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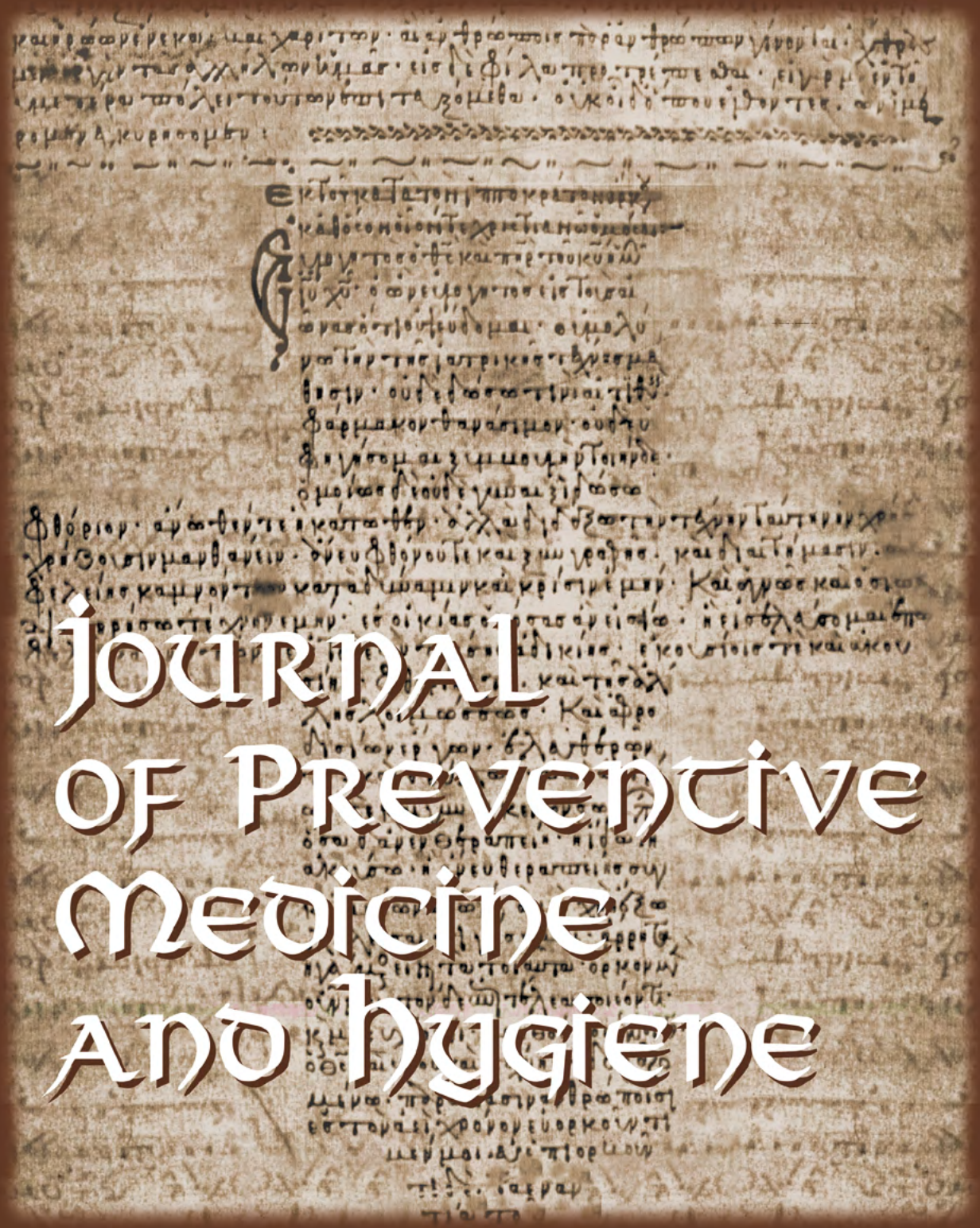

The original document of Hippocrates' oath

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Rationale of the WHO document on Risk Communication and Community Engagement (RCCE) readiness and response to the Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) and of the Italian Decalogue for Prevention Departments

