti F, Bruno S, Boccia S, Damiani G, Laurenti P. Environmental surveillance of Legionella spp. colonization in the water system of a large academic hospital: analysis of the four-year results on the effectiveness of the chlorine dioxide disinfection method. Sci Total Environ 2019;657:248-53. https://doi.org/10.1016/j.scitotenv.2018.12.036

[3] Nakamura I, Amemura-Maekawa J, Kura F, Kobayashi T, Sato A, Watanabe H, Matsumoto T. Persistent Legionella contamination of water faucets in a tertiary hospital in Japan. Int J Infect Dis 2020;93:300-4. https://doi.org/10.1016/j.ijid.2020.03.002

[4] Orsi GB, Vitali M, Marinelli L, Ciorba V, Tufi D, Del Cimmuto A, Ursillo P, Fabiani M, De Santis S, Protano C, Marzuillo C, De Giusti M. Legionella control in the water system of antiquated hospital buildings by shock and continuous hyperchlorination: 5 years experience. BMC Infect Dis 2014;14:394. https://doi.org/10.1186/1471-2334-14-394

[5] Lytle DA, Pfaller S, Muhlen C, Struewing I, Triantafyllidou S, White C, Hayes S, King D, Lu J. A comprehensive evaluation of monochloramine disinfection on water quality, Legionella and other important microorganisms in a hospital. Water Res 2021;189:116656. https://doi.org/10.1016/j.watres.2020.116656

[6] Lin YE, Stout JE, Yu VL. Controlling Legionella in hospital drinking water: an evidence-based review of disinfection methods. Infect Control Hosp Epidemiol 2011;3:166-173. https://doi.org/10.1086/657934

[7] Sheffer PJ, Stout JE, Wagener MM, Muder RR. Efficacy of new point-of-use water filter for preventing exposure to Legionella and waterborne bacteria. Am J Infect Control 2005;33(Suppl 1):S20-5. https://doi.org/10.1016/j.ajic.2005.03.012

[8] Cates EL, Torkzadeh H. Can incorporation of UVC LEDs into showerheads prevent opportunistic respiratory pathogens? - Microbial behavior and device design considerations. Water Res 2020;168:115163. https://doi.org/10.1016/j.watres.2019.115163

[9] Triassi M, Di Popolo A, Ribera D'Alcala G, Albanese Z, Cuccurullo S, Montegrosso S, Crispino M, Borella P, Zarrilli R. Clinical and environmental distribution of Legionella pneumophila in a university hospital in Italy: efficacy of ultravio-

let disinfection. J Hosp Infect 2006;62:494-501. https://doi.org/10.1016/j.jhin.2005.09.029

[10] Hall KK, Giannetta ET, Getchell-White SI, Durbin LJ, Farr BM. Ultraviolet light disinfection of hospital water for preventing nosocomial Legionella infection: a 13-year follow-up. Infect Control Hosp Epidemiol 2003;24:580-3. https://doi.org/10.1086/502257

[11] Liu Z, Stout JE, Tedesco L, Boldin M, Hwang C, Yu VL. Efficacy of ultraviolet light in preventing Legionella colonization of a hospital water distribution system. Water Research 1995;29:2275-80. https://doi.org/10.1016/0043-1354(95)00048-P

[12] Almeida D, Cristovam E, Caldeira D, Ferreira JJ, Marques T. Are there effective interventions to prevent hospital-acquired Legionnaires' disease or to reduce environmental reservoirs of Legionella in hospitals? A systematic review. Am J Infect Control 2016;44:e183-8. https://doi.org/10.1016/j.ajic.2016.06.018

[13] European Commission. 2012/78/EU: Commission Decision of 9 February 2012 concerning the non-inclusion of certain substances in Annex I, IA or IB to Directive 98/8/EC of the European Parliament and of the Council concerning the placing of biocidal products on the market (notified under document C(2012) 645) Text with EEA relevance. Avalaible at: https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX%3A32012D0078 (accessed on 25.05.2021).

[14] Garcia MT, Baladron B, Gil V, Tarancon ML, Vilasau A, Ibanez A, Elola C, Pelaz C. Persistence of chlorine-sensitive Legionella pneumophila in hyperchlorinated installations. J Appl Microbiol 2008;105:837-47. https://doi.org/10.1111/j.1365-2672.2008.03804.x

[15] Bedard E, Trigui H, Liang J, Doberva M, Paranjape K, Lalancette C, Allegra S, Faucher SP, Prevost M. Local Adaptation of Legionella pneumophila within a Hospital Hot Water System Increases Tolerance to Copper. Appl Environ Microbiol 2021;87(10). https://doi.org/10.1128/AEM.00242-21

[16] National Academies of Sciences, Engineering, Medicine. Book Management of Legionella in Water Systems. Washington, DC: The National Academies Press 2020.

[17] Associated Press. Legionella Bacteria Found in 2 Sinks at WVa Hospital. Avalaible at: https://www.usnews.com/news/best-states/west-virginia/articles/2021-04-27/legionella-bacteria-found-in-2-sinks-at-wva-hospital (accessed on 23.05.2021).

[18] The Portugal News. Legionella outbreak at Lisbon Hospital. Avalaible at: https://www.theportugalnews.com/news/legionella-outbreak-at-lisbon-hospital/43778 (accessed on December 20, 2020).

[19] Matt Freije. How Much a Facility Really Pays for a Legionella Risk Management Program. Avalaible at: https://hcinfo.com/blog/how-much-a-facility-really-pays-for-a-legionella-risk-management-program (accessed on 23.05.021).

[20] Centers for Disease Control and Prevention (CDC). Waterborne Diseases Could Cost over $500 Million Annually in U.S. Avalaible at: https://www.cdc.gov/media/pressrel/2010/r100714.htm (accessed on 23.05.2021).

[21] American Society of Heating, Refrigerating and Air-Conditioning (ASHRAE). Book Standard 188-2018 - Legionellosis: risk management for building water systems - 2018.

[22] [22] Best M, Yu VL, Stout J, Goetz A, Muder RR, Taylor F. Legionellaceae in the hospital water-supply. Epidemiological link with disease and evaluation of a method for control of nosocomial legionnaires' disease and Pittsburgh pneumonia. Lancet 1983;2(8345):307-310. https://doi.org/10.1016/s0140-6736(83)90290-8.

[23] Edelstein PH. Control of Legionella in hospitals. J Hosp Infect 1986;8:109-15. https://doi.org/10.1016/0195-6701(86)90037-x

[24] Darelid J, Lofgren S, Malmvall BE. Control of nosocomial Legionnaires' disease by keeping the circulating hot water temperature above 55 degrees C: experience from a 10-year surveillance programme in a district general hospital. J Hosp Infect 2002;50:213-9. https://doi.org/10.1053/jhin.2002.1185

[25] Snyder MB, Siwicki M, Wireman J, Pohlod D, Grimes M, Bowman-Riney S, Saravolatz LD. Reduction in Legionella pneumophila through heat flushing followed by continuous supplemental chlorination of hospital hot water. J Infect Dis 1990;162:127-32. https://doi.org/10.1093/infdis/162.1.127

[26] Federal Ministry of Justice and Consumer Protection of Germany. Ordinance on the Quality of Water intended for Human Consumption. Avalaible at: https://www.bundesgesundheitsministerium.de/fileadmin/Dateien/3_Downloads/E/Englische_Dateien/Drinking_Water_Ordinance.pdf (accessed on 19.05.2020).

[27] Umweltbundesamt. Systemische Untersuchungen Von Trinkwasser-Installationen Auf Legionellen Nach Trinkwasserverordnung – Probennahme, Untersuchungsgang Und Angabe Des Ergebnisses: Empfehlung Des Umweltbundesamtes Nach Anhörung Der Trinkwasserkommission. Bundesgesundheitsblatt Gesundheitsforschung Gesundheitsschutz 2019;62:1032-7. https://doi.org/10.1007/s00103-019-02893-2

[28] Lin YS, Stout JE, Yu VL, Vidic RD. Disinfection of water distribution systems for Legionella. Semin Respir Infect 1998;13:147-59.

[29] Stout JE, Lin YS, Goetz AM, Muder RR. Controlling Legionella in hospital water systems: experience with the superheat-and-flush method and copper-silver ionization. Infect Control Hosp Epidemiol 1998;19:911-4.

[30] Sarjomaa M, Urdahl P, Ramsli E, Borchgrevink-Lund CF, Ask E. Prevention of Legionnaires' disease in hospitals. Tidsskr Nor Laegeforen 2011;131:1554-7. https://doi.org/10.4045/tidsskr.09.0881

[31] Stout JE, Yu VL. Experiences of the first 16 hospitals using copper-silver ionization for Legionella control: implications for the evaluation of other disinfection modalities. Infect Control Hosp Epidemiol 2003;24:563-8. https://doi.org/10.1086/502251

[32] Rohr U, Senger M, Selenka F, Turley R, Wilhelm M. Four years of experience with silver-copper ionization for control of legionella in a german university hospital hot water plumbing system. Clin Infect Dis 1999;29:1507-11. https://doi.org/10.1086/313512

[33] Dallolio L, Scuderi A, Rini MS, Valente S, Farruggia P, Sabattini MA, Pasquinelli G, Acacci A, Roncarati G, Leoni E. Effect of different disinfection protocols on microbial and biofilm contamination of dental unit waterlines in community dental practices. Int J Environ Res Public Health 2014;11:2064-76. https://doi.org/10.3390/ijerph110202064

[34] Muzzi A, Cutti S, Bonadeo E, Lodola L, Monzillo V, Corbella M, Scudeller L, Novelli V, Marena C. Successful Prevention of Nosocomial Legionellosis by Best Water Management adopting an integrated system of pre-filters, filters, pipe protecting products, remote control and chlorine dioxide-based disinfection system. J Hosp Infect 2020. https://doi.org/10.1016/j.jhin.2020.05.002

[35] Cervero-Arago S, Sommer R, Araujo RM. Effect of UV irradiation (253.7 nm) on free Legionella and Legionella associated with its amoebae hosts. Water Res 2014;67:299-309. https://doi.org/10.1016/j.watres.2014.09.023

[36] Arnold FW, Summersgill JT, Lajoie AS, Peyrani P, Marrie TJ, Rossi P, Blasi F, Fernandez P, File TM, Jr., Rello J, Menendez R, Marzoratti L, Luna CM, Ramirez JA, Community-Acquired Pneumonia Organization I. A worldwide perspective of atypical pathogens in community-acquired pneumonia. Am J Respir Crit Care Med 2007;175:1086-93. https://doi.org/10.1164/rccm.200603-350OC

[37] Colville A, Crowley J, Dearden D, Slack RC, Lee JV. Outbreak of Legionnaires' disease at University Hospital, Nottingham. Epidemiology, microbiology and control. Epidemiol Infect 1993;110:105-16. https://doi.org/10.1017/s0950268800050731

[38] Darelid J, Bengtsson L, Gastrin B, Hallander H, Lofgren S, Malmvall BE, Olinder-Nielsen AM, Thelin AC. An outbreak of Legionnaires' disease in a Swedish hospital. Scand J Infect Dis 1994;26:417-25. https://doi.org/10.3109/00365549409008615

[39] Heimberger T, Birkhead G, Bornstein D, Same K, Morse D. Control of nosocomial Legionnaires' disease through hot water flushing and supplemental chlorination of potable water. J Infect Dis 1991;163:413. https://doi.org/10.1093/infdis/163.2.413

[40] Chen YS, Liu YC, Lee SS, Tsai HC, Wann SR, Kao CH, Chang CL, Huang WK, Huang TS, Chao HL, Li CH, Ke CM, Lin YS. Abbreviated duration of superheat-and-flush and disinfection of taps for Legionella disinfection: lessons learned from failure. Am J Infect Control 2005;33:606-10. https://doi.org/10.1016/j.ajic.2004.12.008

Received on December 30, 2020. Accepted on May 26, 2021.

Correspondence: Matthias Unterberg, Klinik für Anästhesiologie, Intensivmedizin und Schmerztherapie, Universitätsklinikum Knappschaftskrankenhaus Bochum GmbH, In der Schornau 23-25, 44892 Bochum, Germany - Tel.: +49 (234) 299-3001 - E-mail: matthias.unterberg@kk-bochum.de

How to cite this article: Unterberg M, Rahmel T, Kissinger T, Petermichl C, Bosmanns M, Niebius M, Schulze C, Jochum H-S, Parohl N, Adamzik M, Nowak H. Legionella contamination of a cold-water supplying system in a German university hospital – assessment of the superheat and flush method for disinfection. J Prev Med Hyg 2021;62:E751-E758. https://doi.org/10.15167/2421-4248/jpmh2021.62.3.1944

Research article

Risk of latent tuberculosis infection among healthcare workers in Italy: a retrospective study with Quantiferon Test

LUCA COPPETA[1], CRISTIANA FERRARI[2], MARIACARMELA FERRARO[3], SAVINO BALDI[2], STEFANIA GRANDE[4], LUDOVICO MARIA DE ZORDO[2], PIER FRANCESCO MATTONE[2], MARIA TERESA DODDATO[2], OTTAVIA BALBI[2], ANDREA MAGRINI[1], ANTONIO PIETROIUSTI[1], PIERGIORGIO LIETO[2]

[1] Department of Biomedicine and Prevention, University of Rome "Tor Vergata", Rome, Italy; [2] Department of Occupational Medicine, University of Rome "Tor Vergata", Rome, Italy; [3] Department of Hygiene and Preventive Medicine, University of Rome "Tor Vergata", Rome, Italy; [4] Department of Anaesthesia, Intensive Care and Pain Management, University of Rome "Campus Bio-Medico", Rome, Italy

Keywords

Latent tuberculosis • Contact screening • Quantiferon • Occupational health

Summary

Objective. *The latent tuberculosis infection (LTBI) is a state of persistent immune response to stimulation by Mycobacterium Tuberculosis antigens without clinical manifestation: the healthcare workers (HCWs) have a higher exposure risk so prevention is an important challenge for occupational medicine. The aim of our study is to evaluate the prevalence of LTBI among HCWs of the Foundation Policlinic "Tor Vergata".*

Methods. *This is a retrospective study conducted by analyzing the clinical records of 825 HCWs of the PTV, from January 1st to December 31th 2016. To evaluate the TB infection we used the Quantiferon TB Gold interferon-gamma release assay.*

Results. *Our study underlines the low prevalence of LTBI in the Italian healthcare workers.*

Conclusion. *Although the LTBI status is not contagious, the diagnosis and the safety strategies require specific clinical and preventive considerations.*

Introduction

Tuberculosis (TB) is one of the top 10 causes of death worldwide: according to the last World Health Organization (WHO) Global report, 10.0 million (range: 8.9-11.0 million) people fell ill with TB in 2019, and 1,6 million died for this infective disease. Despite some progress in the pipeline for the new diagnostic methodic, TB research and development did not improve new drugs and vaccine efficacy [1]. Studies in literature underline that in about 70% of incident cases of TB there is a reactivation of a past infection.

The latent tuberculosis infection (LTBI) is a state of persistent immune response to stimulation by Mycobacterium Tuberculosis antigens without evidence of clinically manifested active TB so the fast identification and prophylactic treatment of individuals with LTBI is crucial for the elimination of the disease [2, 3].

Approximately two billion people in the world are affected by LTBI: in Italy, the National Health Institute reports that the incidence of TB in 2019 is 6.5 case/100.000 inhabitants [4, 5].

The WHO classified Italy as a low incidence country, even if there are groups of population with increased probability to contract TB infection [6]. The healthcare workers (HCWs) have a higher exposure risk to tuberculosis, because of their activities in the hospital setting: the prevention of this new-old infective disease is an important challenge for the occupational medicine [2].

The HCWs may contract the Mycobacterium Tuberculosis in nosocomial environment by the infected patient or get infected in the community setting and being itself a source of infection for colleagues and patients.

According to Italian Legislation is mandatory for Occupational Doctor to evaluate all work risks, including the exposure to biological agents, like viral hepatitis or tuberculosis, and to improve the safety strategies in order to prevent the spread to operators or to limit the severity of its consequences [7]. For the evaluation of TB work risks, in 2013 the Italian Ministry of Health has classified healthcare settings into 5 increasing levels of risk related to a growing risk of infection [8]. Health surveillance flow chart is established according to the level of risk of the structure to which the HCWs are employed [9, 10].

Although the importance of the early identification and treatment of the LTBI among hospital workers is known, only few studies have evaluated the correlation between the infection exposure risk classification and the increased incidence of active disease [11-13].

The aim of our study is to evaluate the prevalence of LTBI in the HCWs of the Foundation PTV Policlinic "Tor Vergata" (PTV) of Rome related to the main demographical and occupational risk factor.

Methods

This is a retrospective study conducted by analyzing all the clinical records of HCWs of the PTV, who

underwent the annual occupational medical visit from January 1st to December 31th 2016. The analyzed sample included medical doctors, nurses, laboratory and radiology technicians. To evaluate the TB infection we extracted from the clinical records the results of the Quantiferon - TB Gold (QFT-G, Qiagen) interferon-gamma (IFN-γ) release assay, highly specific and sensitive. The limit of this test is that it cannot distinguish between active tuberculosis disease and latent tuberculosis infection [14].

Analytical data were extracted from ModuLab, software that was adopted by Chemical Analytical Laboratory of PTV during the investigation period. For each study subject Quantiferon plus results were collected as well as the following data: age, gender, job category, seniority of work.

According with the manufacturer published criteria, the test was classified as positive when the antigen specific IFN gamma serum values was equal or higher than the cut-off level of 0,35 IU/ml, compared to a negative control [15]. All HCWs having positive Quantiferon test were studied by specific clinical examination and traditional radiology and retested during the following year.

Analyses were performed using IBM Stata 11 statistical package software. Results were considered statistically significant a P value threshold of < 0.05.

Results

We collected the clinical records of 825 HCWs: 284 men and 541 women. Positive Quantiferon result was found in the 4.2% of the sample (35 from 825 subjects). All those subjects were classified as LTBI after the radiological and clinical evaluation; among those HCWs, 17 were male and 18 female.

Regarding job task, 22 of LTBI operators were employed as nurses, 11 were doctors, 2 technicians.

Main demographic and occupational charateristics of the study population are shown in Table I.

Among operators who resulted positive at Quantiferon test, 7/35 (%) had a negative determination during the previous 12 months, being classified as new TB conversion, whereas 28/35 LTBI cases had a previous positive Quantiferon result.

No case of active TB has been documented between those subjects in the year following the study. We evaluated the association between LTBI and main demographic and occupational factors (gender, age class, seniority, risk level of employment setting, and job task).

After tested in a multivariate regression model the only variable statistically associated with a higher frequency of LTBI was gender, whereas all the other risk factors tested negative at the regression analysis (Tab. II).

Finally we calculated the conversion rate for TB (negative to positive result during the 1 year period) both in high and low risk setting; we found no statistical difference in the conversion rate between the different risk levels ($P = 0.56$ at χ^2 test).

Tab.I. Main characteristics of the study population.

Variables	N	%
Subjects	825	100
Sex		
Male	284	34.4
Female	541	65.6
Mean (SD) age, year	42.9	
Age		
≤ 40 years old	283	34.3
> 40 years old	542	65.7
Seniority		
≤ 10 years	348	34.3
> 10 years	477	65.7
Job		
Nurse	546	66.2
Medical doctor	181	21.9
Laboratory staff	8	1.0
Technical staff	74	9.0
Others	16	1.9
Working area[§]		
Low-average risk (groups A, B, C)	687	83.3
High risk (groups D, E)	138	16.7
IGRA test outcomes		
Negative	790	95.8
Positive	35	4.2

[§] Tuberculosis prevention in healthcare workers and similar. Italian Ministry of Public Health 2013.

Tab. II. IGRA test outcomes by the main characteristic of the study population.

Variables	Positive IGRA	%	P value univariate	P value multivariate
Sex				
Male	19/284	6.7	0.017	0.015
Female	16/541	3.0		
Age				
≤ 40 years old	5/283	1.8	0.006	0.068
> 40 years old	30/542	5.5		
Seniority				
≤ 10 years	9/348	2.6	0.031	0.142
> 10 years	26/447	5.5		
Job				
Nurse	21/546	3.8	0.46	
Medical doctor	12/181	6.6		
Laboratory technician	0/8	0.0		
Technical staff	2/74	2.7		
Others	0/16	0.0		
Working area[§]				
Low-average risk (groups A, B, C)	5/138	3.6	0.82	
High risk (groups D, E)	30/687	4.4		

[§] Tuberculosis prevention in healthcare workers and similar. Italian Ministry of Public Health. 2013.

Discussion

The healthcare workers have an increased exposure risk to tuberculosis, because of their activities in the hospital setting: in Italy for tuberculosis, the healthcare setting

is classified in 5 levels according to growing exposure risk, from A to E [8]. LTBI condition has been defined by the positivity to Quantiferon test and the negativity to the clinical-radiological assessment, conducted for the purpose of excluding an active infection [16, 17]. Our study confirms the low prevalence of LTBI among healthcare operators in Italian hospital: we found 35 subjects with LTBI off a sample of 825. This data compared with other similar studies conducted among different sanitary population of various countries, shows a lower prevalence of LTBI condition, 4.2% *vs* mean LTBI percentages of 9.2% of other groups [11, 12, 18, 19]. According to this data in our study the prevalence of LTBI assessed by Quantiferon test is statistically related with gender. Furthermore, the low LTBI prevalence in our sample can be associated to the effectiveness of the safety strategies planned by the Amministration and the Occupational Medicine of PTV since 2005, that allows early detecting and reporting of suspected or confirmed case of TB. In previous studies conducted in our hospital during the period 2007/2013, the mean prevalence of positive tests was 5.5% [20]. Lamberti et al retrospective study in 2016 in Naples, based on a sample of students of dentistry showed a prevalence of 2.84% for LTBI [13]. Male Sex, in our study, seems to be statistically associated with LTBI: this data confirms that male gender is a greater tuberculosis risk, as already reported in literature [18]. The work seniority and the higher age class (> 40 years old) showed also an increased risk of latent tuberculosis even if this association was found to be not statistically significant. Moreover, in order to evaluate Italian Health Ministry TB classification for hospital setting to predict the risk of contagion for HCWs, we evaluated the correlation between the areas of employment and the rate of conversion TB test: surprisingly in our study working in high risk setting was not related to a greater prevalence of LTBI and we found no conversion rate differences among high and low work risk groups. In a previous evaluation relative to the year 2014 we found a 16% reversion rate [20], while in the present study no positive QFT test reverted, probably due to the improved standardization of the specific collection, storage and transport procedures. It is also reported that reversion may be indicative of recent exposure to a patient with active and infective Tuberculosis [21, 22]. According to the progression and reactivation rate reported in literature [1, 3], for our sample we may estimate that about 2 to 4 HCWs affected by LTBI could develop the active tuberculosis throughout working life, so as reported by the main scientific statements [1, 2, 7], prophylactic therapy should be offered to those who don't have contraindications.

Conclusions

The control of work exposure to TB infection in the hospital setting represents a major health issue for the Occupational medicine specialists. Results of our study underline the low prevalence of LTBI in the Italian healthcare workers; although LTBI status is not contagious, given the risk of reactivation of active tuberculosis following immunosuppressive treatment or other medical conditions, a specific TB control program should be improved in order to prevent the nosocomial spread of the infection. Based on the results of our study, serial screening for latent TB infection should include all HCWs, regardless to risk classification of the employment setting.

Ethical statement

Ethics approval and consent to participate: all procedures performed in this study were approved by the ethical committee of Policlinic Tor Vergata.

Acknowledgements

Funding sources: this research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Conflict of interest statement

The authors declare no conflict of interest.

Authors' contributions

LC: conception and design of the study; acquisition of data, final approval of the version to be submitted.
CF: revising the article critically for important intellectual content
MF: acquisition of data.
SB: acquisition of data.
SG: drafting the article or revising it critically for important intellectual content.
LMD: analysis and interpretation of data.
Mattone Pier Francesco: analysis and interpretation of data.
MTD: drafting the article or revising it critically for important intellectual content.
OB: acquisition of data.
AM: drafting the article or revising it critically for important intellectual content.
AP: conception and design of the study.
PL: conception and design of the study, drafting the article or revising it critically for important intellectual content, final approval of the version to be submitted.

References

[1] World Health Organization. Global Tuberculosis Report - 2018.

[2] Jensen PA, Lambert LA, Iademarco MF, Ridzon R; CDC. Guidelines for preventing the transmission of Mycobacterium tuberculosis in health-care settings, 2005. MMWR Recomm Rep 2005;54:1-141.

[3] World Health Organization. WHO policy on TB infection control in health-care facilities, congregate settings and households - 2009. http://whqlibdoc.who.int/publications/2009/9789241598323_eng.pdf

[4] Centers for Disease Control and Prevention. Guidelines for the investigation of contacts of persons with infectious tuberculosis. Recommendations from the National Tuberculosis Controllers Association and CDC. MMWR Morb Mortal Wkly Rep 2005;54:1-47.

[5] Istituto Superiore di Sanità. Tubercolosi. Aspetti epidemiologici: dati generali. Antonietta Filia. http://www.epicentro.iss.it/problemi/Tubercolosi/epid.asp

[6] https://www.who.int/tb/publications/global_report/gtbr2018_main_text_28Feb2019.pdf?ua=1

[7] Decreto legislativo 9 aprile 2008, n. 81 "Attuazione dell'articolo 1 della legge 3 agosto 2007, n. 123, in materia di tutela della salute e della sicurezza nei luoghi di lavoro".

[8] Conferenza permanente per i rapporti tra lo Stato, le Regioni e le Province Autonome di Trento e Bolzano - Provvedimento 17 dicembre 1998 - Linee Guida per il controllo della malattia tubercolare, su proposta del Ministro della Sanità, ai sensi dell'art. 115, comma 1, lettera b), del decreto legislativo 31 marzo 1998, n. 112.

[9] Ministero del Lavoro della Salute e delle Politiche Sociali. Aggiornamento delle raccomandazioni per le attività di controllo della tubercolosi in Italia. Anno 2013. http://www.salute.gov.it/imgs/C_17_pubblicazioni_1221_allegato.pdf

[10] Ministero del Lavoro della Salute e delle Politiche Sociali. Prevenzione della tubercolosi negli operatori sanitari e soggetti ad essi equiparati. Approvato come Accordo nella Conferenza Stato-Regioni-Province Autonome del 7 febbraio 2013.

[11] Zwerling A, van den Hof S, Scholten J, Cobelens F, Menzies D, Pai M. Interferon-gamma release assays for tuberculosis screening of healthcare workers: a systematic review. Thorax 2012;67:62-70. https://doi.org/10.1136/thx.2010.143180

[12] Uden L, Barber E, Ford N, Cooke GS. Risk of tuberculosis infection and disease for health care workers: an updated meta-analysis. Open Forum Infect Dis 2017;4:ofx137. https://doi.org/10.1093/ofid/ofx137

[13] Lamberti M, Muoio MR, Westermann C, Nienhaus A, Arnese A, Ribeiro Sobrinho AP, Di Giuseppe G, Garzillo EM, Crispino V, Coppola N, De Rosa A. Prevalence and associated risk factors of latent tuberculosis infection among undergraduate and postgraduate dental students: a retrospective study. Arch Environ Occup Health 2016:1-7.

[14] Mazurek GH, Jereb J, Vernon A, LoBue P, Goldberg S, Castro K; IGRA Expert Committee; Centers for Disease Control and Prevention (CDC). Updated guidelines for using Interferon Gamma Release Assays to detect Mycobacterium tuberculosis infection - United States, 2010. MMWR Recomm Rep 2010;59:1-25.

[15] https://www.diasorin.com/sites/default/files/allegati_prodotti/brochure-qft_m0870004375_lr.pdf

[16] Muñoz L, Stagg HR, Abubakar I. Diagnosis and management of latent tuberculosis infection. Cold Spring Harb Perspect Med 2015;5:a017830. https://doi.org/10.1101/cshperspect.a017830

[17] https://www.ecdc.europa.eu/sites/portal/files/media/en/publications/Publications/1103_GUI_IGRA.pdf

[18] Coppeta L, Baldi S, Somma G, Tursi E, Policardo S, Balbi O, Lieto P, Pietroiusti A, Magrini A. QuantiFERON-TB Gold Plus evaluation for latent tuberculosis infection among Italian healthcare workers: a cross-sectional study. Epidemiol Biostat Public Health 2019;16:2. https://doi.org/10.2427/13123

[19] Coppeta L, Somma G, Baldi S, Tursi E, D'Alessandro I, Torrente A, Perrone S, Pietroiusti A. Cost-effectiveness of annual screening for tuberculosis among Italian healthcare workers: a retrospective study. Int J Environ Res Public Health 2020;17:1697. https://doi.org/10.3390/ijerph17051697

[20] Magrini A, Coppeta L, Somma G, Neri A, Gentili S, Fiocco G, Pietroiusti A. Risk of tuberculosis in healthcare workers: risk assessment and medical surveillance. Ig Sanità Pubbl 2016;72:137-43.

[21] Verrall AJ, Netea MG, Alisjahbana B, Hill PC, van Crevel R. Early clearance of Mycobacterium tuberculosis: a new frontier in prevention. Immunology 2014;141:506-13. https://doi.org/10.1111/imm.12223

[22] Nardell EA, Wallis RS. Here today gone tomorrow: the case for transient acute tuberculosis infection. Am J Respir Crit Care Med 2006;174:734-5. https://doi.org/10.1164/rccm.200607-923ED.

Received on January 10, 2020. Accepted on July 17, 2021.

Correspondence: Piergiorgio Lieto, Department of Occupational Medicine, University of Rome "Tor Vergata", viale Oxford 81, 00133 Rome, Italy - Tel.: +39 3289611446 - E-mail: piergiorgiolieto@gmail.com

How to cite this article: Coppeta L, Ferrari C, Ferraro M, Baldi S, Grande S, De Zordo LM, Mattone PF, Doddato MT, Balbi O, Magrini A, Pietroiusti A, Lieto P. Risk of latent tuberculosis infection among healthcare workers in Italy: a retrospective study with Quantiferon Test. J Prev Med Hyg 2021;62:E759-E762. https://doi.org/10.15167/2421-4248/jpmh2021.62.3.1471

Research article

The content of acoustic signals and biological effects of noise in conditions of high level of work intensity

IRYNA MYSHCHENKO[1,3], VASYL NAZARENKO[2], ANATOLII KOLHANOV[1], MYKHAILO IONDA[1], OLHA MALYSHEVSKA[1], LIDIIA HRECHUKH[1], MYKOLA POHORILY[1], OLEKSANDR NYKYFORUK[2]

[1] Ivano-Frankivsk National Medical University, Department of Hygiene and Ecology, Ukraine; [2] State Institution "Kundiev Institute of Occupational Health of the National Academy of Medical Sciences of Ukraine", Laboratory for the Study and Standardization of Physical Factors, Ukraine; [3] Wroclaw University of Science Technology, Department of Geoengineering, Mining and Geology, Accredited Laboratory of Occupational Health and Safety, Poland

Keywords

Auditory perception • Occupational stress • Call centres • Health status • Workplace

Summary

Background. *The biological effects of noise depend on its physical parameters, combination with other hazards, the content of acoustic signals. This article aimed to analyze the difference in biological effects caused by the selection of nonverbal and verbal signals in conditions of a high level of work intensity.*

Methods. *Work conditions, physical characteristics of noise, levels of work intensity were studied among 75 telephone operators and 96 geophone operators. Levels of permanent hearing thresholds, evaluated by pure-tone audiometry, and results of self-estimation of operators' health were compared. The contribution of the content of acoustic signals in the shifting of hearing thresholds was evaluated by the one-way analysis of variance.*

Results. *Selection of acoustic signals in the noise background (< 65 dB), in conditions of high work intensity, causes a significant increase of permanent hearing thresholds in both studied groups comparing to the non-noise exposed population. A combination of the high level of work intensity and distinguishing of nonverbal acoustic messages leads to significant deterioration of health resulting in decreasing of hearing sensitivity and a number of complaints on the state of health ($p < 0.05$). The content of acoustic signals significantly contributes to the biological effects of the nose.*

Conclusion. *Obtained results testify necessity to revise safe criteria of noise levels for workers, engaged in selection, recognition and distinguishing of acoustic messages in the noise background combined with a high level of work intensity. In case when the energy of the acoustic field cannot be reduced, occupational safety measures should focus on decreasing of work intensity.*

Introduction

The accepted international standards set a daily noise exposure level at 85 dBA [1, 2] for an 8-hour working day. However, when the job requires signal selection, observation, control and precise work, this threshold should be reduced to 60-65 dBA [3-5]. At the same time, the question about the safety of such levels for human health, peculiarly when work is associated with high levels of work intensity is still under discussion [6]. The conventional approach of rating sound exposure by the principle of energy equivalence can lead to a misleading assessment of their physiological costs [7]. First of all, it concerns professions connected with the selection of speech in the noise background – call centres – [8] or nonverbal acoustic messages – sonar operators of submarines [9, 10] or geophone operators in coal mines [11]. The perception, selection and distinction of speech and nonverbal acoustic signals, transmitted by abstract sound symbols, are significantly different and much more complex in the second case. It happens due to many reasons, including different neural mechanisms of signal processing, higher entropy of abstract acoustic messages compared to speech and difficulty in distinguishing of masking sounds, the need to learn an alphabet of nonverbal signals, and so on. For example, if part of the message "I was reading a newspaper" was lost, the call centre operator could relatively easily retrieve the phrase by having the rest of it. It is virtually impossible to do the same decoding an abstract message, where signals do not have a logical sequence and hindered by noise with similar physical characteristics. Therefore, sensory loads on the auditory analyzer and higher psychological functions (memory, attention) should be higher in the case of selection and distinction of abstract acoustic messages, manifesting itself in higher hearing thresholds and worsening of physical well-being. Besides, mistakes made while decoding abstract messages can lead to health violations or even the death of other people (professional duties of sonar or geophone operators), which significantly increase job strain, affecting workers' health.

The hypothesis of our study is the following: in conditions of high work intensity, the selection of abstract acoustic signals causes more negative effects than speech distinguishing at the same level of background noise.

This work aimed to perform a comparative analysis of health effects caused by the action of the linguistic and abstract alphabets on the operators engaged in the selection of acoustic signals at the different levels of job strain to optimize their working conditions.

Material and methods

The study group included 75 telephone operators of JSC "Ukrtelecom" (mean age 36.5 ± 2,3 ranged from 20 to 59 years) selecting speech and 96 geophone operators of coal mines (mean age 33.2 ± 1.26 years ranged from 19 to 54 years) selecting non-verbal acoustic messages. All the participants were females.

Hygienic assessment of the workplace conditions aimed to measure levels of all possible occupational factors. It included the evaluation of microclimatic parameters, the levels of lighting and noise. The background noise level was measured by a sound meter ВШВ-003-М2 (Russia) according to ISO 9612:2009 [12] at the workplaces of operators. The levels of noise in the headsets of telephone operators were measured by the means of an 'artificial ear' (type 4152, Denmark) which has an acoustic impedance, corresponding to the physical characteristics of a human ear.

Physiological measurements consisted of the evaluation of the levels of permanent hearing thresholds (PHTs) by the method of pure-tone audiometry by the means of an audiometer MA-31 in the conventional range of test frequencies (125-8.000 Hz) using the ascending-descending technique in 5 dB step separately for the left and the right ear. Measured hearing thresholds compared to levels of non-noise exposed population of the same mean age according to ISO 7029:2017 [13].

The *level of job strain* in both studied groups was assessed by the evaluation of the Occupational Stress Index (OSI) [14] and the level of work intensity according to the Ukrainian Hygienic Classification of Work [15]. OSI is a questionnaire, adopted by SI "Kundiev Institute of Occupational Health of the National Academy of Medical Sciences of Ukraine". Arranged as a two-dimensional matrix, it represents four levels of informational transmission (input, general decision making, output/task performance, general) placed according to the vertical axis and seven stressor aspects (underload, high demand, strictness, extrinsic time pressure, exposure, symbolic aversiveness, conflict/uncertainty), composed along with the horizontal one. All the elements were equally weighted, scored from 0 ("not present") to 2 ("strongly present") and summed. Each participant completed the questionnaire. Being a normative document, the Hygienic classification of work comprises the following indexes of work intensity: intellectual, sensory, emotional loads, the monotony of work, labour regime. Obtained class of work conditions reflects the level of work intensity and predicts possible health deteriorations.

All the participants completed the *health-related questionnaire* "Self-assessment of health" suggested by the National Institute of Gerontology (Ukraine) [16], containing 29 questions about lifestyle and well-being. The total score was calculated for each participant according to the scale "Healthy-Unhealthy" (from 0 to 29 points).

A personalized database was statistically processed using the office suite "EXCEL 2017". Mean values and standard deviations were calculated for all measured parameters. Comparative analysis between studied groups was done by Student's t-test. Correlation analysis was done between individual values of OSI and score in the test "Self-assessment of health" (Spearman's rank correlation). The one-way analysis of variance (ANOVA) was used to identify the contribution of the independent variable (the content of acoustic signals) in the level of the PHTs. The significance level used for all the tests and the correlations was $p < 0.05$.

Ethics approval

The research complied with the standards and recommendations for biomedical research involving human subjects adopted by the 18th World Medical Assembly, Helsinki, Finland, June 1964 and the 59th Meeting, Seoul, 2008. Informed written consent was obtained from each subject before enrollment with approval by the Ethics Committee of State Institution "Kundiev Institute of Occupational Health of the National Academy of Medical Sciences of Ukraine".

Results

General assessment of work conditions and a level of job strain in the studied groups

Both telephone and geophone operators are engaged in active listening of acoustic signals in the noise background and have similar work conditions. Telephone operators use single-ear headsets for communication. 95% of studied participants prefer putting it on the left ear. Thus, one ear is listening to speech (subscriber conversation, dialling operation), whereas another one is exposed to the noise background from the office (conversations of the other operators). The headsets are connected to a volume control facility so an operator can easily adjust the loudness. The work of telephone operators includes the high number of acoustic and visual signals (175-300 her an hour) and loads on vocal apparatus (15-40% of work shift). Additional sources of electromagnetic fields are video terminal units, phones, headsets. The levels of the magnetic induction of 50 Hz at the workplaces do not exceed permissible ones.

Geophone operators are involved in microseismic monitoring, serving deep coal mines prone to a sudden outburst. A workplace of an operator is a 13-15 m^2 office, equipped with a computer, acoustic speakers, register, telephone. These operators distinguish seismoacoustic information, consisting of nearly 40 patterns, including relevant signals (impulses of acoustic emission), masking signals (noise made by cutting machines, rock-drillers, downhole tractors). Geophone operators analyse the information in real-time due to the prediction of a sudden methane/rock/coal outburst and bear criminal responsibility for the wrong prognosis of the seismic situation in the coal mine. Using personal computers primarily for switching acoustic channels, geophone operators do not have additional visual loads, but the

Tab. I. Parameters of the working environment at the workplaces of telephone and geophone operators.

Parameters of the working environment	Average level at the workplace of		Normative value
	Telephone operators	Geophone operators	
Microclimatic conditions			
Average temperature, ^{0}C	25.7 ± 0.20	24 ± 0.6	21-23*
Relative humidity, %	24.3 ± 0.05	45	40-60*
Air velocity, m/s	0.02 ± 0.01	0.06 ± 0.1	< 0.1*
Equivalent noise level, dBA	65.1 ± 0.2	59.6 ± 0.93	65*
Equivalent sound pressure level in headsets, dBA	91.3 ± 1.3	-	85**
Characteristics of the noise	Continuous	Continuous	
Characteristics of the signals' alphabet	Linguistic	Abstract	
Density of signals per hour	175-300	> 300	

* Normative values according to the national sanitary norms: ДСН 3.3.2.007-98; ** Upper exposure action value established by European Union Directive 2003/10/EC [1].

density of acoustic signals is extremely high (more than 300 per hour).

The characteristics of microclimatic conditions and the noise at the workplaces of telephone and geophone operators are shown in Table I.