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Keywords

SARS-CoV-2 • Risk communication • Community engagement

Dear Editor,
According to the interim guidance on Risk Communication and Community Engagement (RCCE) readiness and response to the Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2), published on 26th January 2020 by the World Health Organization (WHO), "One of the major lessons learned during public health events of the 21st Century – including outbreaks of Severe Acute Respiratory Syndrome (SARS), Middle East Respiratory Syndrome (MERS), influenza A (H1N1) and Ebola – is that RCCE is integral to the success of responses to health emergencies" [1].
At the end of January, the diffusion of the SARS-CoV-2 and the impact of the novel Coronavirus (COVID-19) were mainly limited to China, especially the Hubei Province, with 9,826 confirmed cases worldwide (9,720 of which in China) and 213 deaths [2]. In Italy, only three imported cases (a couple of Chinese tourists and a university researcher back from the Hubei Province) were laboratory confirmed, the patients being hospitalized at the "Lazzaro Spallanzani" Hospital in Rome [3].
The Working Group for Communication in Public Health of the Italian Society of Hygiene, Preventive Medicine and Public Health (S.It.I. - the main Italian Scientific Society for Public Health professionals, with over 2000 members) was created at the end of April 2019, one of its objectives being to conduct technical and scientific investigations into community engagement in public health [4].
For these reasons, the working group unanimously started the translation and adaptation to the Italian context of the WHO's "Risk communication and community engagement (RCCE) readiness and response to the Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2)" Interim Guidance v2 [1].
The process lasted around 7 days and the final version was shared on the principal website of the S.It.I. ("Igienisti Online") on 17th February 2020.
After an introductory section supporting the rationale of including risk communication and community engagement (RCCE) as part of a national public health emergency response, the document is divided into three main sections [5]:

a. an RCCE readiness checklist for countries preparing for a possible imported case of COVID-19 (i.e. no cases yet identified in the country);
b. an RCCE initial-response checklist for countries in which one or more COVID-19 cases have been identified (such as Italy at the time when the WHO document was published);
c. an RCCE crisis-and-control checklist for countries with ongoing COVID-19 transmission (such as China at the time when the WHO document was published).

Just one week after the publication on "Igienisti Online" of the translated WHO document, the Italian *scenario* changed (21st February 2020), when two main outbreaks of COVID-19 were identified and laboratory confirmed in two of the largest and most populous Northern Italian administrative Regions (Lombardia, and Veneto) [6].
Thus, according to the WHO's RCCE document, Italy passed from status "b" (one or more imported cases of COVID-19) to "c" (local ongoing COVID-19 transmission) [1, 5].
The WHO's RCCE document could constitute a useful tool for all Italian public health professionals working at universities, hospitals or the Prevention Departments of Local Health Units, in order to prepare, improve or modify the risk communication system of every organization involved in the management of the outbreak [1, 5]. Indeed, with regard to all the possible scenarios, the document describes the steps to be taken in order to ensure coordinated communication between internal actors and external partners, and the strategies for improving public communication and

community engagement and managing uncertainty, false perceptions and misinformation [1, 5].
Finally, during the coming weeks, the Working Group for Communication in Public Health will extrapolate the main messages from the WHO RCCE interim guidance, and publish a risk communication and community engagement "Decalogue" for public health professionals working in the Prevention Departments of the Italian Local Health Units.
The Decalogue will be organized as follows:

1. Proactive communication strategies.
2. Periodic and continually updated communication guidelines.
3. Adaptation of messages to all literacy levels.
4. Strategies to prevent a SARS-CoV-2 "infodemic" (excessive amount of information on SARS-CoV-2 and COVID-19, which makes it difficult to identify a solution).
5. Community engagement policies.
6. Actions for appropriate public communication of COVID-19 cases.
7. Strategies for rapid risk perception analysis among the general population.
8. Preparation of posters, flyers or news on institutional websites.
9. Actions for monitoring and responding to "fake news".
10. Periodic update of the risk communication plan for public health professionals.

In conclusion, we hope that the documents made available by the S.It.I Working Group for Communication in Public Health will help those health authorities that are currently facing the COVID-19 emergency to draw up adequate, standardized and evidence-based RCCE strategies. In this context, public health professionals must play a leading role in ensuring correct communication and strengthening community engagement.

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Conflict of interest statement

The authors declare no conflict of interest.

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Letter to the Editor

Knowledge of sexually transmitted infections and risky behaviors among undergraduate students in Tirana, Albania: comparison with Italian students

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Keywords

Students • Sexually transmitted infections • Sexual education

Dear Editor,

Reading the results of the survey on the knowledge of sexually transmitted infections (STIs) and risky behaviors among Sicilian high-school and university students recently published in your journal [1] prompted us to report our survey on this topic among a group of Albanian students. In a previous study, we analyzed the knowledge of STIs and risky behaviors among Italian adolescents by distributing a questionnaire to a sample of 2867 secondary school students in Genoa (northern Italy) and Lecce (southern Italy): we found a serious lack of knowledge of STIs and considerable exposure to risk factors for STI transmission, such as alcohol and recreational drug use [2]. We subsequently administered the same anonymous questionnaire to undergraduate students at a university in Tirana, Albania, with the aim of assessing knowledge of STIs and risky behaviors among young Albanians and comparing these with the Italian data. The questionnaire, which was written in Italian, comprised 39 questions divided into three sections concerning the social context, knowledge of STIs, and sexual behavior [2]. It was distributed by one of the authors (A.P.) in April 2016 to students attending the first year of the Nursing and of the Physiotherapy degree courses held in the Italian language at the Catholic University "Our Lady of Good Counsel", a private University in Tirana.