Hygienic assessment of work conditions revealed that the average temperature exceeded the standard value at the workplaces of both studied groups, whereas the level of relative humidity was significantly lower than the permissible one at the workplaces of telephone operators. Our measurements confirmed the operators' responses because 30,9% of respondents in this study group reported microclimate to be an uncomfortable parameter of the working environment.

Noise level, listening by geophone operators and that one present in the offices of telephone operators corresponded to the national hygienic standards (< 65 dBA). Noise at the studied workplaces is continuous with an energy peak in the low-frequency range. The noise level in headsets of telephone operators exceeded the Upper Exposure Action Value, established by the European Union Directive 2003/10/EC. It ranged from 88 to 104 dB being on average 91.3 ± 1.3 dBA and forming the main acoustic load on the auditory analyzer.

Level of job strain

The assessment, according to Ukrainian Standard "Hygienic classification of work…" [15], has revealed that the labour process of studied groups belongs to harmful work conditions by the indexes of work intensity (degree 3.1 in telephone and 3.3 in geophone operators). In other words, degree 3.1 means that levels of harmful factors and the work process itself can cause functional changes beyond the limits of physiological fluctuations and increase the risk of health deterioration, including occupational diseases. Degree 3.3 assumes such levels of harmful factors of the production environment and work process, which increase chronic morbidity (conditionally caused and the incidence with a temporary disability), lead to the development of occupational diseases.

Analysis of job strain level by the OSI score has shown that the group of geophone operators had approximately twice a total OSI score compared to those of telephone operators and a significantly higher level of job strain according to the majority of dimensions aspects (Tab. II).

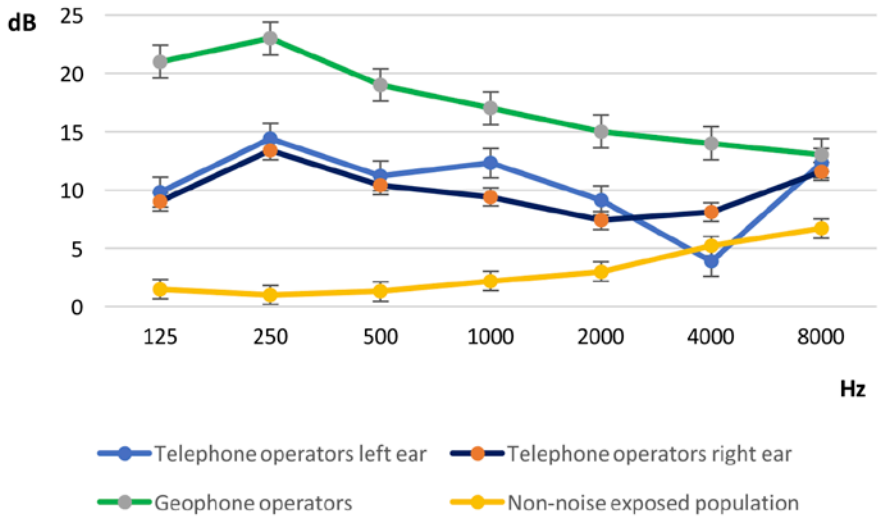
Considering such a high level of OSI in the group of geophone operators, we conducted additional questioning which revealed the following list of work activities and tasks regarded as difficult ones (in decreasing order):

- the necessity of constant attention;
- continual readiness to the action (explosion risk);
- criminal responsibility for the lives of other people;
- long work hours;
- absence of breaks;
- night work shifts;
- distinguishing of acoustic signals in the noise background;
- classification of acoustic signals;
- sedentary work;
- monotony of work.

Tab. II. Mean OSI score and stress dimensions aspects of the OSI for the studied groups.

Occupational Stress Index determinants	Geophone operators (mean +/- SD)	Telephone operators (mean +/- SD)	Level of significance, p <
Underload	13.8 ± 1.3	10.6 ± 0.9	-
High demands	21.2 ± 1.2	16.4 ± 1.3	0.007
Strictness	13.1 ± 1.2	6.7 ± 0.6	0.000004
Extrinsic time pressure	6.9 ± 0.4	2.3 ± 0.3	0.000001
Exposures	2.0 ± 0.7	3.0 ± 0.8	-
Symbolic aversiveness	10.4 ± 1.5	2.6 ± 0.3	0.000001
Conflict/uncertainty	9.6 ± 1.6	3.4 ± 0.8	0.00067
Total OSI score	77.3 ± 2.2	35.4 ± 3.5	0.000001

Fig. 1. Levels of PHT in telephone and geophone operators compared to a non-noise exposed population.



Permanent hearing thresholds

Comparative analysis of PHTs conducted in the conventional range of frequencies (Fig. 1) evidenced that there was no significant difference between the levels of PHTs of right and left ear in geophone operators whereas hearing sensitivity in telephone operators depended on the ear and in most of the cases was worse in the left ear as they preferred putting a headset on it.

Considering Figure 1, at least three specific characteristics, contradicting the energy concept of noise, mentioned:

1. although background noise levels at the workplaces of both study groups corresponded to permissible levels, the PHTs were quite high, exceeding levels of non-noise exposed population of the same mean age according to ISO 7029:2017 [13];
2. PHTs of geophone operators were significantly higher even though the noise level in headsets of telephone operators was greater;
3. in both study groups hearing sensitivity was worse in the range of low frequencies, which contradicts the theory that hearing loss starts in the high-frequency range.

Self-estimation of health (SEH)

The questionnaire revealed that the mean score in the group of telephone operators was 10.5 ± 0.8 and 13.4 ± 1.18 out of 29 in the group of geophone operators ($p < 0.05$). Data analysis showed that the number of subjective complaints on the state of health increased with length of employment. For instance, 81.2% of geophone operators employed up to 1 year felt rested after a night sleep, whereas the number of workers employed more than 5 years affirming the same was only 33.3%. The distribution of complaints of the state of health in both groups has shown in Table III.

A strong positive correlation between total OSI score and score in the "Self-estimation of health" questionnaire at the level 0.74 ($p < 0.01$) in the group of coal mine operators and 0.66 ($p < 0.01$) in the group of telephone operators confirms the point of view about the negative influence of job strain on health.

Tab. III. Subjective complaints of operators according to the "Self-estimation of health" questionnaire.

Self-reported health disturbances	Number of complaints		Difference between the study groups, p<
	Telephone operators N (%)	Geophone operators N (%)	
Mental health/ Nervous system			
Sleep loss due to nervousness	53 (70.6)	88 (91.6)	0.0001
Frequent headaches	45 (60)	72 (75)	0.00183
Sudden awake due to unessential noise	36 (48)	72 (75)	0.0001
Dizziness	42 (56)	60 (62.5)	-
Musculoskeletal system			
Spine pain	45 (60)	71 (73.9)	0.0264
Pain in the joints	36 (48)	48 (50)	-
Sensory organs			
Visual deterioration	55 (64)	40 (41.6)	0.01
Impairment of hearing	27 (36)	32 (33.3)	-
Tinnitus	24 (32)	32 (33.3)	-
General complaints			
Walking dyspnea	43 (57)	49 (51)	-
Edemas on the legs	49 (65.3)	66 (68,8)	-
Weather sensitivity	51 (68)	72 (75)	-
Intestinal obstruction	35 (46.6)	40 (41.6)	-
Heart pain	34 (45.3)	48 (50)	-
Bad aftertaste in the mouth	17 (22.6)	32 (33.3	-
Liver pains	21 (28)	29 (30.2)	-

As can be seen from the obtained results, negative biological effects increase at the combined influence of low-intensity noise and a high level of work intensity. It is possible to suggest the following: the more intensive work is, and the highest entropy (uncertainty) of the acoustic field takes place, the more negative physiological response will be. One-way analysis of the variance allowed us to conclude that the independent variable (the content of acoustic signals) significantly contributes to the levels of PHTs ($p < 0.001$) at the frequencies 125, 250, 500 and 1,000 Hz and $p < 0.01$ at 4,000 Hz.

Discussion

The primary aim of this article was to answer the question if the content of acoustic signals contributes to the biological effects of noise in conditions of a high level of job strain. At first glance, the work conditions of both studied groups characterizing by the combination of a high level of job strain and selection of relevant acoustic signals in the noise background are unique. But low-intensity noise itself is a widely spread factor in modern offices [17]. It is interesting to note that according to Cohen S, the uncontrollability of sound rather than its intensity causes stress in workers [18]. Glass D. and Singer J. mentioned that reducing noise intensity from 108 to 56 dB, did not cause any ameliorative effects [19]. Moreover, the unpredictability and uncontrollability of sound (noise entropy) influenced the most on work efficiency. The authors emphasized that the magnitude of adverse aftereffects was greater following unpredictable noise. Our previous study concerning the contribution of noise dose and entropy in nonspecific physiological response among rolling-mill operators revealed that adverse health effects increased when both noise dose and entropy were at the upper level of variation [20]. Entropy or uncertainty of the acoustic field had a significant impact on indexes of the cardiovascular system, attention, information perception.

In the mentioned above studies acoustic field is considered an unwished component of work rather than the essential source of information. In the case of acoustic operators, distinguishing linguistic or abstract signals in the noise background might cause additional changes in an auditory analyzer. This suggestion is affirmed by the levels of PHT in studied groups which significantly exceeded population standard (Fig. 1).

Obtained results concerning PHT of telephone operators confirm recent studies [21-24]. Many participants underlined the necessity to increase loudness in their headsets due to the high level of noise background in the office or too quiet speech of callers. However, 95% of telephone operators had normal hearing (PHTs in the range 0.25-8 kHz ≤ 20 dB for both ears).

Instead, the highest levels of PHT in geophone operators selecting abstract acoustic signals in the noise background less than 65 dB aline with the theory, that the biological effect of noise is not only in its energy but in the content of listened information. For instance, Strasser H. and others showed that listening to the different kinds of music (house music, European and Chinese classical music) with the mean level 94 dBA within an hour, causes different physiological responses [25]. They found house music characterizing by rhythm, percussion, and a medley to cause significantly longer restitution period and higher accumulated hearing thresholds shifts. Moreover, the simple arithmetic averaging of decibels used in the energy concept of noise tends to underestimation of the physiological impact of noise, especially in terms of continuous noise [26]. It is necessary to underline that the energy of acoustic oscillations listened to by the geophone operators distributes unevenly on the frequency band. It happens because coal and rock layers extinguish the high-frequency waves so that operators listen to the noise with a peak in the low-frequency range from 20 to 1,500 Hz where PTHs were maximum. Another reason seems to be in the signal to noise ratio (SNR), defined as the target stimulus power compared to the noise background power measured in dB. Being one of the most effective physical characteristics of speech perception in the noise, SNR is applicable for the distinguishing of abstract acoustic signals in the noise background. The alphabet of relevant signals, listening by geophone operators, comprises around 40 items. Following the normative document for coal-mines seismoacoustic services, the coefficient of information load depends on the number of acoustic signatures and on the difficulty of their distinguishing from the impulse of acoustic emission. The last one has the lowest score while rock sloughing the highest, masking the impulse of acoustic emission, making distinguishing more difficult and contributing to the auditory fatigue.

In the occupational conditions of acoustic operators, auditory fatigue, accompanied by a significant level of job stress, intensifies adverse health effects. Venet T. concluded that normal levels of noise, combined with emotional strain, caused increasing of hearing thresholds by the end of the work shift [27] in call dispatchers. This auditory fatigue intensifies by cognitive fatigue, emotional exhaustion due to the heavy mental workloads. The total score of OSI in both groups of acoustic operators was quite high. In a group of geophone operators, it was two times more than those in telephone operators. Table II shows that the main aspect contributing to OSI in both study groups is “High demand”. It includes such elements as the presence of several info sources, high frequency of upcoming signals, decisions affect the work of others, rapid decision making, etc. The mean score on every studied aspect apart from “Exposure” was significantly more in the group of geophone operators. Job strain, being the main adverse factor, is primarily formed by sensory acoustic loads. It is also necessary to point out an extremely high score of “symbolic-aversiveness” or “treat-avoidance” among geophone operators. According to the literature [14], this aspect does not belong to the sociological work-stress models. Because our nervous system focuses on threatening stimuli, it should be ready for rapid response

in conditions of possibly fatal consequences (methane outburst, death of coal miners). It causes an additional load on the nervous system of geophone operators resulting in more negative health outcomes.

Most of the acoustic operators complained about sleeping difficulty due to nervousness (91.6% of geophone and 70.6% of telephone operators) or sudden awake in the night (75 and 48% correspondingly). Similar disturbances of circadian rhythms in acoustic operators were noticed by Raja JD et al. Studying sleep quality in 375 call centre operators, he reported 77.6% of respondents having insomnia or other sleep-related problems [28]. Headache and dizziness were other frequently encountered health problems, comparable with literature data [29]. It is possible to suggest that such reactions of the nervous system are caused by specific occupational factors i.e. necessity to handle stress, long work shift, night shifts, high density of signals, time pressure ecc.

We also noticed a high amount of musculoskeletal problems such as spine pain and pain in the joints, reported in both study groups, which possibly related to sedentary work within 12 hours which contributes significantly to the physical discomfort of operators [30]. A great number of acoustic operators reporting about oedema on the legs (68.8% of geophone and 65.3% of telephone operators) confirms this point of view. Nearly every other acoustic operator reported eye-related problems which possibly caused by the necessity to work with VDUs and the high density of visual signals.

Conclusions

A combination of job strain and low-intensity noise at the workplaces of acoustic operators has different biological effects. The most adverse health consequences were found in geophone operators, distinguishing abstract acoustic signals at a significantly higher level of job strain than the telephone operators. PHTs were found to be higher comparing to the non-noise exposed population despite levels of noise that corresponded to hygienic standards. The fact, that combination of job strain and low-intensity noise can cause worsening of hearing sensitivity and general well-being of operators contradicts the energy concept of noise. It requires revision of safe levels of acoustic irritant depending on the level of job strain. Considering that levels of noise at the studied workplaces are low enough, their decreasing is not acceptable because an acoustic signal might have sufficient intensity for the distinguishing. Instead, the level of job strain requires elimination.

Acknowledgements

Funding sources: the present study was funded by National Academy of Sciences of Ukraine (No 0113U001441). The funders had no role in the study design, data collection, analysis and interpretation of results, decision to publish, or preparation of the manuscript.

The authors would like to thank the companies Zasyadko coal-mine and JSC Ukrtelecom for their comprehensive support of the present study.

Conflict of interest statement

The authors declare no conflict of interest.

Authors' contributions

IM, VN, AK were involved in the experimental design, OM, MP, LH, MI and ON performed the measuring of physical factors at the workplaces and evaluated the OSI level. IM, VN assessed PHTs in study groups and measured noise levels in headsets of telephone operators by artificial ear. IM, VN, AK, OM, LH analyzed the data. IM, VN, AK wrote and edited the paper. All authors have read and approved the final version of the manuscript.

References

[1] Directive 2003/10/EC of the European Parliament and of the Council of 6 February 2003 on the minimum health and safety requirements regarding the exposure of workers to the risks arising from physical agents (noise). Off J Eur Communities 2003;42:38-44. Available from: https://osha.europa.eu/en/legislation/directives/82

[2] United States Department of Labor. Washington: The Department [cited 2019 Apr 17]. Occupational Safety and Health Administration. OSHA regulations: Occupational noise exposure. Code of Federal Regulations 29 CFR 1910.95. Available from: https://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=standards&p_id=9735.

[3] ДСН 3.3.6.037-99. Sanitary norms of industrial noise, ultra and infrasound. State sanitary norms. Kyiv, Ukraine: 1999;23. Available from: https://zakon.rada.gov.ua/rada/show/va037282-99

[4] PN-N-01307:1994. Noise. Permissible values of noise in the workplace. Requirements relating to measurements. Warsaw, Poland: Polish Committee for Standardization 1994.

[5] Bildschirmarbeit - Lärmminderung in kleinen Büros, Lärmminderung in Mehrpersonenbüros (VDU work - Noise reduction in small offices, noise reduction in open plan offices). Dortmund 2003. Bundesanstalt für Arbeitsschutz und Arbeitsmedizin. Arbeitswissenschaftliche Erkenntnisse Nr. 123 and 124.

[6] Kryter K. The effects of noise on man. Academic Press 1970:654. https://doi.org/10.1016/B978-0-12-427450-1.50001-7

[7] Strasser H, Irle H, Legler R. Temporary hearing threshold shifts and restitution after energy-equivalent exposures to industrial noise and classical music. Noise Health 2003;5:75-84.

[8] Charbotel B, Croidieu S, Vohito M, et al. Working conditions in call-centers, the impact on employee health: a transversal study. Part II. Int Arch Occup Environ Health 2009;82:747-56. https://doi.org/10.1007/s00420-008-0351-z.

[9] Tran TR, Letowski T, Abouchacra K. Evaluation of acoustic beacon characteristics for navigation tasks. Ergonomics 2010;43:807-27. https://doi.org/10.1080/001401300404760

[10] Lindblad A, Hagerman B. Hearing tests for selection of sonar operators. Acta Acustica united with Acustica 1999;85:870-6.

[11] Myshchenko I, Nazarenko V, Kolganov A, Tereshchenko P. Peculiarities of hearing impairment depending on interaction with acoustic stimuli. Indian J Occup Environ Med 2015;19:141-4. https://doi.org/10.4103%2F0019-5278.173997

[12] ISO 9612:2009. Acoustics - Determination of occupational noise exposure - Engineering method. Geneva, Switzerland: International Organization for Standardization 2009. Available from: https://www.iso.org/standard/41718.html

[13] ISO 7029:2017. Acoustics-statistical distribution of hearing thresholds related to age and gender. Geneva, Switzerland: International Organization for Standardization 2017. Available from: https://www.iso.org/standard/42916.html

[14] Belkić K, Savić Č. The occupational stress index - an approach derived from cognitive ergonomics applicable to clinical practice. SJWEH Suppl 2008;(6):169-76. Available from: http://www.sjweh.fi/show_abstract.php?abstract_id=1264

[15] On Approval of the State Sanitary Norms and Rules "Hygienic Classification of Labor According to Indicators of Harmfulness and Hazard of Factors of the Working Environment, Severity and Intensity of the Labor Process". The Order of the Ministry of Health of Ukraine of 08.04.2014. No 248. [in Ukrainian]. Available from: https://zakon.rada.gov.ua/laws/show/z0472-14

[16] Vojtenko VP, Tokar AV, Rudaia ES. Method of biological age determination. Voprosy gerontologii 1989;11:9-16.

[17] Di Blasio S, Shtrepi L, Puglisi GE, Astolfi AA. Cross-sectional survey on the impact of irrelevant speech noise on annoyance, mental health and well-being, performance and occupants' behavior in shared and open-plan offices. Int J Environ Res Public Health 2019;16(280). https://doi.org/10.3390/ijerph16020280

[18] Cohen S. Aftereffects of stress on human performance and social behavior: a review of research and theory. Psychological Bulletin 1980;88:82-108. https://doi.org/10.1037/0033-2909.88.1.82

[19] Glass DC, Singer JE. Urban stress. New York: Experiments on noise and social stress. Academic Press 1972.

[20] Myshchenko I, Kolhanov A. Physiological features of non-specific influence of noise. Proceedings of international conference ACOUSTICS 2019 High Tatras. 2019;102-12. Available from: http://map-atf-2019.acoustics.sk/proceedings/ISBN978-80-228-3157-4

[21] Patel JP, Broughton K. Assessment of the noise exposure of call centre operators. Ann Occup Hyg 2002;46:653-61. https://doi.org/10.1093/annhyg/mef091

[22] Smagowska B. Noise at work in the call center. Arch Acoust 2010;35:253-64. https://doi.org/10.2478/v10168-010-0024-2

[23] Pawlaczyk-Luszczynska M, Dudarewicz A, Zamojska-Daniszewska M, Zaborowski K, Rutkowska-Kaczmarek P. Noise exposure and hearing status among call center operators. Noise Health 2018;20:178-89. https://doi.org/10.4103/nah.NAH_11_18

[24] Lawton B.W. Audiometric findings in call centre workers exposed to acoustic shock. Proceedings of the Institute of Acoustics 2003;25:249-58.

[25] Strasser H, Chiu MC, Irle H, Wagener A. Threshold shifts and restitution of the hearing after different music exposures. Theoretical Issues in Ergonomic Science 2008;9:405-24. https://doi.org/10.1080/14639220701650842

[26] Goldstein J. Description of auditory magnitude and methods of rating community noise. In: Reppin RJ (ed.). Community noise. Kansas City: American society for testing and materials 1979;345.

[27] Venet T, Bey A, Campo P, Ducourneau J, Mifsud Q, Hoffmann C, Thomas A, Mouze-Amady M, Parietti-Winkler C. Auditory fatigue among call dispatchers working with headsets. Int J Occup Med Environ Health 2018;31:217-26. https://doi.org/10.13075/ijomeh.1896.01131

[28] Raja JD, Bhasin SK. Sleep quality of call handlers employed in international call centers in National Capital Region of Delhi, India. The Int J Occup Environ Med 2016;7:207-14. https://doi.org/10.15171/ijoem.2016.783

[29] Gilardi L, Fubini L, d'Errico A, Falcone U, Mamo C, Migliardi A, Quarta D, Coffano ME. Working conditions and health problems among call-centre operators: a study on self-reported data in the Piedmont Region (Italy). La Medicina del Lavoro 2008;99:415-23. Available at: https://www.ncbi.nlm.nih.gov/pubmed/19086614

[30] D'Ericco A, Caputo P, Falcone U, Gilardi L, Mamo, Migliardi A, Quarta D, Coffano E. Risk factors for upper extremity musculoskeletal symptoms among call center employees. J Occup Health 2010;52:115-24. https://doi.org/10.1539/joh.l9117.

Received on June 8, 2020. Accepted on June 4, 2021.

Correspondence: Iryna Myshchenko, Biology, 91a Fedkovicha St., Ivano-Frankivsk, 76008 Ukraine - Tel.: +380676205356 - E-mail: kolg.ira21@gmail.com

How to cite this article: Myshchenko I, Nazarenko V, Kolhanov A, Ionda M, Malyshevska O, Hrechukh L, Pohorily M, Nykyforuk O. The content of acoustic signals and biological effects of noise in conditions of high level of work intensity. J Prev Med Hyg 2021;62:E763-E769. https://doi.org/10.15167/2421-4248/jpmh2021.62.3.1588

RESEARCH ARTICLE

Knowledge and attitude related to use of electronic cigarettes among undergraduate nursing students in an urban university setting in Philippines

MADONNA PALMES[1], SHEILLA M. TRAJERA[2], ANAND K. SAJNANI[3]
[1] College of Nursing, West Visayas State University, Iloilo City, Philippines; [2] College of Nursing, University of St. La Salle, Bacolod City, Philippines; [3] Department of Pediatric Dentistry KIMS Qatar Medical Centre, Wakra, Qatar

Keywords

E-cigarettes • Nursing students • Health knowledge • Attitude of health personnel • Health care surveys

Summary

Background. *Electronic cigarette (e-cigarette) use has risen dramatically since its introduction in 2004. Nurses play a critical role in screening, disease prevention and smoking cessation for their patient. Their knowledge and attitude related to e-cigarettes will play a major part in development of tobacco control activities.*
Aim. *Thus, this study was conducted to determine the knowledge and attitude toward e-cigarettes among undergraduate nursing students in the Philippines.*
Methods. *The participants of the study were 122 level four nursing students of West Visayas State University, Iloilo city, Philippines. A standardized self-administered questionnaire was used to collect the data and statistical analyses were performed.*
Results. *Majority of the participants were female, were never smokers and were aware or conscious of the existence of the e-cigarettes but had poor knowledge on e-cigarettes. Furthermore, in terms of attitude the students as an entire group had a positive attitude opposing e-cigarette use. Never and former smokers had positive attitude opposing e-cigarette use while current smokers had negative attitude supporting e-cigarette use. There was no significant relationship between knowledge and attitude of nursing students towards e-cigarettes.*
Conclusion. *Nursing students did not have adequate knowledge regarding e-cigarettes but maintained a positive attitude opposing e-cigarette use. Poor knowledge did not influence the attitude of participants towards e-cigarettes.*

Introduction

Electronic cigarette (e-cigarette) is a battery-powered device that resembles tobacco cigarette and delivers nicotine that is vaporized electronically to simulate tobacco smoke [1]. E-cigarettes have been made available commercially as a "healthier" substitute to tobacco and its use has become progressively common, predominantly among the youth [2-4]. Past 30-day e-cigarette use prevalence increased from 1.5% in 2011 to 20.8% in 2018 in United States (US) high school students [5]. A similar rise in e-cigarette use have been reported amongst adolescents in Poland, Korea, Canada, and Hong Kong [6-9].

Despite the fact that e-cigarettes are a worldwide phenomenon, there is a paucity of data regarding the knowledge and attitude of e-cigarette users particularly among the youth in the Philippines. Since its introduction in 2004, e-cigarettes have been marketed as an alternative to nicotine delivery as well as been advertised as a suitable means for smoking cessation worldwide [10]. These claims made by e-cigarette advertisers, have sparked an international debate as clinical and laboratory studies to determine the long and short-term potential harmful health effects on e-cigarette users remain insufficient and inconclusive [11].

The data on use of e-cigarette and its potential harmful effects is equivocal. The Royal College of Physicians suggests that e-cigarettes represent a "viable harm-reduction option" with respect to tobacco smoking and that "the hazard to health arising from long-term vapour inhalation from e-cigarettes available today is unlikely to exceed 5% of the harm from smoking tobacco" [12]. In contrast, the European Respiratory Society (ERS) stated that there is no evidence that e-cigarettes would be safer than tobacco in the long term [13]. However, ERS did acknowledge that e-cigarette aerosol contained potentially less toxic chemicals and in fewer concentration when compared to conventional cigarette.

Nurses play a critical role in screening, disease prevention and smoking cessation for their patients. They have the potential to influence patient behaviour as well as promote healthy lifestyle. Nursing students' knowledge and attitude towards e-cigarettes are of utmost importance because it has been demonstrated that healthcare providers who themselves smoke are less likely to assess and counsel their patients about smoking cessation [14]. Healthcare providers as a group have amongst the lowest rates of smoking with smoking rates having declined among physicians and registered nurses in the last two decades [15]. An international review of tobacco smoking among nurses revealed an overall pattern of smoking reduction since the 1970's with

https://doi.org/10.15167/2421-4248/jpmh2021.62.3.1709

higher rates in some developing countries. However, Asian countries generally had lower rates for tobacco smoking for female nurses who culturally are less inclined to smoke [16].

Nevertheless, as the use of e-cigarettes increases dramatically, nurses will have to adapt their counselling skills to address these changes. Moreover, understanding the nursing students' knowledge and attitude towards e-cigarettes would be valuable for development of tobacco control activities. Furthermore, there is a dearth of data on the knowledge and attitudes of nursing student towards e-cigarettes in Asian countries, particularly Philippines [4]. Thus, the objective of this study was to determine the knowledge and attitude of nursing students towards e-cigarettes and to assess the relationship between these two variables.

Methods

The investigation was conducted among level 4 nursing students of the Western Visayas State University (WYSU), Iloilo city, Philippines using a descriptive correlation design. The total number of students in the level 4 nursing for the academic year 2017-2018 was 175 as ascertained by the Registrar's office of WVSU. The sample size of the study was determined using the Slovin's formula (1960): $n = N/ (1 + Ne^2)$; where n = number of samples, N = total population admitted in level 4 in the University and e = error tolerance [17]. The margin of error was set at 0.05 which provided a confidence interval of 95% and the minimum sample size was calculated to be 102. The simple random sampling technique was employed to determine the participants of the study. Participants not available on the day of data collection were replaced with other participants from the total population.

A standardized self-administered 25-point questionnaire was used to gather data and consisted of four sections. The standardized research instrument was adapted from University of Philippines Manila Public Health [18] and several valid and reliable measures were accommodated from international tobacco research studies including National Youth Tobacco Survey [19] and Global Health Professional Surveyv[20]. Section one of the questionnaire recorded personal data and information regarding the participant's name, sex, smoking status, socioeconomic status based on STFAP (Socialized Tuition Fee Assistance Program) Bracketing. STFAP program is a program where brackets are assigned to students based on their annual family income (Tab. I) [18]. Section two recorded the awareness status of participants on e-cigarettes and consisted of only two items. Item 1 recorded the participants' awareness of e-cigarettes whilst item 2 determined how the participant had learned about e-cigarettes. If the response of the participants was yes, then they were categorized as "aware" or otherwise "unaware".

Part three determined the knowledge of participants and consisted of 10 items that measured the knowledge on characteristics of e- cigarettes, its chemical content, health effects of e-cigarettes, regulation status and policies on e-cigarettes. A correct answer to individual question was assigned a score of "one" while a wrong answer fetched a score of "zero". A cumulative score range of 0-4.99 indicated that the participant had insufficient knowledge about e-cigarettes whilst a cumulative score range of 5-10 demonstrated that the participant had sufficient knowledge about e-cigarettes. Section four recorded the attitude of participants towards e-cigarettes and consisted of 13 items. These set of questions measured the attitude and beliefs towards e-cigarettes as well as perceived advantages and disadvantages of e-cigarettes with the use of a Likert scale. It was categorized as attitudes supporting e-cigarette use and attitudes opposing e-cigarette use. Response options on the 5-point Likert scale included "Strongly Agree"," Agree", "Neutral", "Disagree" and "Strongly Disagree". Corresponding points were given depending on the question: 5 points merited to responses having positive attitudes opposing the use of e- cigarettes while those with negative attitudes supporting e-cigarette use garnered only 1 point. Participants who obtained a score of 40 points or higher were classified as having positive attitudes opposing e-cigarette use while those who obtained a score of 39 or less were classified as having negative attitudes supporting e-cigarette use.

Data were coded and entered in a computer to facilitate retrieval, processing and statistical analyses. The questionnaire was tested in a pilot study which preceded the main study to test the feasibility of this approach. The pilot study included 25 nursing students of level 3 at the Western Visayas State University, who were selected using the simple random sampling technique. This study determined the appropriateness of the data collection method and assisted to identify if the questionnaire format was comprehensible. The data from the pilot study were not included in the main study. The standardized instrument underwent reliability testing with Cronbach's alpha score of 0.71 for knowledge and 0.89 for attitude.

Permission to conduct the study was secured from the University President of WVSU and from the Dean of the College of Nursing. The chi-square test was used to determine the significance of difference between

Tab. I. Socialized Tuition Fee Assistance Program bracketing according to annual income.

Bracket	Income (in Philippine Peso)
Bracket 1	25,000 and below
Bracket 2	25,001-50,000
Bracket 3	50,001-75,000
Bracket 4	75,001-100,000
Bracket 5	101,000-200,000
Bracket 6	200,001-300,000
Bracket 7	301,000-400,000
Bracket 8	400,001-500,000
Bracket 9	Over 500,000

the scores obtained by the participants across different variables. Pearson's Correlation Coefficient was used to measure the degree of association between knowledge and attitude of the nursing students towards e-cigarettes. The p-value for all inferential treatments was set at 0.05.

Results

Majority of the participants in this investigation (89.34%) were female and more than half of the participants (66.30%) belonged to Bracket 9 on the socioeconomic status scale. A large number of subjects were never smokers (80.33%), while 11.48% were former smokers and 8.20 % were current smokers. Most of the participants (93.40%) were aware of the existence of e-cigarettes and the most common source of this knowledge were "friends" (n = 95, 77.87%) (Tab. II).

The nursing students had poor knowledge (Mean score 3.50 ± 1.64) on e-cigarettes particularly on the characteristics of e- cigarettes, chemical content, health effects, regulation status and policies (Tab. III). Participants belonging to bracket 5 had a significantly higher mean score (4.20 ± 2.35) for knowledge when compared to other brackets on the socioeconomic status scale (p = 0.03). Also, current smokers had a statistically significant (p = 0.04) higher mean score (4.30 ± 1.64) for knowledge when compared to never smokers (3.42 ± 1.66) and former smokers (3.50 ± 1.40). However, when classified according to sex, socioeconomic status, smoking status and awareness status, the participants still demonstrated poor knowledge on e-cigarettes.

Overall, the level 4 nursing students exhibited an opposing attitude towards e-cigarette use (Tab. IV). However, when classified according to sex, socioeconomic status, smoking status and awareness status, the participants had a varying attitude toward e-cigarette use. Male participants demonstrated an attitude supporting e-cigarette use (mean score 39.85 ± 4.90) while female participants had a mean score of 40.07 which favoured attitude opposing e-cigarette use. However, this difference was statistically insignificant (p = 0.19). In terms of socioeconomic status, participants belonging to Bracket 5, 6 and 8 had an attitude opposing e-cigarette while participants belonging to Bracket 7 and Bracket 9 had an attitude supporting e-cigarette use (p = 0.67) (Tab. IV4). Majority of the participants were never smokers and maintained an attitude opposing e-cigarette use. Former smokers favoured an attitude opposing e-cigarette use while, participants who were current smokers had an attitude supporting e-cigarette use (p = 0.03). Furthermore, participants who were aware about the existence of e-cigarettes exhibited an attitude supporting the use of e-cigarettes when compared to students who had not heard about e-cigarettes previously (p = 0.04).

Pearson's correlation coefficient demonstrated that there was no significant association between knowledge and association towards e-cigarettes among the nursing students (Computed r-value of -0.107 at 0.241).

Tab. II. Distribution of participants according to sex, socioeconomic status, smoking status, awareness status and source of awareness.

Category	Frequency (%)
Sex	
Male	13 (10.7)
Female	109 (89.3)
Socioeconomic status (STFAP bracket)	
Bracket 5	10 (8.2)
Bracket 6	7 (5.74)
Bracket 7	16 (13.11)
Bracket 8	6 (4.92)
Bracket 9	80 (65.57)
Smoking status	
Non smoker	98 (80.33)
Former smoker	14 (11.48)
Current smoker	10 (8.2)
Awareness status	
Aware	114 (93.4)
Unaware	8 (6.6)
Source of awareness	
Friends	95 (77.87)
Internet	88 (72.13)
Saw one	81 (66.39)
TV/radio	49 (40.16)
Stores	48 (39.34)
Family	31 (25.41)
Printed materials	28 (22.95)
Overall	122 (100)

Tab. III. Knowledge of nursing students on e-cigarettes categorized according to sex, socioeconomic status, smoking status and awareness status.

Category	Mean (± S.D.)	Chi square test
Sex		
Male	3.46 (1.45)	χ^2 (1) = 7.43, p = 0.15
Female	3.50 (1.66)	
Socioeconomic status		
Bracket 5	4.20 (2.35)	
Bracket 6	2.88 (1.46)	χ^2 (4) = 10.07, p = 0.03
Bracket 7	3.00 (1.75)	
Bracket 8	3.33 (1.97)	
Bracket 9	3.60 (1.49)	
Smoking status		
Never	3.42 (1.66)	
Former	3.50 (1.40)	χ^2 (2) = 4.6, p = 0.04
Current	4.30 (1.64)	
Awareness status		
Aware	3.49 (1.65)	χ^2 (1) = 7.2, p = 0.14
Unaware	3.63 (1.51)	
Overall	3.50 (1.64)	

0.00-4.99: poor knowledge; 5.00-10.00: sufficient knowledge.

Tab. IV. Attitude of nursing students on e-cigarettes categorized according to sex, socioeconomic status, smoking status and awareness status.

Category	Mean (± S.D.)	Chi square test
Sex		
Male	39.85 (4.90)	χ^2 (1) = 6.97, p = 0.19
Female	40.07 (4.35)	
Socioeconomic status		
Bracket 5	40.60 (5.21)	
Bracket 6	40.63 (3.93)	χ^2 (4) = 11.77, p = 0.67
Bracket 7	39.94 (3.57)	
Bracket 8	42.67 (1.21)	
Bracket 9	39.81 (4.67)	
Smoking status		
Never	40.09 (4.41)	
Former	41.20 (3.36)	χ^2 (2) = 5.9, p = 0.03
Current	36.93 (5.69)	
Awareness status		
Aware	39.91 (4.47)	χ^2 (1) = 5.3, p = 0.04
Unaware	42.33 (2.24)	
Overall	40.09 (4.41)	

40.00-65.00: attitude opposing e-cigarette; 00.00-39.99: attitude supporting e-cigarette.

Discussion

Worldwide, e-cigarettes have surged in popularity with an increase in product awareness, rise in internet search queries, and growth in sales [18]. Media marketing strategies through print, television, radio, and the internet such as endorsing with popular celebrities and brandishing various flavours to e-cigarettes have further amplified the popularity of e-cigarettes. A real-time surveillance method based on internet search query data from Google showed that searches for e-cigarettes increased in all nations from July 2008 to February 2010; and were several hundred times greater than the search for smoking alternatives in the United Kingdom [2]. However, the major contributor to the boosted sales of these products is the frequent use of unsubstantiated marketing claims. These claims include: e-cigarettes are healthier and cleaner than conventional cigarettes; e-cigarettes are smoking cessation aids; and the aerosols emitted are safe for people who are exposed, among others. Although cited by some tobacco harm reduction advocates as a viable replacement for smoking, the limited scientific knowledge on the potential adverse health effects of the product has sparked disagreement and concern among healthcare authorities. Decades of efforts in tobacco control have reduced daily cigarette smoking prevalence across many countries worldwide. Any renormalization of tobacco through new products such as e-cigarettes would threaten to halt or reverse the progress made [9].

School level e-cigarette use has been associated with cigarette smoking susceptibility in never cigarette smokers. This is consistent with the e-cigarette industry's vision of using vaping to renormalize smoking [21]. It is possible that school environments with prevalent e-cigarette use normalized not only e-cigarette use but also "smoking-like" behaviours in general and thus led students to be more susceptible to cigarette smoking. This effect of e-cigarette use, if confirmed, would represent a pathway by which e-cigarettes negatively affect population health.

The use of e-cigarettes has a conflicting influence on assisting traditional smokers to quit cigarettes. A Cochrane review updated in 2016 concluded that nicotine e-cigarettes helped smokers quit smoking in the long term compared with placebo e-cigarettes but the evidence for this conclusion was rated low [4, 22]. However, a meta-analysis of 38 studies found that the odds of quitting traditional cigarettes were 28% lower in those who used e-cigarettes than in those who did not [4, 23]. Hence, it is critical to determine the knowledge and attitude related to use of e-cigarettes particularly among students.

Although, majority of participants in this investigation were females, both males and females demonstrated similar level of knowledge on e-cigarettes. This result is supported by the study of Lozano and colleagues (2015) who showed that levels of knowledge in students between sexes are similar [18]. However, community-based surveys have revealed that knowledge rate was higher among males (73.5%) than females (26.5%). Also, in the present survey, the male participants possessed an attitude supporting e-cigarette use when compared to females. This may be attributed to the fact the knowledge about cigarettes and similar products, including e-cigarettes is considered a taboo for females and hence female participants may deliberately deny knowledge of e-cigarettes and maintain an attitude opposing the use of these products to avoid retribution [24, 25].

Education and income levels have shown to have inconsistent association with the awareness of e-cigarettes [26]. Currently, there is no data on the knowledge of e-cigarettes amongst Filipinos based on their income bracket. In the present investigation, all nursing students demonstrated poor knowledge about e-cigarettes based on their annual family income bracket. This finding asserts the fact that e-cigarettes are comparatively a novel nicotine delivery product and no knowledge is imparted to the nursing students about e-cigarettes in their nursing curriculum. However, students belonging to the higher income groups i.e. bracket 7 and bracket 9 possessed an attitude supporting the use of e-cigarettes though this finding was not statistically significant. A plausible explanation for this outcome is that the participants from the higher socioeconomic strata of the society may display a pretentious behaviour and spuriously support the use of e-cigarettes as it is a relatively contemporary commodity.