Seventy Albanian students (42 from the Nursing course and 28 from the Physiotherapy course completed the questionnaire: 49 females and 21 males). Their average age was 21.8 years (ranging from 18 to 29 years), which was slightly higher than that of the Sicilian students interviewed by Visalli et al. (most of whom were aged 17-19 years) [1] and the Italian students involved in our previous research (average age 17 years) [2].

Regarding the sources of information on STIs, unlike the Sicilian school students [1], but in line with our previous survey [2], the Albanian students obtained information mostly from teachers (49%) and parents (44%). Indeed, 77% of the Albanian students stated that they were sufficiently informed about STIs: sex education received at school was considered good or sufficient by 53%, and communication with parents excellent by 51.4% and good by 37.2%. Conversely, most of the Italian students complained about the lack of information on STIs provided by qualified staff [1, 2]. This difference may reflect the fact that in Albania education in "sexuality and life skills" has been mandatory for students aged 10-18 since 2015, despite opposition from certain segments of the Muslim population [3]. In Italy, by contrast, there are no laws regarding this subject, even though many proposals have been made over the last 30 years. Indeed, the headteacher of each school is in charge of the school's policy on sex education [4]. Another substantial difference between Albanian and Italian students regards communication with parents, probably because talking about sex in a family setting is considered a taboo in Italy, especially in the southern regions. However, several studies have demonstrated that parents have the potential to protect adolescents against sexual risks, including early sexual behavior, inconsistent condom use and outcomes such as pregnancy and STIs [5, 6].

Notably, Albanian students showed a better knowledge of STIs than their Italian counterparts: 20% of the Albanians recognized all the STIs in a list of diseases, versus only 0.5% of the students from Genoa and Lecce [2] and 7.9% of those from Messina, Sicily [1]. In line with other European and non-European studies, HIV/AIDS was the best-known STI among those listed [1, 2, 7-9]. Furthermore, most of the Albanian students (79%) reported knowing what a PAP test was, while awareness of HPV as an STI and of HPV vaccination proved poor in other European studies [1, 2 7]. The differences between the Albanian and the Italian students reflect the different national policies on sex education in the two countries and highlight the urgent need to introduce sex education as a proper subject in Italian schools. Nevertheless, knowledge of STIs remains unsatisfactory in Albania [10], as in other European countries where sex education programs are compulsory in schools. In Hungary, for instance, al-

though sex education for pupils aged 14 to 18 years was introduced in 1978, high-school students' knowledge of and attitudes towards STIs remain poor [11]. Moreover, in Germany, where sex education at school begins at the age of 9 years, a recent study involving 1771 secondary school students in Berlin documented suboptimal levels of knowledge of STIs other than HIV [7]. This widespread lack of awareness is particularly noteworthy if we consider that HPV and *Chlamydia trachomatis* are, respectively, the most frequent viral and bacterial STIs. They have a particularly high incidence among adolescents and young adults, and can cause infertility; HPV can also cause cancers of the mucosa and skin [12].

The percentage of Albanian students who currently used contraceptive methods (51%) was lower than that of the Italians (58% of the students interviewed by us [2] and 76.8% of those interviewed by Visalli G. et al. [1]). In the latter study, however, condom use was investigated specifically with regard to sexual intercourse with a casual partner [1], a risky behavior that seems common (45.5%) among Sicilian students [1], but which was not investigated in the Albanian study. Regarding other risk factors for the transmission of STIs, the Albanian students reported using alcohol (43%) and recreational drugs (21%) much less than their Italian counterparts [2]. Nevertheless, these percentages are not negligible and are a cause for concern, as both alcohol and recreational drugs reduce self-control and increase risky behaviors, such as unsafe sex and violence. In this regard, a recent study on adolescent drinking found that adolescents were more likely to start using alcohol and to experience intoxication at an earlier age when living in families in which alcohol was more readily available [13].

In conclusion, our study emphasizes the importance of sex education in improving young people's knowledge of STIs and behaviors. Sex education may have a lifelong, positive effect on the health and well-being of young people, and is an investment that is likely to pay off later in the form of reduced health-care and social-support costs. Indeed, those European countries that have a long tradition of sex education can boast the lowest teenage pregnancy rate in Europe (The Netherlands) and a very low prevalence of HIV infections (Sweden) [4].

We are aware that the Albanian population studied was smaller smaller and slightly older than the Italian groups used for comparison. However, having had the opportunity to administer to Albanian students the same questionnaires that had been completed by their Italian peers prompted us to compare these two populations.