An online survey of e-cigarette users found that 35% of the respondents heard about e- cigarettes from a personal contact, 41% from the internet, 10% via other media sources while 8% saw it being used [27]. Likewise, nearly all healthcare providers (92%) were aware of e-cigarettes in an investigation conducted in

Minnesota [28]. The most frequently cited sources of information about e-cigarettes for healthcare providers have been patient, news, stories, advertisements and internet rather than professional sources [18]. In the present study, almost all students reported that they had heard about e-cigarettes, indicating a high level of awareness. These results are in line with the results of other studies carried out in the United Kingdom and United States, which have also shown high awareness among smokers and non-smokers in the adult population [29-31]. Irrespective of the source of information; it cannot be denied that personal contacts and media have a vital role in the awareness of e-cigarettes.

The knowledge about the content and regulations of e-cigarettes has been low amongst the population. In spite of being aware of e-cigarettes, healthcare providers knew "a little" or "nothing at all" about e- cigarettes [28]. Majority of young adults did not know that some e-cigarettes contain nicotine and were incorrect about toxic chemical content of e-cigarette [28]. Compared to knowledge about e-cigarettes constituents, even fewer young adults were knowledgeable about the regulation [32]. The results of this study revealed that even though nursing students had poor knowledge and were not familiar with the characteristics of e- cigarettes, chemical content, health effects, regulation status and policies but they still possessed an attitude opposing to e-cigarette use. This suggests that the participants were aware of healthy demeanour and possessed an attitude promoting well being.

Knowledge about e-cigarettes may not necessarily be related to smoking status [24]. However, in the present study, current smokers had more information about e-cigarettes than former smokers and non-smokers probably due to their present exposure to smoking. Also, current smokers possessed an attitude supporting the use of e-cigarettes. Likewise, participants who were aware about the existence of e-cigarettes also displayed an attitude supporting the use of this product. With the current survey design, it is difficult to ascertain the rationale behind this result but one conceivable explanation is that the projection of e-cigarettes as smoking cessation tools as a marketing strategy, influences the decision of current smokers to exhibit an attitude supporting the use of e-cigarettes.

The current investigation provides new insights to the limited data available on the knowledge and attitude of nursing students towards e-cigarettes. In spite of the interesting findings, this study is not without drawbacks. Although the sample size for the study was sufficient to conduct a statistical analysis, it is not large enough to be representative of all nursing college students. The sample was drawn from the senior class and had higher proportions of female students. Thus, the study may not represent the knowledge and attitude of the entire student body particularly of male and younger college students. Therefore, the ability to generalize the results is limited. The study was based on questionnaire survey data and may thus be affected by reporting bias. The findings of the study pose an urgent need to be addressed in terms of the inadequacy of knowledge among nursing students in relation to chemical content, possible health effects and regulation of e-cigarettes.

Conclusions

Nursing students did not have adequate knowledge regarding e-cigarettes but maintained an attitude opposing e-cigarette use. Poor knowledge did not influence the attitude of participants towards e-cigarettes.

Acknowledgements

Funding sources: this research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Conflict of interest statement

The authors declare no conflict of interest.

Authors' contributions

Study conception and design: PM, TSM.
Data acquisition: PM, TSM.
Analysis and interpretation of results: PM, TSM, SAK.
Draft manuscript preparation: PM, TSM, SAK.
All authors reviewed the results and approved the final version of the manuscript.

References

[1] Caponnetto P, Campagna D, Papale G, Russo C, Polosa R. The emerging phenomenon of electronic cigarettes. Expert Rev Respir Med 2012;6:63-74. https://doi.org/10.1586/ers.11.92

[2] Ayers JW, Ribisl KM, Brownstein JS. Tracking the rise in popularity of electronic nicotine delivery systems (electronic cigarettes) using search query surveillance. Am J Prev Med 2011;40:448-53. https://doi.org/10.1016/ j.amepre.2010.12.007

[3] Pippard BJ, Shipley MD. Healthcare staff attitudes towards the use of if electronic cigarettes ('e-cigarettes') compared with a local trust policy. Perspect Public Health 2017;137:216-9. https://doi.org/10.1177/1757913916659311

[4] Canzan F, Finocchio E, Moretti F, Vincenzi S, Tchepnou-Kouaya A, Marognolli O, Poli A, Verlato G. Knowledge and use of e-cigarettes among nursing students: results from a cross-sectional survey in north-eastern Italy. BMC Public Health 2019;19:976. https://doi.org/10.1186/s12889-019-7250-y

[5] Cullen KA, Ambrose BK, Gentzke AS, Apelberg BJ, Jamal A, King BA. Notes from the field: use of electronic cigarettes and any tobacco product among middle and high school students – United States, 2011-2018. MMWR Morb Mortal Wkly Rep 2018;67:1276-7. Https://doi.org/10.15585/mmwr.mm6745a5

[6] Goniewicz ML, Gawron M, Nadolska J, Balwicki L, Sobczak A. Rise in electronic cigarette use among adolescents in Poland. J Adolesc Health 2014;55:713-5. https://doi.org/10.1016/j.jadohealth.2014.07.015

[7] Lee S, Grana RA, Glantz SA. Electronic cigarette use among Korean adolescents: a cross-sectional study of market penetration, dual use, and relationship to quit attempts and former smoking. J Adolesc Health 2014;54:684-90. https://doi.org/10.1016/j.jadohealth.2013.11.003

[8] Azagba S, Baskerville NB, Foley K. Susceptibility to cigarette smoking among middle and high school e-cigarette users in Canada. Prev Med 2017;103:14-9. https://doi.org/10.1016/j.ypmed.2017.07.017

[9] Chen J, Ho SY, Leung LT, Wang MP, Lam TH. School-level electronic cigarette use prevalence and student-level tobacco use intention and behaviours. Sci Rep 2019;9:1690. https://doi.org/10.1038/s41598-018-38266-z

[10] Bertholon JF, Becquemin MH, Annesi-Maesano I, Dautzenberg B. Electronic cigarettes: a short review. Respiration 2013;86:433-38. https://doi.org/10.1159/000353253

[11] Farsalinos KE, Romagna G, Allifranchini E, Ripamonti E, Bocchietto E, Todeschi S, Tsiapras D, Kyrzopoulos S, Voudris V. Comparison of the cytotoxic potential of cigarette smoke and electronic cigarette vapour extract on cultured myocardial cells. Int J Environ Res Public Health 2013;10:5146-62. https://doi.org/10.3390/ijerph10105146

[12] Royal College of Physicians. Nicotine without smoke: tobacco harm reduction. London: RCP 2016. Available at: https//www.rcplondon.ac.uk/projects/outputs/nicotine-without-smoke-tobacco-harm-reduction-0 (accessed January 5, 2020).

[13] Bals R, Boyd J, Esposito S, Foronjy R, Hiemstra PS, Jiménez-Ruiz CA, Katsaounou P, Lindberg A, Metz C, Schober W, Spira A, Blasi F. Electronic cigarettes: a task force report from the European Respiratory Society. Eur Respir J 2019;53:1801151. https://doi.org/10.1183/13993003.01151-2018

[14] Braun BL, Fowles JB, Solberg LI, Kind EA, Lando H, Pine D. Smoking-related attitudes and clinical practices of medical personnel in Minnesota. Am J Prevent Med 2004;27:316-22. https://doi.org/10.1016/j.amepre.2004.07.010

[15] Sarna L, Bialous SA, Nandy K, Antonio AL, Yang Q. Changes in smoking prevalences among healthcare workers from 2003 to 2010-2011. JAMA 2014;311:197-9. https://doi.org/10.1001/jama.2013.284871

[16] Smith DR, Leggat PA. An international review of tobacco smoking research in the nursing profession, 1976-2006. J Res Nursing 2007;12:165-81. https://doi.org/10.1177/1744987106074875

[17] Blair E, Blair J. Applied survey sampling. USA: Inc Sage Publications 2015. https://doi.org/https://dx.doi.org/10.4135/9781483394022

[18] Lozano P, Sabino A, David V, Villarta Jr. R, Salvedia K. Awareness, knowledge, attitudes and practices (AKAP) toward electronic cigarettes among 3rd and 4th year undergraduate students of the University of the Philippines. November 2015. https://doi.org/10.13140/RG.2.1.4242.8881

[19] Centres for Disease Control and Prevention. Drop in cigarette consumption offset by increases in other forms of smoked tobacco. 2012. Retrieved from: http://www.cdc.gov/mediareleases/2012/p0802_tobacco_consumption.html

[20] CDC Foundation. World Health Organization and World Lung Foundation. The GATS Atlas: Global Adult Tobacco Survey 2015. Retrieved from: http://www.who.int/tobacco/publications/surveillance.gatlas/en

[21] Fairchild AL, Bayer R, Colgrove J. The renormalization of smoking? E-cigarettes and tobacco "endgame". N Engl J Med 2014;370:2354. https://doi.org/10.1056/NEJMp1313940

[22] Hartmann-Boyce J, McRobbie H, Bullen C, Begh R, Stead LF, Hajek P. Electronic cigarettes for smoking cessation. Cochrane Database Syst Rev 2016;9:CD010216. https://doi.org/10.1002/14651858.CD010216.pub3

[23] Kalkhoran S, Glantz SA. E-cigarettes and smoking cessation in real-world and clinical settings: a systematic review and meta-analysis. Lancet Respir Med 2016;4:116-128. https://doi.org/10.1016/S2213-2600(15)00521-4

[24] Abo-Elkheir OI, Sobh E. Knowledge about electronic cigarettes and its perception: a community survey, Egypt. Respir Res 2016;17:58. https://doi.org/10.1186/s12931-016-0365-0

[25] Shaikh A, Ansari HT, Ahmad Z, Shaikh MY, Khalid I, Jahangir M, Majeed A, Shakeel N, Ahmed A, Memon RS, Tariq E, Irfan R, Madni D. Knowledge and attitude of teenagers towards electronic cigarettes in Karachi, Pakistan. Cureus 2017;9:e1468. https://doi.org/10.7759/cureus.1468

[26] King BA, Alam S, Promoff G, Arrazola R, Dube SR. Awareness and ever-use of electronic cigarettes among U.S. adults, 2010-2011. Nicotine Tob Res 2013;15:1623-7. https://doi.org/10.1093/ntr/ntt013

[27] Dawkins L, Turner J, Roberts A, Soar K. 'Vaping' profiles and preferences: an online survey of electronic cigarette users. Addiction 2013;108:1115-25. https://doi.org/10.1111/add.12150

[28] Pepper JK, Reiter PL, McRee AL, Cameron LD, Gilkey MB, Brewer NT. Adolescent males' awareness of and willingness to try electronic cigarettes. J Adolesc Health 2013;52:144-150. https://doi.org/10.1016/j.jadohealth.2012.09.014

[29] Dockrell M, Morrison R, Bauld L, McNeill A. E-cigarettes: prevalence and attitudes in Great Britain. Nicotine Tob Res 2013;15:1737-44. https://doi.org/10.1093/ntr/ntt057

[30] Zhu SH, Gamst A, Lee M, Cummins S, Yin L, Zoref L. The use and perception of electronic cigarettes and snus among U.S. population. PLoS One 2013;8:e79332. https://doi.org/10.1371/journal.prone.0079332

[31] Brown J, West R, Beard E, Michie S, Shahab L, McNeill A. Prevalence and characteristics of e-cigarettes users in Great Britain: findings from a general population survey of smokers. Addict Behav 2014;39:1120-25. https://doi.org/10.1016/j.addbeh.2014.03.009

[32] Sanders-Jackson AN, Tan AS, Bigman CA, Henriksen L. Knowledge about e-cigarette constituents and regulation: results from a national survey of U.S. young adults. Nicotine Tob Res 2015;17:1247-54. https://doi.org/10.1093/ntr/ntu276

Received on August 4, 2020. Accepted on June 23, 2021.

Correspondence: Anand K. Sajnani, KIMS Qatar Medical Centre, Abdulrahman Bin Jassim Al Thani Street, 82125 Wakra, Qatar - Tel.: +974-30181952 - E-mail: aksajnani@gmail.com

How to cite this article: Palmes M, Trajera SM, Sajnani AK. Knowledge and attitude related to use of electronic cigarettes among undergraduate nursing students in an urban university setting in Philippines. J Prev Med Hyg 2021;62:E770-E775. https://doi.org/10.15167/2421-4248/jpmh2021.62.3.1709

RESEARCH ARTICLE

The effect of women's sexual functioning on quality of their sexual life

RAHMAN PANAHI[1], MOHAMMAD ANBARI[2], ERFAN JAVANMARDI[3], KHADIJE JAHANGASHT GHOOZLU[4], LEILA DEHGHANKAR[5]
[1] School of Medical Sciences, Tarbiat Modares University, Tehran, Iran; [2] Msc in Occupational health department, school of public health and Institute of Public Health Research Tehran university of medical science, Tehran, Iran; [3] Clinical Research Development Center, the Persian Gulf Martyrs Hospital, Bushehr University of Medical Sciences, Bushehr, Iran; [4] PhD Candidate of Nursing, Instructor of Ramsar School of Nursing, Babol University of Medical Sciences, Babol, Iran; [5] Department of Nursing, Social Determinants of Health Research Center, Research Institute for Prevention of Non-Communicable Diseases, School of Nursing & Midwifery, Qazvin University of Medical Sciences, Qazvin, Iran

Keywords

Women • Sexual function • Quality of sexual life

Summary

Introduction. *Considering the high prevalence of sexual dysfunction among women and the role of quality of sexual life in women's life and health, in addition to the important role of sexual function evaluation in measuring quality of life, this study aimed to determine the effect of female sexual function on the quality of sexual life.*

Material and methods. *This research was a descriptive and cross-sectional. The population of this study was 420 women from Qazvin in 2020, who were selected by multi-stage sampling. The data collection tool was a demographic questionnaire and Persian version of the Female Sexual Function Assessment questionnaire (FSFI) and Sexual Quality of Life Questionnaire (SQOL-F). Data were analyzed using SPSS 23, and descriptive statistics and logistic regression were applied.*

Results. *The mean (SD) of sexual function score was 21.56 (4.83) out of 36, therefore, it was at an unfavorable level. Also, the mean (SD) score of sexual quality of life 59.71 (19.21) was out of 108 (moderate). The results of logistic regression test showed that the variables of sexual function, age and level of education of women were the factors affecting the quality of women's sexual life ($P < 0.05$).*

Conclusions. *Young women with lower sexual function, and lower level of education had lower quality of sexual life. Hence, it is necessary to pay more attention to these women in designing educational programs for improving the quality of their sexual life.*

Introduction

Sexual activity is one of the important aspects of human life that can be influenced by personal characteristics, interpersonal relationships, family and socio-cultural circumstances, surrounding environment, history of sexual activity between spouses, in addition to the physical/mental and hormonal health status [1]. Sexual health is one of the main pillars for the stable marital life, hence, having comfortable sexual relations is highly influential in triggering happiness and improving quality of life [2]. Sexual health is the harmony between body, mind and feeling which contributes in shaping social and intellectual dimensions of one's personality [3, 4].

Sexual function is a part of human life and behavior, and sexual health is strongly intertwined with the individual's personality [5]. Human sexual function is a process that stands for a combination of different parts and requires coordination between the nervous, vascular and endocrine systems [6]. Normal sexual function is a component of a woman's sexual and mental health, and changes in this function due to any reason can cause problems in emotions and interpersonal communication that might affect the other functions of women [1]. Sexual function for women is a state of ability to achieve sexual arousal, orgasm and satisfaction, which enhances health and status with a good quality of life [6]. Latest research on sexual health in Iran showed that women had poor sexual function [5]. Also, in Ladari et al. [7] and Tabaghdehi et al. [8] studies, 48.5 and 45.2% of women experienced sexual dysfunction, respectively.

On the other hand, sexual function is defined as a substantial part of health and an integral part of life in order to achieve sexual pleasure, which leads to better health and promoted quality of life [4]. One of the important physical and psychological dimensions of women's quality of life is their way in practicing sexual life, which is affected by many factors [9].

Quality of sexual life is one of the key issues in the field of sexual and reproductive health. In most studies, sexual dysfunction is the main feature used to investigate the quality of life [10]. In other words, evaluation of sexual function plays a crucial role in measuring quality of life [11, 12]. Nowadays, there is a consensus on the interrelation between the quality of sexual life, and the level of satisfaction, and the level of general quality of life, so that the low quality of sexual life can be an indication to the low general quality of life [10]. The results of studies conducted in Iran and other countries have reported different levels of sexual quality of life among women. Moderate levels of sexual quality of life were reported in the

https://doi.org/10.15167/2421-4248/jpmh2021.62.3.1945

studies of AJ et al. [13] and Kisa et al. [14], while these levels were good in Samimi of et al. [15], Aduloju et al. [16] and Roshan Chesli et al. [17].
Considering the high prevalence of sexual dysfunction among women [10], and its determining role of quality of women's sexual life [9], in addition to its importance in measuring quality of life [11, 12], this study aimed to determine the effect of women's sexual function on their quality of sexual life.

Methods

The present study was a descriptive-analytical cross-sectional conducted in 2020 among women referring to health centers in Qazvin. Sampling was done through one-stage cluster method so that at first a list of all comprehensive health centers in Qazvin was prepared. Then, out of these 24 centers, 6 centers from the north, south, and the city center were randomly selected and all women referring to these centers, who met the inclusion criteria, entered the study after obtaining written informed consent, and all eligible women referring to these centers were selected to participate in the study after granting the informed consent.
Regarding inclusion criteria, women who were referring to health centers in Qazvin, having a spouse and living together for at least one year, sexually-active, not having any chronic debilitating disease, not having a spouse suffering from premature ejaculation or impotence, with no diagnosed mental health problems (according to the participant's report), finished at least their basic education, and showed willingness to participate in the study. Suffering from genital diseases and/or genital surgery affecting sexual potency, tubectomy, and use of drugs to reduce libido were exclusion criteria in this study. Moreover, incomplete questionnaires were excluded, and non-willingness to take part was considered as exclusion criteria.
One of the study objectives was to assess women's sexual function. Therefore, according to the results of Maasoumi et al. study [5] and considering P = 0.52 for the frequency of sexual function, as well as using the formula of Cochrane's sample size and calculating d = 0.05, the estimated sample size was 383. However, non-response rate was considered 10%, thereby, the sample size has been increased to 420.
Data were collected in this study using a questionnaire that included the following:

- *demographic and contextual information*: including age of participant, level of education, employment status, age of first child, age of spouse, spouse's educational level, duration of marriage, age at marriage, number of weekly sexual intercourses, and use of contraceptives;
- *the Persian version of the Female Sexual Function Questionnaire* (FSFI) was used to assess women's sexual activity in the last four weeks prior to the study. This questionnaire consists of 19 items; sexual desire (2 items for example: Over the past 4 weeks, how often did you feel sexual desire or interest?), arousal (4 items for example: Over the past 4 weeks, how often did you feel sexually aroused ("turned on") during sexual activity or intercourse?), orgasm (3 items), sexual pain (3 items for example: Over the past 4 weeks, when you had sexual stimulation or intercourse, how often did you reach orgasm (climax)?), genital softening (4 items for example: Over the past 4 weeks, how often did you become lubricated ("wet") during sexual activity or intercourse?) and sexual satisfaction (3 items for example: Over the past 4 weeks, how satisfied have you been with the amount of emotional closeness during sexual activity between you and your partner?).
  Each item has 6 choices; 'I did not have sexual activity = 0', 'never = 1', 'rarely = 2', 'sometimes = 3', 'often = 4' and 'always = 5.' The minimum score of the questionnaire was 2, the maximum score was 36, and the cut-off point was 28. In other words, scores higher than the cut-off point indicated desirable sexual performance [18]. The validity and reliability of this instrument in Iran have been assured by Mohammadi et al. as they found the Cronbach's alpha coefficient in their study was 0.87 [19]. Also in the present study, Cronbach's alpha coefficient for FSFI was 0.81. Therefore, the Persian version of FSFI is a reliable tool for assessing the sexual performance of Iranian women.
- To evaluate the quality of women's sexual life, the Persian version of the Sexual Quality of Life Questionnaire (SQOL-F) was used. This questionnaire was firstly designed in 1998, and revised and validated in 2005 by Symonds et al. [20]. This questionnaire is composed of 18 questions (for example 3 question: When I think about my sexual life, I find it an enjoyable part of my whole life. I have lost my self-confidence as a sexual partner. When I think about my sexual life, I feel like I have lost something) on a six-point Likert scale (strongly agree = 6, agree = 5, neutral = 4, disagree = 5 and strongly disagree = 6). The minimum score obtained was 18 and the maximum score was 108. The higher scores indicate a better quality of sex life [20]. For judging the results, the references values adopted in that study were classified as follow: (18-36) = poor quality, (37-72) = medium quality and (73-108) = good quality [20-21]. In the present study, the standardized questionnaire in Maasoumi et al. [21] was used. This questionnaire was translated and psychometric in 2013, and the Cronbach's alpha coefficient was 0.73 and the internal correlation coefficient was 0.88. Also, content validity index and content validity ratio have been reported as 0.91 and 0.84, respectively [21]. In the current study, Cronbach's alpha coefficient for this questionnaire was

0.76. According to the researchers of the present study, the quality of sexual life was descried as: undesirable when the score was in the range 18-36, and desirable when it was between 37 and 108. Data were analyzed using SPSS software version 23, and the descriptive statistics and logistic regression were applied to show the characteristics of study sample size, and to determine the influential factors on the measures under study, respectively. It should be noted that the quality of sexual life was the dependent variable, and the variables of age, level of education, employment status, age of first child, age of spouse, level of spouse education, duration of marriage, age at marriage, number of sexual intercourses per week, contraceptive use and sexual function, were the independent variables. In addition, the level of significance in this study was considered at $p < 0.05$.

Ethical considerations

Ethical approval was granted by the Vice Chancellor for Research and Technology at Qazvin University of Medical Sciences (IR.QUMS.REC.1399.077). An introductory letter was sent to the health centers in Qazvin explaining the nature and study objectives, and presenting the study questionnaires. Confidentiality of collected information was assured for the officials of the comprehensive health centers as well as the participating women.

Results

A total of 420 women with mean (SD) age 33.14 (4.59) years were included in the study (the response rate was 100%). Of them, 59.5% (n = 250) were under 30 years old, 43.8% (n = 184) were housewives, and 47.4% (n = 199) were holding bachelor degree or higher. Table I shows the other sociodemographic characteristics of the participating women.

The results showed that the mean (SD) score of sexual performance of female participants was 21.56 (4.83) out of 36, and this indicated an unfavorable level. Also, 59.3% (n = 249) and 40.7% (n = 171) experienced poor and good sexual function, respectively. The mean (SD) score of quality of sexual life of the participants was 59.71 (19.21) was out of 108 points, and lied in the moderate level. In addition, 25.5% (n = 107) had poor quality of sex life, while, 60% (n = 252) and 14.5% (n = 61) reported moderate and good quality of sexual life, respectively.

Table II illustrates the results of logistic regression which sought to determine the factors affecting the quality of sexual life of women in the study. The results revealed that age, level of education and sexual function were the most influential factors on the quality of women's sexual life ($p < 0.05$):

Age variable was one of the factors affecting the quality of women's sexual life ($p = 0.024$); so that the chance of having a desirable quality of sex life in women aged ≥ 30 was 1.104 times higher than women < 30 years old. Also, the level of education was also an influential factor on the quality of women's sexual life ($p = 0.017$); so that the women with bachelor's and higher education, and post-diploma education had a desirable quality of sex life 1.586 and 1.258, respectively, higher than those with elementary education. Meantime the variable of sexual functioning significantly affected the quality of women's sexual life of ($p = 0.009$), thus, the women with good sexual performance was 3.221 times better than women with poor sexual performance regarding quality of sexual life.

Unlike, employment status, age of the first child, age of spouse, level of spouse education, duration of marriage, age at marriage, number of sexual intercourses per week and use of contraceptives have led to statistically non-significant differences in the quality of women's sexual life.

Tab. I. Demographic and contextual characteristics of the study participants.

#	Variable		Frequency	
			(n)	(%)
1.	Age (years)	Under 30	170	40.5
		30 or above	250	59.5
2.	Educational level	Elementary	45	10.7
		Middle school	32	7.6
		Diploma	47	11.2
		Associate degree	97	23.1
		Bachelor and higher	199	47.4
3.	Employment status	Housewife	184	43.8
		Unemployed	47	11.2
		Employee	131	31.2
		Self-employed	58	13.8
4.	Age of first child (years)	< 10	150	35.7
		10-20	139	33.1
		> 20	131	31.2
5.	Age of spouse (years)	< 35	196	46.7
		≥ 35	224	53.3
6.	Educational level of spouse	Elementary	44	10.5
		Middle	31	7.4
		Diploma	59	14
		Associate degree	89	21.2
		Bachelor and higher	197	46.9
7.	Marriage duration (years)	< 10	149	35.5
		10-20	140	33.3
		> 20	131	31.2
8.	Age at marriage (years)	< 25	188	44.7
		25-35	162	38.6
		> 35	70	16.7
9.	Sexual intercourses per week	0	82	19.5
		1	113	26.9
		2-3	134	31.9
		≥ 4	91	21.7
10.	Use of contraceptives	Yes	226	53.8
		No	194	46.2

Tab. II. Factors affecting the quality of women's sexual life based on logistic regression analysis.

#	Variable		Significance level	OR
1.	Age		0.025	0.104
2.	Educational level	Elementary	0.017	
		Middle school	0.447	0.217
		Diploma	0.258	0.616
		Associate degree	0.031	0.258
		Bachelor and higher	0.021	1.586
3.	Employment status	Housewife	0.366	
		Unemployed	0.744	0.584
		Employee	0.599	0.249
		Self-employed	0.312	0.125
4.	Age of first child (years)	< 10	0.325	
		10-20	0.086	12.288
		> 20	0.586	4.347
5.	Age of spouse		0.181	1.214
	Educational level of spouse	Elementary	0.753	0.133
		Middle	0.512	0.222
		Diploma	0.799	0.219
		Associate degree	0.847	0.334
		Bachelor and higher	0.745	0.211
7.	Marriage duration (years)	< 10	0.788	
		10-20	0.941	0.447
		> 20	0.957	1.458
8.	Age at marriage (years)	< 25	0.081	
		25-35	0.093	2.111
		> 35	0.884	0.254
9.	Sexual intercourses per week	0	0.061	
		1	0.873	0.258
		2-3	0.071	3.245
		≥ 4	0.062	2.554
10.	Sexual activity		0.009	3.221
11.	Use of contraceptives		0.588	2.471
12.	Intercept		1.000	6.23

Discussion

The aim of this study was to determine the effect of women's sexual function from in Qazvin, Iran on their quality of sexual life. The results of the present study showed that the quality of sexual life of participating women was moderate, and was in line with the results of Kisa et al. [14], Aj et al. [13] and Sezgin et al. [22] studies, but inconsistent with the results of Samimi et al. [15], Maasoumi et al. [21] and Roshan Chesli and Et al. [17] and Ahmadian Chashemi et al. [23] and Aduloju et al. [16]. In the abovementioned studies, the quality of women's sexual life was at a good level. The potential reasons for this discrepancy could be attributed to the difference in the research community, context and employment status of women in these studies compared to the present one, in which the majority of women were housewives, while in the aforementioned studies, most of them were employees. The nature of work is also one of the important factors that can affect the quality of life and, consequently, the quality of sexual life [15].

The results of the present study demonstrated that the sexual performance of participating women was an unfavorable. Considering the average level of quality of sexual life and its relationship between with sexual function in this study, it was assumed that sexual functioning will be also moderate. Thereby, this indicates that in addition to sexual functioning, there are some other confounders might influence the quality of sexual life of women under study. In the study of Maasoumi et al., the sexual performance of the participating women was also unfavorable [5]. The results of Kingsberg [24] and Aslan [25] studies were consistent with the results of the present study as well. Conversely, Sahebalzamani et al. [26] and Karamidehkordi [27] stated that the majority of participants in their studies had good sexual functioning. One of the reasons for this difference can be owned to the variation in the statistical population, cultural conditions and tools used. Furthermore, embarrassment of women to talk about sexual issues, lack of clear understanding sexual-related issues, and the paucity of studies in this domain, can be other reasons for this discrepancy.

In the current study, age was one of the factors affecting the quality of sexual life of women. It is noteworthy that age can led to differences in couples' sexual performance and, consequently, the quality of women's sexual life by making changes in sexual feelings and desires, sexual harmony, body shape, sexual ability and health status. These results were consistent with the studies of Beigi et al. [28] and Shahraki et al. [29]. Similarly, Samimi et al. believed that the role of age is prominent in the sexual functioning and quality of sexual life, and this role cannot be ignored [15].

The educational level of women was one also an influential factor on the quality of women's sexual life. Science and knowledge play a role in the growth and intellect of individuals. It also affects the way people behave and how they socially interact with each other in general and with their family members in particular. Therefore, this can justify the contribution of education level in improving the quality of women's sex life, which in turn were consistent with the results of various studies in the literature [28, 30-33].

The effect of sexual functioning on the quality of sexual life of women was also notable. This can be associated with the relationship between sexual desire and the impact on individual, social and family relationships; and this ultimately affects the quality of life of women and consequently the quality of their sexual life. Moreover, both sexual functioning and quality of sexual life focus on sexual issues, therefore, existence of this relationship is conceivable. These results were in line with the results of studies carried out by Nazarpour et al. [34], Chedraui et al. [35], Nappi et al. [36], Nicolosi et al. [37] and Ambler et al. [38].

To the best of our knowledge, the present study was the first to examine the relationship between sexual functioning and quality of women's sexual life. The most important limitation of this study was the lack of previous which in turn limited the comparability, and drew attention toward

the necessity of conducting further studies in the future. Additionally, self-report in completing the questionnaire is not expected to provide accurate information about the participant. Also, the relatively small sample size was another limitation. Furthermore, the results of the study cannot be generalizable as it was conducted only among selected women of several comprehensive health centers in one province, Qazvin. Accordingly, further researches on a larger scale are recommended on women in this city and other cities, especially in rural areas.

Conclusions

Overall, the results of the present study showed that the quality of sexual life and sexual functioning among the participating women were moderate and unfavorable, respectively. Also, variables including; age, level of women's education and sexual performance were factors affecting the quality of women's sexual life. Therefore, there is a compelling need to design and implement the necessary training to improve the quality of sexual life among these women, especially those younger women with weak sexual functioning, and lower level of education.

Acknowledgements

Funding sources: this research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.
Authors would like to thank the Vice Chancellor for Research and Technology of Qazvin University of Medical Sciences for their support, and highly appreciate the cooperation of the officials at the comprehensive health centers, and all women for their active participation in this study.

Conflict of interest statement

The authors declare no conflict of interest.

Authors' contributions

This study substantial contributions to the conception design of the work LD and RP, the acquisition, analysis and interpretation of data RP and LD, MA, EJ, KHJ; the creation of new software used in the work LD, and MA, EJ, KHJ; have drafted the work or substantively revised it LD and RP. All authors have read and approved the manuscript.

References

[1] Nezal AJ, Samii Rad F, Kalhor M, Hasanpour K, Alipour M, Montazeri A. Sexual quality of life in pregnant women: A cross sectional study. IHSR 2019-17:421-9.

[2] Setoudeh S, Motaghi M, Mosavi M. Survey of sexual satisfaction in women referred to public health centers of Mashhad in 2017. JSUMS 2019;26:73-80.

[3] Birnbaum GE. Attachment orientations, sexual functioning, and relationship satisfaction in a community sample of women. JSPR 2007;24:21-35. https://doi.org/10.1177/0265407507072576

[4] Ahmadnia E, Haseli A, Karamat A. Therapeutic interventions conducted on improving women's sexual satisfaction and function during reproductive ages in Iran: a systematic review. J Mazandaran Univ Med Sci 2017;27 :146-62.

[5] Masoumi S.Z, Alavipour N, Parsa P, Kazemi F. Demographic factors affecting sexual dysfunction in postmenopausal women. IJECH 2020;7:5-12.

[6] Hajnasiri H, Aslanbeygi N, Moafi F, Mafi M, Bajalan Z. Investigating the relationship between sexual function and mental health in pregnant females. IJPN 2018;6 :33-40.

[7] Ramezani Tehrani F, Farahmand M, Mehrabi Y, Malek-afzali H, Abedini M. Sexual dysfunction and its influencing factors: population -based study among women living in urban areas in four provinces. Payesh 2012;11:869-75.

[8] Hoseini Tabaghdehi M, Haji Kazemi E, Hoseini F. The relative frequency of sexual dysfunction and some related factors in the women referred to the health centers of Sari City (2006). J Mazandaran Univ Med Sci 2012;22:102-7.

[9] Nejat S. Quality of life and its measurement. JHIPH 2008;2:57-62.

[10] Lamyian M, Zarei F, Montazeri A, Hajizadeh E, Maasoumi R. Exploring the factors affecting Iranian women's quality of sexual life. HAYAT 2016;22:185-200.

[11] Daker-White G, Donovan J. Sexual satisfaction, quality of life and the transaction of intimacy in hospital patients' accounts of their (hetero) sexual relationships. Sociol Health Illn 2002;24:89-113. https://doi.org/10.1111/1467-9566.00005

[12] Hisasue S, Kumamoto Y, Sato Y, Masumori N, Horita H, Kato R, Kobayashi K, Hashimoto K, Yamashita N, Itoh N. Prevalence of female sexual dysfunction symptoms and its relationship to quality of life: a Japanese female cohort study. Urology 2005;65:143-8. https://doi.org/10.1016/j.urology.2004.08.003

[13] Nezal AJ, Fatemi Samii Rad, Mehri Kalhor, kobra hasanpour, Mahmood Alipour, Ali Montazeri. Sexual quality of life in pregnant women: a cross sectional study. Payesh 2018;17:421-9.

[14] Kisa S, Zeyneloğlu S, Yilmaz D, Güner T. Quality of sexual life and its effect on marital adjustment of Turkish women in pregnancy. J Sex Marital Ther 2014;40:309-22. https://doi.org/10.1080/0092623X.2012.751071

[15] Samimi K, Mokarami HR, Tontab Haghighi S,Taban E, Yazdani Aval M, Maasoumi R. Assessment of affecting factors on women's sexual quality of life among hospital employees. GOUMS 2016;18:128-34.

[16] Aduloju OP, Olaogun OD, Aduloju T. Quality of life in women of reproductive age: a comparative study of infertile and fertile women in a Nigerian tertiary Centre. J Obstet Gynaecol 2017;18:1-5. https:///doi.org/10.1080/01443615.2017.1347916

[17] Roshan Chesli R, Soleymani Z, Tahoora E, Mantashloo S, Hashemi A. Evaluate the psychometric properties of sexual quality of life questionnaire (SQOL-F). CPAP 2019;17:213-24.

[18] Rosen R, Brown C, Heiman J, Leiblum S, Meston C, Shabsigh R, D'Agostino R. The female sexual function index (FSFI): a multidimensional self-report instrument for the assessment of female sexual function. J Sex Marital Ther 2000;26:191-208. https://doi.org/10.1080/009262300278597

[19] Mohammadi K, Heidari M, Faqihzadeh S. The validation of female sexual function index (FSFI) in the women: Persian Version. Payesh Journal 2008;7:270-8.

[20] Symonds T, Boolell M, Quirk F. Development of a questionnaire on sexual quality of life in women. J Sex Marital Ther 2005;31:385-97. https://doi.org/10.1080/00926230591006502

[21] Maasoumi R, Lamyian M, Montazeri A, Azin SA, Aguilar-

Vafaie ME, Hajizadeh E. The sexual quality of life-female (SQOL- F) questionnaire: translation and psychometric properties of the Iranian version. Reprod Health 2013;10:25. https://doi.org/10.1186/ 1742-4755-10-25

[22] Sezgin H, Hocaoglu C, Guvendag-Guven ES. Disability, psychiatric symptoms, and quality of life in infertile women: a cross-sectional study in Turkey. Shanghai Arch Psychiatry 2016;28:86-94. https://doi.org/10.11919/j.issn.1002-0829.216014

[23] Ahmadian Chashemi N, Mirrezaie SM, Nouhi Sh, Khastar H. Evaluating the relationship between sleep disturbances and sexual quality of life among female shift working nurses. JKH 2018;13:19-25.

[24] Kingsberg SA. The impact of aging on sexual function in women and their partners. Arch Sex Behav and sexual function in menopausal age; a population based cross-sectional study. Iran J Reprod Med 2013;11:631-6.

[25] Aslan E, Beji NK, Gungor I, Kadioglu A, Dikencik BK. Prevalence and risk factors for low sexual function in women: a study of 1,009 women in an outpatient clinic of a university hospital in Istanbul. J Sex Med 2008;5:2044-52. https://doi.org/10.1111/j.1743-6109.2008.00873.x

[26] Sahebalzamani M, Mostaedi Z, Farahani H, Sokhanvar M. Relationship between health literacy and sexual function and sexual satisfaction in infertile couples referred to the Royan Institute. Int J Fertil Steril 2018;12:136-41. https://doi.org/10.22074/ijfs.2018.5185

[27] Karamidehkordi A, Roudsari RL. Body image and its relationship with sexual function and marital adjustment in infertile women. Iran J Nurs Midwifery Res 2014;19(7-1):S51-58.

[28] Beigi M, Fahami F, Hassan-Zahraei R, Arman S. Sexual dysfunction in menopause. JIMS 2008;26:294-300.

[29] Shahraki Z, Tanha FD, Ghajarzadeh M. Depression, sexual dysfunction and sexual quality of life in women with infertility. BMC 2018;18:92. https://doi.org/10.1186/s12905-018-0584-2

[30] Kim JS, Kang S. A study on body image, sexual quality of life, depression, and quality of life in middle-aged adults. Asian Nurs Res (Korean Soc Nurs Sci) 2015;9:96-103. https://doi.org/10.1016/j.anr.2014.12.001

[31] Ramezani Tehrani F, Farahmand M, Mehrabi Y, Malek Afzali H, Abedini M. Prevalence of female sexual dysfunction and its correlated factors: a population based study. Payesh 2012;11:869-75.

[32] Mirzaei H, Aghayari T, Katebi M. A study on life quality among married women in family institution. SSI 2014;1:71-93.

[33] Santelli JS , Abma J , Ventura S, Lindberg L, Morrow B, John A, Lyss SH, Hamilton B. Can changes in sexual behaviors among high school students explain the decline in teen pregnancy rates in the 1990s? JAH 2005:35;80-90.

[34] Nazarpour S, Simbar M, Ramezani Tehrani F, Alavi Majd H. Relationship between sexual function and quality of life in postmenopausal women. J Mazandaran Univ Med Sci 2016;26:90-8.

[35] Chedraui P, San Miguel G, Avila C. Quality of life impairment during the female menopausal transition is related to personal and partner factors. Gynecol Endocrinol 2009;25:130-5. https://doi.org/10.1080/09513590802617770

[36] Nappi RE, Lachowsky M. Menopause and sexuality: prevalence of symptoms and impact on quality of life. Maturitas 2009;63:138-41. https://doi.org/10.1016/j.maturitas.2009.03.021

[37] Ambler DR, Bieber EJ, Diamond MP. Sexual function in elderly women: a review of current literature. Rev Obstet Gynecol 2012;5:16-27.

[38] Nicolosi A, Laumann EO, Glasser DB, Moreira ED Jr, Paik A, Gingell C, Gingell C. Sexual behavior and sexual dysfunctions after age 40: the global study of sexual attitudes and behaviors. Urology 2004;64:991-7. https://doi.org/10.1016/j.urology.2004.06.055

Received on December 29, 2020. Accepted on July 12, 2021.

Correspondence: Leila Dehghankar, Department of Nursing, Social Determinants of Health Research Center, Research Institute for Prevention of Non-Communicable Diseases, School of Nursing & Midwifery, Qazvin University of Medical Sciences, Qazvin, Iran - Tel. 02833338034 - E-mail: Dehghan247@gmail.com

How to cite this article: Panahi R, Anbari M, Javanmardi E, Jahangasht Ghoozlu KH, Dehghankar L. The effect of women's sexual functioning on quality of their sexual life. J Prev Med Hyg 2021;62:E776-E781. https://doi.org/10.15167/2421-4248/jpmh2021.62.3.1945

RESEARCH ARTICLE

Epidemiological and virological surveillance of Severe Acute Respiratory Infections in the 2019/2020 season in Siena, Tuscany, Italy

ELENA CAPITANI[1], EMANUELE MONTOMOLI[2,3], ANDREA CAMARRI[4], GIOVANNI BOVA[4], PIER LEOPOLDO CAPECCHI[5], ASTRID MERCONE[7], NICOLA NANTE[1,2], ILARIA MANINI[2,6]

[1] Postgraduate School of Public Health, University of Siena, Siena, Italy; [2] Department of Molecular and Developmental Medicine, University of Siena, Siena, Italy; [3] Vismederi S.r.l., Siena, Italy; [4] Emergency and Transplants Department, University Hospital of Siena, Siena, Italy; [5] Department of Medical Sciences, Surgery and Neurosciences, University of Siena, Siena, Italy; [6] Interuniversity Research Center on Influenza and Other Transmissible Infections (CIRI-IT), Genoa, Italy; [7] Public Hygiene and Nutrition Unit, LHA Tuscany Southeast, Siena, Italy.

Keywords

Influenza A and B viruses • Severe Acute Respiratory Infections • Epidemiological and virological surveillance

Summary

Background. *Influenza is a major public health issue. Indeed, in Italy there were 7.6 million symptomatic cases of influenza in the 2019/2020 influenza season (from October 2019 to April 2020). The aim of this study is to analyse the circulation of influenza A and B viruses in hospitalized adult and elderly patients with Severe Acute Respiratory Infections (SARI) at Le Scotte University Hospital in Siena.*

Methods. *Oropharyngeal swabs were taken from SARI patients, who also completed a questionnaire recording their underlying diseases and vaccination status. Total RNA was extracted from each respiratory swab by means of the QIAamp Viral RNA Mini kit, and RT-PCR was carried out. All statistical analyses were performed by means of GraphPad Prism 6 software and STATA.*

Results. *In this study we collected 68 swabs. The average age of subjects was 79.4 years (C.I.: 76.6-82.3) and 52.9% were female. The subjects had fever (89.7%), fatigue (77%), headache (47%), cough (75%), sore throat (70.5%), and breathlessness (63.2%). We found that 20% of the 68 subjects were positive (13% for A H3N2 and 7% for A H1N1). Of the 68 subjects, 25% had received a seasonal influenza vaccine (91.6% trivalent and 8.4% quadrivalent).*

Conclusions. *Our study is important in order to determine the timing and spread of influenza viruses and track changes in circulating influenza viruses, so as to inform seasonal influenza vaccine composition. Seasonal vaccination is considered the most effective way to prevent influenza and its complications.*

Introduction

Influenza is a major public health problem, causing an estimated 3 to 5 million cases of serious illness and 290,000 to 650,000 deaths due to respiratory infections per year worldwide [1]. There are four types of influenza viruses: A, B, C and D. Influenza A and B viruses cause seasonal epidemics of influenza disease; influenza type A viruses, unlike type B viruses, can also cause influenza pandemics, as their reservoir of infection is not only humans but also animal species. Influenza A viruses are further classified into subtypes according to the combinations of their two surface proteins, haemagglutinin (HA) and neuraminidase (NA), which are responsible for the infectious cycle of the influenza virus. Currently circulating in humans are subtypes A(H1N1) and A(H3N2) [2, 3]. A(H1N1) is also called A(H1N1)pdm09, as it caused a pandemic in 2009 and subsequently replaced the seasonal influenza A(H1N1) virus which had circulated prior to 2009. Influenza B viruses are not classified into subtypes, but can be broken down into lineages. Currently circulating influenza type B viruses belong to either the B/Yamagata or the B/Victoria lineage. Influenza C virus is detected less frequently and usually causes mild infections; it does not therefore arouse public health concern. Influenza D viruses primarily affect cattle and are not known to infect or cause illness in people [1, 4]. At the global level, influenza surveillance is conducted by the Global Influenza Surveillance and Response System (GISRS), which is coordinated by the WHO [1]. The virological surveillance of influenza is an important means of determining the timing and spread of influenza viruses, tracking changes in circulating influenza viruses and informing seasonal influenza vaccine composition [5]. In Siena, the epidemiological surveillance of influenza has been carried out since the 1980s [6, 7].

Only during the 2009 influenza pandemic did the need for more global data on severe influenza disease starkly emerge, promoting the World Health Organization to recommend conducting surveillance for severe acute respiratory infection in hospitalised patients; indeed, before 2011 a global surveillance case-definition of Severe Acute Respiratory Infections (SARI) did not exist. The proposed clinical case-definition of

https://doi.org/10.15167/2421-4248/jpmh2021.62.3.2297

SARI in all age-groups therefore became "an acute respiratory illness with a history of fever or measured fever of ≥ 38°C and cough, with onset within the past 10 days, requiring hospitalization". To simplify the implementation process, the same criterion, i.e. "onset within the past 10 days", was subsequently used in the case-definitions of both ILI (Influenza-like illness) and SARI [8-10].

Since the 2009/2010 pandemic season, Italy has been monitoring the evolution of severe and complicated forms of seasonal influenza. This surveillance aims to collect information on severe forms and deaths, in order to better understand the epidemiology of severe forms in the country, also in terms of possible risk factors and viral mutations during influenza epidemics [11].

In Italy, the virological and epidemiological surveillance of influenza is carried out by InfluNet [12]. This national surveillance system is based on a network of sentinel doctors made up of general practitioners and paediatricians, recruited by the Regional health authorities, who report cases of influenza-like syndrome (ILI) observed among their patients. Sentinel doctors and other doctors working in the territory and in hospitals also collaborate in the collection of biological samples for the identification of circulating viruses.

The collection and processing of disease reports is carried out by the Public Health Institute (ISS), which processes them at the national level and produces a weekly report that is published on the Ministry of Health website. The InFluNet network is integrated by FluNews, which collects the results of several influenza surveillance systems (Sismg, InfluWeb, InfluNet-Epi, InfluNet-Vir) [13]. Influenza severity measurements proposed by the WHO vary by influenza epidemic and cannot be deduced from ILI surveillance alone, thus emphasizing the potential use of and the necessity for prospective SARI surveillance, in order to assess the burden of seasonal influenza [14, 15].

The Italian Ministry of Health recommends that the monitoring of SARI be widely implemented in the intensive care units of local hospitals, and has requested their compliance [16]. Seasonal (or inter-pandemic) influenza surveillance generates information that can be used to plan appropriate measures of control and intervention (including vaccination), allocate health resources, and make recommendations for influenza case management [17].

All these surveillance systems are essential to the creation of a comprehensive representation of influenza from both the epidemiological and virological standpoints. Moreover, the reporting of SARI in a patient with chronic diseases ensures that the complications of influenza are not underestimated [18]. The consequences of influenza infection can be severe both for individuals and for the healthcare system. The severity of the infection depends on the type/subtype of the virus and the characteristics of the patient, including age (infants < 1 year and over 65 years) and the presence of cardiovascular, respiratory, or immunodeficiency diseases. SARI caused by the influenza virus can result in hospitalisation [19-21]. Influenza vaccination is the most effective measure to prevent influenza disease. The WHO and EU countries, including Italy, recommend routine seasonal influenza vaccination for the elderly and individuals at increased risk of influenza complications, and have set a target of 95% influenza vaccine coverage for the elderly. In Italy, the three objectives of the seasonal vaccination campaign are: to reduce the individual's risk of disease, hospitalization and death, to reduce the risk of transmission to subjects at risk of other complications or at risk of hospitalization, and to reduce the costs associated with the morbidity and mortality of the disease [22].

The 2017/2018 season saw the launch of the Development of Robust and Innovative Vaccine Effectiveness (DRIVE) project [23]. This project is a public–private partnership aimed at building the capacity for yearly estimation of brand-specific influenza vaccine effectiveness (IVE) in Europe. DRIVE is a five-year project funded by the IMI (Innovative Medicines Initiative) and our study is part of this project. It was initiated as a response to the guidelines on influenza vaccines issued by the EMA (European Medicines Agency), which advised vaccine manufacturers to work with public health institutes to set up a joint IVE study platform [23]. The data generated through DRIVE are expected to increase the understanding of influenza vaccine effectiveness, lead to enhanced monitoring of influenza vaccine performance by public health institutes and allow manufacturers to fulfil regulatory requirements [24].

In this study, we analysed the circulation of influenza viruses in the hospital setting in adult and elderly patients with SARI during the 2019/2020 season.

Materials and Methods

Study Design

Oropharyngeal swabs were collected at the Unit of Emergency Medicine and Internal Medicine II of Le Scotte University Hospital in Siena, Italy, in the 2019/2020 influenza season. In Italy, the influenza season lasts from 47/2019 to 17/2020 weeks. The study is an observational case-control study in which SARI cases confirmed for influenza and controls will be identified as such after the test has been performed cases confirmed for influenza and controls will be identified as such following laboratory testing laboratory test. The study is multicentre (see setting section), non-commercial and will be conducted during the influenza season from 18 November 2019 and will end on 26 April 2020.

Sample collection was conducted in the context of the project DRIVE. The study was approved by the Ethics Committee of Area Vasta Sud Est Tuscany: approval Report n. 16344 of 16th December, 2019. Written

consent was obtain from all patients enrolled in the study.
The study population is made up of all non-institutionalized subjects hospitalized for SARI, who do not present contraindications to flu vaccination.
Patients enrolled in the study presented symptoms (at least one systemic sign and symptom and one respiratory sign and symptom) and/or deterioration of their general condition at the time of hospital admission or within 48 hours after admission. The symptoms considered were: fever, headache, myalgia, generalized malaise, cough, sore throat and breathing difficulties. During interviews, patients were asked about their vaccination status; each patient's general practitioner was then asked to confirm the vaccination status and the type of vaccine (trivalent or quadrivalent). Patients were included if they had been vaccinated more than 14 days before the onset of SARI symptoms. The information was collected through a standardized questionnaire in which socio-demographic data and any underlying conditions were recorded. The swabs were collected by the ward doctor, stored at + 4°C and transported to the Molecular Epidemiology laboratory of the University of Siena and processed within 24 hours.

Laboratory Analysis

Total RNA was extracted from swabs by means of the QIAamp Viral RNA Mini kit (Qiagen, Hilden, Germany).
One-step real time RT-PCR was performed in a final volume of 25 µl with 0.8 µM forward and reverse primers, 0.2 µM probe and 5 µl of extracted RNA, in accordance with the manufacturer's instructions for the use of the One-Step RT-PCR Kit (SuperScript III Platinum One-Step qRT-PCR Kit, Thermo Fisher Scientific, Waltham, MA, USA): Cycling conditions were 50°C for 30 minutes, 95°C for 2 minutes and 45 cycles of 15 seconds at 95°C and 30 seconds at 55°C. Fluorescence was measured during the 55°C annealing/extension step.

Statistical Analysis

The average ages of the study population and positive subjects were calculated. Frequencies, Standard Deviation (SD) and Confidence Interval (CI) were calculated. All statistical analyses were performed by means of GraphPad Prism 6 software and STATA.

Results

Sixty-eight oropharyngeal swabs were taken from patients with SARI. The first swab was collected on December 15, 2019, and the last swab was collected on March 15, 2020. Their average age was 79.4 years (SD:1.44; C.I.: 76.6-82.3). The median age was 82 and 52.9% were female.
The patients had fever (89.7%), fatigue (77%), headache (47%), cough (75%), sore throat (70.5%), and breathlessness (63.2%). Of the 68 patients, 25% had received a seasonal influenza vaccine (91.6% trivalent and 8.4% quadrivalent); 23.5% had not undergone anti-pneumococcal vaccination, while 76.5% whether they had or not .We found that 20% of the 68 subjects were positive (13% for A H3N2 and 7% for A H1N1). The median age of the positive subjects was 79.5 years and 57.1% were male. There were 12 positives among the unvaccinated, only 2 positives among the vaccinated were hospitalised. The positive subjects mostly had fever (100%), fatigue (71.4%), headache (28.6%), myalgia (35.7%), cough (78.6%), sore throat (57.1%), and breathlessness (50%) (Tab. I).

Tab. I. Symptoms of positive subjects: number of subjects (N) and frequency (%).

Symptoms	(N)	%	C.I.
Fever	14	100	0
Fatigue	10	71.4	0.01 - 0.55
Headache	4	28.6	0.44-0.98
Myalgia	6	42.9	0.27-0.86
Cough	11	78.6	-0.03-0.46
Sore throat	8	57.1	0.13-0.72
Breathlessness	7	50.0	0.20-0.79

Positive subjects had a mean of 2.2 underlying conditions. The most common underlying diseases found in the positive subjects were: obesity (100%), cardiovascular diseases (50%), hypertension (50%), renal diseases (50%), lung diseases (42.8%), diabetes (35.7%), and cancer (35%). Other underlying conditions found in positive subjects were: haemopoietic organ diseases (14.3%), acquired immunosuppression (14.3%), liver disease/cirrhosis (7.1%), dementia (7.1%), stroke (7.1%), leukaemia or lymphomas (7.1%), and rheumatic diseases (7.1%) (Tab. II).

Tab. II. The most frequent underlying condition in positive subjects

Underlying Conditions	Freq.	%	C.I.
Cardiovascular diseases	7	50.0	0.20-0.79
Hypertension	7	50.0	0.20-0.79
Lung diseases	6	42.9	0.27-0.86
Diabetes	5	35.7	0.35-0.92
Renal diseases	7	50.0	0.20-0.79
Haemopoietic organ disease	2	14.3	0.64-1.06
Cancer	5	35.7	0.35-0.92
Liver disease/cirrhosis	1	7.1	0.77-1.08
Immunosuppression	2	14.3	0.64-1.06
Obesity	14	100	1

Among the positive subjects, 2 were smokers, 5 were ex-smokers, 4 had never smoked and 3 did not answer (Tab. III).

Tab. III. Smoking among positive subjects

Smoker	Freq.	%
No	4	28.6
Yes	2	14.3
Ex	5	35.7
no answer	3	21.4
Total	14	100.0

Tab. IV. Positive patients: number of subjects (N) and type of influenza virus.

	A/H1N1 *(N.)*	A/H3N2 *(N.)*
Positive subjects	5	9
No Vaccination	4	8
Cardiovascular diseases	2	5
Hypertension	2	5
Lung diseases	1	6
Diabetes	1	4
Renal diseases	1	6
Haemopoietic organ disease	0	2
Cancer	3	2
Liver disease/cirrhosis	0	1
Immunosuppression	1	1
Fever	5	9
Fatigue	3	7
Headache	1	3
Myalgia	1	5
Cough	3	8
Sore throat	4	4
Breathlessness	1	6

Two of the positive subjects had been vaccinated with trivalent vaccine; in a 90-year-old woman, influenza virus A(H3N2) was identified, and in an 86-year-old woman, influenza virus A (H1N1)pdm09 was identified. Both women had fever and cough. The 86-year-old also had muscle pain and breathlessness.
Table IV shows positive patients based on the type of influenza virus, symptoms, underlying conditions and vaccination status.

Discussion

In this study, we found that 20.5% of 68 subjects hospitalized in Siena, Tuscany with SARI symptoms were positive for influenza virus infection. Most of the infections were sustained by type A viruses, especially A (H3N2) viruses, which accounted for two-thirds of infections in our study. These values are in line with the trend reported by virological surveillance in Italy and in Europe [13,25-27]. In Europe, the first detections during the 2019-2020 season indicated co-circulation of influenza types A (71%) and B (29%) viruses in the WHO European Region. All four influenza subtypes and lineages circulated. Of the types A and B viruses detected, the A(H3N2) subtype and B/Victoria lineage were dominant in north-western Europe and Central Asia, respectively [26]. In Italy, from a virological point of view, the season was characterised by the predominant circulation of type A viruses (68%); 32% of viruses were of type B, and were isolated by InfluNet laboratories. Of the type A viruses, 54% belonged to the A(H3N2) subtype, 39% belonged to the A(H1N1) pdm09 subtype, and 7% were not subtyped [25]. In particular, the most frequently identified subtype was A(H1N1)pdm09 at the sites in Finland, France and Spain (range 71.7% to 91.3%), and A(H3N2) at the sites in Austria, Italy and Romania[28].
In Italy, influenza vaccination coverage in the 2019/2020 season was 54.6% in subjects aged over 65 years and 16.8% in the general population [29]. In Tuscany instead, influenza vaccination coverage in the 2019/2020 season was 54.6% in subjects aged over 65 years[29]. In support of the importance of vaccination coverage, our study shows that of the hospitalised patients only two were vaccinated, all the others who tested positive had not been vaccinated.
The WHO recommended that quadrivalent vaccines for the 2019/2020 season should contain: an A/Brisbane/02/2018 (H1N1)pdm09-like virus; an A/Kansas/14/2017 (H3N2)-like virus, and a B/Colorado/06/2017-like virus (B/Victoria/2/87 lineage) [30]. In the case of trivalent vaccines, the WHO recommended the insertion of the B/Washington/02/2019-like virus strain (lineage B/Victoria), in addition to the two types of A strain mentioned above.
During the 2019/2020 season, mismatch between the circulating A(H3N2) virus and the vaccine strain prompted the WHO to modify the composition of the vaccine for the 2020/2021 season [31, 32].
Following the first report of cases of acute respiratory syndrome in the Chinese municipality of Wuhan at the end of December 2019 [33], a pneumonia outbreak caused by human-to-human transmission of a new coronavirus rapidly spread, becoming a global pandemic [34]. In February 2020, the World Health Organization (WHO) named the novel coronavirus "SARS-CoV-2" and its associated spectrum of respiratory diseases "COVID-19" [35].
The signs and symptoms of SARS-CoV-2 infection overlap with those of many other viral respiratory tract infections, including those caused by influenza viruses. Beside "integrated COVID-19 surveillance", which is specifically designed to track COVID-19 disease and to assess its burden, influenza surveillance can provide timely, high-quality data that can help to evaluate the SARS-CoV2 burden among populations with mild respiratory symptoms [36, 37]. The COVID-19 outbreak impacted influenza surveillance; thus, the study period of the main analysis was truncated. Indeed, the pandemic and the subsequent lockdown measures curbed the already modest circulation of influenza and impacted data collection within DRIVE study sites [24]. Several DRIVE study sites implemented a different triage protocol in response to the SARS-CoV-2 emergency, whereby all SARI patients arriving at hospitals were first tested for SARS-CoV-2; if the

results were negative, tests were performed for other respiratory viruses, such as influenza. This new triage strategy was not expected to significantly reduce the number of influenza cases captured in the DRIVE dataset in 2019/2020, as very few cases of co-infection of influenza/SARS-CoV-2 were reported at the DRIVE sites that did test swabs for both viruses; this was due the minimal overlap between the influenza season and the emergence of the SARS-CoV-2 pandemic [24]. Moreover, during the pandemic, the implementation of strict public health measures (e.g. working from home, school closures, limiting social gatherings, increased hygiene measures, wearing masks etc.) to reduce SARS-CoV-2 transmission also reduced the circulation of other respiratory viruses. This was reflected by an all-time low level of influenza activity in the southern hemisphere and elsewhere in 2020 [38].

After consultation with the EMA and IMI in April 2020, the DRIVE consortium decided to take COVID-19 into account in its study documents (protocols, SAP, etc.) and operational procedures for the 2020/2021 season. Since then, DRIVE has closely tracked the evolution of the pandemic and has liaised with study sites in order to adapt rapidly to this ever-changing situation [24].

In the WHO European Region, unusually late and low-level influenza activity was predicted for the 2020/21 winter; these predictions were based on the low numbers of specimens testing positive for influenza virus that were detected in the summer months by sentinel and non-sentinel surveillance, despite substantial testing for influenza viruses during the COVID-19 pandemic [26,38]. Moreover, influenza surveillance can act as a global alert mechanism for the emergence of viruses with pandemic potential [1, 37].

The importance of influenza vaccination, especially for at-risk groups, remains a priority, as a higher influenza vaccination coverage rate in people aged 65 and over is associated with a reduced spread and a less severe clinical expression of COVID-19 [39]. The WHO recommends reconsidering the priority of risk groups for influenza vaccination during the COVID-19 pandemic for the following reasons: to ensure optimal influenza control among groups at high risk of severe COVID-19 disease and influenza; to reduce emergency room admissions and hospitalisations for influenza; and to ensure optimal management and use of potentially limited seasonal influenza vaccines worldwide [22, 39, 40].

Our study has some limitations. First, as the sample size was limited by the overall availability of swabs collected, it may not have been fully representative of the population. The hospital where the study was conducted is a 2nd level hospital with about 700 beds and the specific catchment area of the hospital has around 120,000 inhabitants as a reference for basic activities but only two departments participated in the study. In addition, many patients were not able to provide adequate answers regarding their medical history and vaccination status. In the future we will try to increase the sample by involving other units of the Le Scotte University Hospital in Siena.

Conclusions

Overall, our data support the importance of seasonal influenza vaccination in subjects with chronic diseases, in order to reduce hospitalisations and mortality, and highlight the key role of epidemiological and virological surveillance as an essential tool for monitoring circulating viruses, identifying possible mismatches with seasonal vaccine strains, and providing information that can be used to improve the composition of influenza vaccines.

The virological surveillance of influenza is important, in order to determine the timing and spread of influenza viruses, to track changes in circulating influenza viruses and to inform seasonal influenza vaccine composition. Seasonal vaccination is considered the most effective way to prevent influenza and its complications. During the COVID-19 pandemic, influenza vaccination is an essential supplement for people at risk.

Acknowledgements

The authors thank Patrick Bernard for the linguistic review.

Conflict of interest statement

The authors declare no conflict of interest.

Authors' contributions

E.C.: conceptualisation, writing original draft, data curation, formal analysis, supervision. E.M.: review and editing. A.C.: resources, review and editing. G.B.: resources, review and editing. P.L.C.: resources, review and editing. A.M.: resources, review and editing. N.N.: review and editing. I.M.: conceptualisation, investigation, writing-review and editing, supervision. All authors have read and agreed to the published version of the manuscript.

References

[1] World Health Organization. Influenza (seasonal). https://www.who.int/news-room/fact-sheets/detail/influenza-(seasonal). Accessed on 04/05/2021.

[2] Park J-E, Ryu Y. Transmissibility and severity of influenza virus by subtype. Infect Genet Evol 2018;65:288-92. https://doi.org/10.1016/j.meegid.2018.08.007

[3] Influenza Type A Viruses | Avian Influenza (Flu) 2020. Available at: https://www.cdc.gov/flu/avianflu/influenza-a-virus-subtypes.htm. Accessed on: 09/07/2021).

[4] Trombetta CM, Marchi S, Manini I, Kistner O, Li F, Piu P, et al. Influenza D Virus: Serological Evidence in the Italian Population from 2005 to 2017. Viruses 2019;12. https://doi.org/10.3390/v12010030

[5] CDC. Selecting Viruses for the Seasonal Flu Vaccine. Cent Dis Control Prev 2020. Available at: https://www.cdc.gov/flu/prevent/vaccine-selection.htm. Accessed on: 04/05/2021.

[6] Pozzi T, Zanda M, Quartesan E, Rossolini GM, Cvallucci F, Biagioli C, Bagnoli A, D'Errico A, Nante N. Influenza epidemiology in Sienna from 1 October 1986 to 31 May 1987. Giorn Ig Med Prev 1988;29:154-61.

[7] Nante N, Baldaccini P, Tiezzi G, Pieretti VM. Diffusion and effects of influenza vaccination in a aged population group in Tuscany (Italy). Giorn Ig Med Prev 1990;31:43-6.

[8] Fitzner J, Qasmieh S, Mounts AW, Alexander B, Besselaar T, Briand S, et al. Revision of clinical case definitions: influenza-like illness and severe acute respiratory infection. Bull World Health Organ 2018;96:122-8. https://doi.org/10.2471/BLT.17.194514

[9]World Health Organization. Global epidemiological surveillance standards for influenza. Available at: https://www.who.int/influenza/resources/documents/WHO_Epidemiological_Influenza_Surveillance_Standards_2014.pdf. Accessed on: 04/05/2021.

[10] Commissione delle Comunità Europee. Available at: https://www.seremi.it/sites/default/files/Definizione_Caso_TB_europea_2008.pdf. Accessed on: 04/05/2021.

[11] Salute M della. Monitoraggio delle forme gravi e complicate. Available at: http://www.salute.gov.it/portale/influenza/dettaglioContenutiInfluenza.jsp?lingua=italiano&id=4246&area=influenza&menu=vuoto. Accessed on: 04/05/2021.

[12] Salute M della. Sistema di sorveglianza InfluNet. Available at: http://www.salute.gov.it/portale/influenza/dettaglioContenutiInfluenza.jsp?lingua=italiano&id=704&area=influenza&menu=vuoto. Accessed on: 04/05/2021.

[13] EpiCentro. Influenza - situazione in Italia - FluNews Italia, rapporto della sorveglianza integrata dell'influenza. Available at: https://www.epicentro.iss.it/influenza/FluNews19-20. Accessed on: 04/05/2021.

[14] van Asten L, Luna Pinzon A, de Lange DW, de Jonge E, Dijkstra F, Marbus S, et al. Estimating severity of influenza epidemics from severe acute respiratory infections (SARI) in intensive care units. Crit Care Lond Engl 2018;22:351. https://doi.org/10.1186/s13054-018-2274-8

[15] van Asten L, Luna Pinzon A, van de Kassteele J, Donker G, de Lange DW, Dongelmans DA, et al. The association between influenza infections in primary care and intensive care admissions for severe acute respiratory infection (SARI): A modelling approach. Influenza Other Respir Viruses 2020;14:575-86. https://doi.org/10.1111/irv.12759

[16] Antonino B. Protocollo Operativo InfluNet: stagione 2019-20. Available at: https://www.salute.gov.it/imgs/C_17_pubblicazioni_2889_allegato.pdf. Accessed on: 04/05/2021.

[17] Ministero della Salute. Piano pandemico influenzale 2021-2023. Available at: http://www.salute.gov.it/portale/influenza/dettaglioContenutiInfluenza.jsp?lingua=italiano&id=722&area=influenza&menu=vuoto. Accessed on: 04/05/2021.

[18] Macias AE, McElhaney JE, Chaves SS, Nealon J, Nunes MC, Samson SI, et al. The disease burden of influenza beyond respiratory illness. Vaccine 2021;39(Suppl 1):A6-14. https://doi.org/10.1016/j.vaccine.2020.09.048

[19] Thompson WW, Shay DK, Weintraub E, Brammer L, Bridges CB, Cox NJ, et al. Influenza-associated hospitalizations in the United States. JAMA 2004;292:1333-40. https://doi.org/10.1001/jama.292.11.1333

[20] Chow EJ, Doyle JD, Uyeki TM. Influenza virus-related critical illness: prevention, diagnosis, treatment. Crit Care Lond Engl 2019;23:214. https://doi.org/10.1186/s13054-019-2491-9

[21] Caini S, Kroneman M, Wiegers T, El Guerche-Séblain C, Paget J. Clinical characteristics and severity of influenza infections by virus type, subtype, and lineage: A systematic literature review. Influenza Other Respir Viruses 2018;12:780-92. https://doi.org/10.1111/irv.12575

[22] Ministero della Salute. Prevenzione e controllo dell'influenza: raccomandazioni per la stagione 2021-2022. Available at: https://www.trovanorme.salute.gov.it/norme/renderNormsanPdf?anno=2021&codLeg=79647&parte=1%20&serie=null. Accessed on: 04/05/2021.

[23] Home - DRIVE. Available at: https://www.drive-eu.org/. Accessed on: 28/05/2021.

[24] Carmona A, Muñoz-Quiles C, Stuurman A, Descamps A, Mira-Iglesias A, Torcel-Pagnon L, et al. Challenges and Adaptation of a European Influenza Vaccine Effectiveness Study Platform in Response to the COVID-19 Emergence: Experience from the DRIVE Project. Int J Environ Res Public Health 2021;18. https://doi.org/10.3390/ijerph18031058

[25] EpiCentro. Influenza: un primo bilancio per la stagione 2019-2020. Available at: https://www.epicentro.iss.it/influenza/stagione-2019-2020-primo-bilancio. Accessed on: 04/05/2021.

[26] Rapporto influent. Available at: https://w3.iss.it/site/RMI/influnet/pagine/rapportoInflunet.aspx. Accessed on: 04/05/2021

[27] Influenza season 2019/2020: early situation assessment. Available at: https://www.ecdc.europa.eu/sites/default/files/documents/influenza-situation-assessment-18-December-2019.pdf. Accessed on: 04/05/2021.

[28] Stuurman AL, Biccler J, Carmona A, Descamps A, Díez-Domingo J, Muñoz Quiles C, et al. Brand-specific influenza vaccine effectiveness estimates during 2019/20 season in Europe - Results from the DRIVE EU study platform. Vaccine 2021;39:3964-73. https://doi.org/10.1016/j.vaccine.2021.05.059

[29] Salute M della. Influenza, coperture vaccinali stagione 2019-2020. Available at: http://www.salute.gov.it/portale/influenza/dettaglioNotizieInfluenza.jsp?menu=notizie&id=5048. Accessed on: 04/05/2021.

[30] May update Amended EU recommendation vaccine composition 2019-2020. Available at: https://www.ema.europa.eu/en/documents/regulatory-procedural-guideline/biologics-working-party-bwp-ad-hoc-influenza-working-group-amended-european-union-recommendations/2020_en.pdf. Accessed on: 04/05/2021.

[31] Rose A, Kissling E, Emborg H-D, Larrauri A, McMenamin J, Pozo F, et al. Interim 2019/20 influenza vaccine effectiveness: six European studies, September 2019 to January 2020. Euro Surveill Bull Eur Sur Mal Transm Eur Commun Dis Bull 2020;25. https://doi.org/10.2807/1560-7917.ES.2020.25.10.2000153

[32] BWP Ad hoc Influenza Working Group: Amended EU recommendations for the seasonal influenza vaccine composition for the season 2020/2021. Available at: https://www.ema.europa.eu/en/documents/regulatory-procedural-guideline/biologics-working-party-bwp-ad-hoc-influenza-working-group-amended-european-union-recommendations/2021_en.pdf. Accessed on: 04/05/2021.

[33] Zhou P, Yang X-L, Wang X-G, Hu B, Zhang L, Zhang W, et al. A pneumonia outbreak associated with a new coronavirus of probable bat origin. Nature 2020;579:270-3. https://doi.org/10.1038/s41586-020-2012-7

[34] Jin Y, Yang H, Ji W, Wu W, Chen S, Zhang W, et al. Virology, Epidemiology, Pathogenesis, and Control of COVID-19. Viruses 2020;12. https://doi.org/10.3390/v12040372

[35] Coronavirus disease (COVID-19): How is it transmitted? Available at: https://www.who.int/news-room/q-a-detail/coronavirus-disease-covid-19-how-is-it-transmitted. Accessed on: 04/05/2021.

[36] Strategies for the surveillance of COVID-19. Eur Cent Dis Prev Control 2020. Available at: https://www.ecdc.europa.eu/en/publications-data/strategies-surveillance-covid-19. Accessed on: 04/05/2021.

[37] Grosso F, Castrofino A, Del Castillo G, Galli C, Binda S, Pellegrinelli L, et al. A comparative study between the incidence and epidemiological features of Influenza-Like Illness and laboratory-confirmed COVID-19 cases in the Italian epicenter (Lombardy). J Infect Public Health 2021;14:674-80. https://doi.org/10.1016/j.jiph.2021.02.003

[38] Adlhoch C, Mook P, Lamb F, Ferland L, Melidou A, Amato-Gauci AJ, et al. Very little influenza in the WHO European Region during the 2020/21 season, weeks 40 2020 to 8 2021. Eurosurveillance 2021;26:2100221. https://doi.org/10.2807/1560-7917.ES.2021.26.11.2100221

[39] Amato M, Werba JP, Frigerio B, Coggi D, Sansaro D, Ravani A, et al. Relationship between Influenza Vaccination Coverage Rate and COVID-19 Outbreak: An Italian Ecological Study. Vaccines 2020;8. https://doi.org/10.3390/vaccines8030535

[40] WHO | Protecting lifesaving immunization services during COVID-19: New guidance from WHO. Available at: http://www.who.int/immunization/news_guidance_immunization_services_during_COVID-19/en/. Accessed on: 04/05/2021.

Received on August 17, 2021. Accepted on September 29, 2021.

Correspondence: Elena Capitani, Department of Molecular and Developmental Medicine, University of Siena, via Aldo Moro 2, 53100 Siena, Italy- Tel.: 0039-0577232280 - E-mail: capitani4@student.unisi.it

How to cite this article: Capitani E, Montomoli E, Camarri A, Bova G, Capecchi PL, Mercone A, Nante N, Manini I. Epidemiological and virological surveillance of Severe Acute Respiratory Infections in the 2019/2020 season in Siena, Tuscany, Italy. J Prev Med Hyg 2021;62:E782-E788. https://doi.org/10.15167/2421-4248/jpmh2021.62.3.2297

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J Prev Med Hyg 2021;62:E584-E495. https://doi.org/10.15167/2421-4248/jpmh2021.62.2.1865

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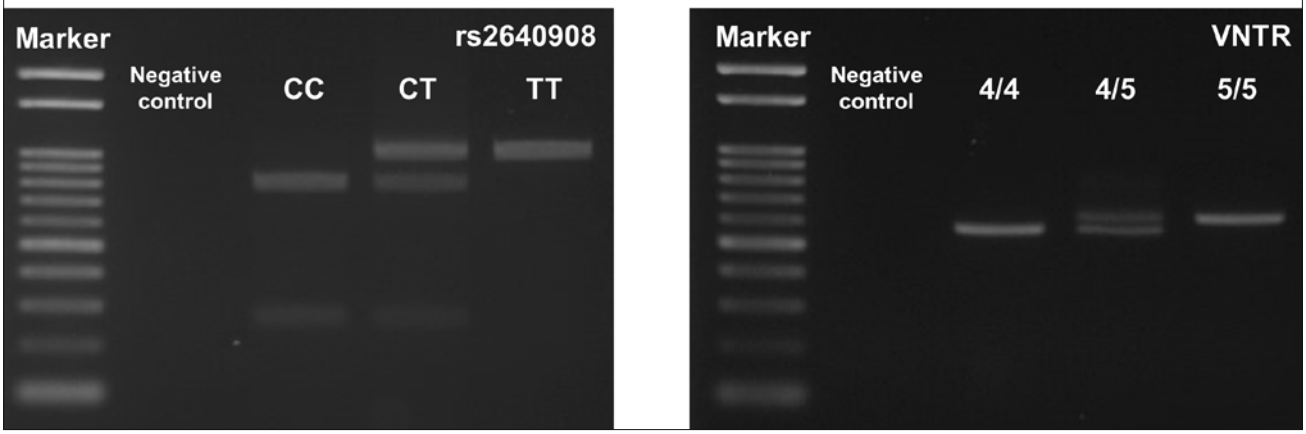
J Prev Med Hyg 2021;62:E789. https://doi.org/10.15167/2421-4248/jpmh2021.62.3.1865

Figure 1 has not been published for mistake

Fig. 1. The electrophoresis images of each genotypes among PER3 polymorphisms (rs2640908 and VNTR).



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J Prev Med Hyg 2021;62:E584-E573. https://doi.org/10.15167/2421-4248/jpmh2021.62.2.1734

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J Prev Med Hyg 2021;62:E790-E792. https://doi.org/10.15167/2421-4248/jpmh2021.62.3.1734

ERRATA

Bacterial lysates (OM-85 BV): a cost-effective proposal in order to contrast antibiotic resistance

GIANMARCO TROIANO[1], GABRIELE MESSINA[2], NICOLA NANTE[2]
[1] Post Graduate School of Public Health, University of Siena; [2] Department of molecular and developmental medicine, University of Siena; [3] Department of molecular and developmental medicine, University of Siena

CORRIGE

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Introduction

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Introduction

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Results

.....controls and outcomes is shown in Table I. .....

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Introduction

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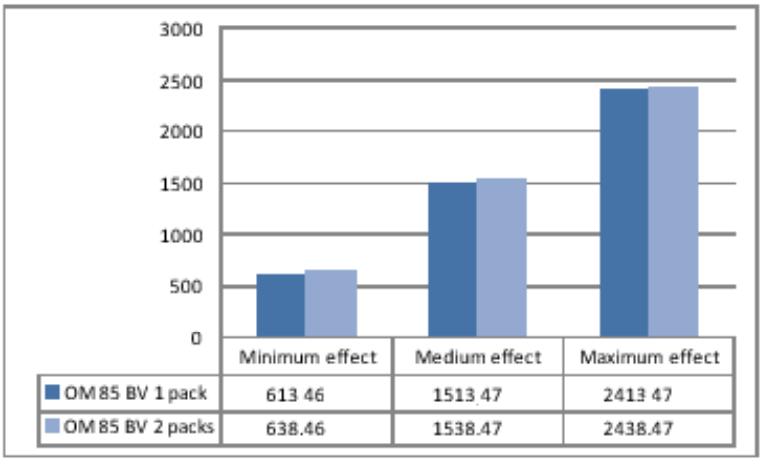
Fig. 7. Cost-effectiveness analysis: (**A**) savings, in Euros, on an exacerbation with Hospitalization, (**B**) CER.

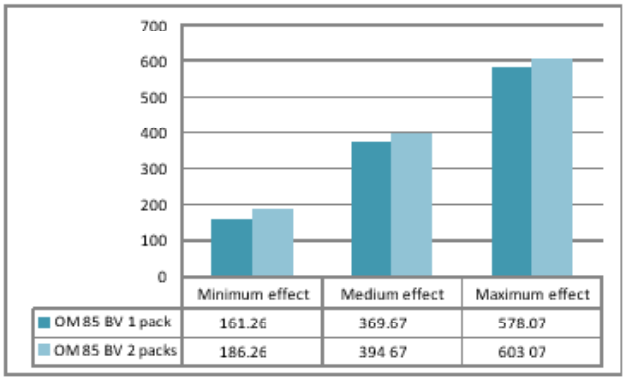
A



B

	Minimum effect	Medium effect	Maximum effect
OM-85 BV 1 pack	-1804.31	-1759.85	-1748.9
OM-85 BV 2 packs	**-1877.84**	**-1788.92**	**-1767.01**

Fig. 8. Cost-effectiveness analysis: (**A**) savings, in Euros, on an exacerbation without hospitalization, (**B**) CER



A

	Minimum effect	Medium effect	Maximum effect
OM-85 BV 1 pack	-474.309	-429.85	-418.896
OM-85 BV 2 packs	**-547.839**	**-458.92**	**-437.012**

B

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Discussion

.....The administered orally OM-85 BV (bacterial lysate .....

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Discussion

.....The orally administered OM-85 BV (bacterial lysate .....

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References

[1] Epicentro. Resistenze agli antibiotici. 2012 3/7/2017. Available from: http://www.epicentro.iss.it/focus/resistenza_antibiotici/resistenza.asp (accessed on: 25/08/2020).

[6] Rossi A. Antibiotici nel trattamento della broncopneumopatia cronica ostruttiva riacutizzata. 2005. Available from: https://www.progettoasco.it/riviste/rivista_simg/2005/02_2005/3.pdf (accessed on: 25/08/2020).

[30] Prontuario farmaceutico 2017. Available from: http://www.paginesanitarie.com/euromedia/farmaci.nsf/98ef2137c89e914cc12569f20053d193/ec5e57f24d013709c12576320051bc08!OpenDocument (accessed on: 25/08/2020).

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References

[1] Epicentro. Resistenze agli antibiotici. 2012 3/7/2017. Available from: http://www.epicentro.iss.it/focus/resistenza_antibiotici/resistenza.asp (accessed on: 14/11/2019).

[6] Rossi A. Antibiotici nel trattamento della broncopneumopatia cronica ostruttiva riacutizzata. 2005. Available from: https://www.simg.it/Riviste/rivista_simg/2005/02_2005/3.pdf (accessed on: 14/11/2019).

[30] Prontuario farmaceutico 2017. Available from: http://prontuariofarmaceutico.it (accessed on: 14/11/2019).


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