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Conflict of interest statement

The authors declare no conflict of interest.

Authors' contributions

AP collected data, GC and FD wrote the article, AP, AH, LC, AR, FZ provided support and suggestions.

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Letter to Editor

The experience of Careggi Hospital (Florence) regarding Not Received Samples (NRS): a pilot study of Risk Management in the Clinical Laboratory

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Keywords

Laboratory • Risk management • Pre-analytical phase

Dear Editor,
In laboratory medicine, errors and their possible impact on patient safety have become an increasingly important problem [1, 2].
The so-called pre-analytical phase includes patient identification and sample identification, collection and transport to the laboratory, each of which is a potential source of error [2-6]. Indeed, the pre-analytical phase is not directly controllable by the laboratory, and involves many operators [1, 7, 8].
A typical error in the pre-analytical phase is the so-called "Not Received Sample" (NRS): i.e. following a computerized test request, the sample is not delivered to the laboratory. In Careggi Hospital (Florence) we decided to conduct a multi-step pilot study in order to: i) establish the magnitude of the phenomenon; ii) identify possible determinants.

Phase 1

From 9 to 15 April 2018 (Monday-Sunday) we used the laboratory management software in order to extract the data on NRS in that week. During the study period, 19,521 exam requests were made; 735 (3.7%) were NRS. Of these, 551 (74.9%) concerned the General Laboratory, 84 (11.4%) the Laboratory of Microbiology and Virology, and the remaining 13.6% other laboratories. The highest percentage of NRS was found on Sunday (9.9% of requests) and the lowest on Monday and Tuesday (3.7%).
The wards that generated the most NRS were the Emergency Room (37%), Short-Stay Observation - SSO (5%), and Cardiological Sub-intensive Care and Hospitalization (5%).
Of the NRS documented, 40% were requested in a situation of emergency, 25% in urgency, 35% routinely. The requests that displayed the highest frequency of NRS were for aspartate aminotransferase (AST) (13%), blood count (10%), urea (8%) and glucose (7%) tests. In the microbiological field, the most common NRS concerned stool culture examinations (3% of the total), followed by blood cultures.

Phase 2

A random survey was carried out in June 2018 (June 22, 26, 27). A doctor from the hospital's medical direction questioned the nursing coordinators (or nurses) that collected the samples in the morning (who usually stop working at about 1.00 p.m.) as to the possible causes of each NRS. These interviews were conducted around 12.00 noon, immediately after extraction of the daily NRS (requests for which were inserted between 7:00 a.m. and 9:00 a.m.) from the central database. All the wards that generated a significantly higher number of NRS (on the day considered) were included in the study (on average 4-5 wards per day, avoiding repeat interviews in the same ward, if possible).
In this phase, 159 NRS were identified; the personnel interviewed reported that the causes of NRS were: "sample regularly collected and sent" (53%), "sample not collected" (26%), "sample collected but not yet sent" (8%), and "other causes" (13%).

Phase 3

On 17-18 July 2018, 4 wards were randomly selected from among those that had generated the most NRS in phase 2. With the help of the nursing coordinators in these 4 wards, the outgoing samples (between 8:00 a.m. and 12:00 a.m.) and the samples that reached the laboratory were directly verified, and these data were compared with those from the laboratory management software. The choice to widen the time-window derived from the necessity to limit the number of samples sent in late (the so-called "samples collected but not yet sent"), which cannot strictly be considered real NRS (and which, in phase 2, accounted for almost 50% of the "other causes").
During phase 3, the number of samples collected and the number of samples that reached the laboratory were identical.
The first phase revealed that, in Careggi Hospital, NRS constituted around 4% of the requests made,

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and that their percentage increased on Saturday and Sunday. This is in line with what is reported in the literature; indeed, a study conducted in 2010 showed that medical and nursing errors (including laboratory errors) increased at night and during weekends [9]. The main factors involved in this kind of error are, we suppose, the reduced number of personnel (at night and at weekends), the patient load, sleep deprivation, and work stress [10].

The distribution of NRS in the wards is probably related to the type of request. Indeed, the rapid transfer of patients in critical conditions could mean that some samples are requested but not collected, as the patient has already been transferred to another ward (e.g. from the E.R. to the Intensive Care Unit, or to the operating room). This conviction is partially supported by the findings of Salvagno et al., in whose 2008 study most NRS were generated in intensive care units and in medical and clinical departments. However, it should be noted that, in their study, pre-analytical errors mainly involved pediatric wards; as Careggi Hospital has no pediatric wards, this comparison must be made with appropriate caution [11].

As for the type of analysis, stool culture requires particular attention, as sampling depends on the patient's ability to evacuate.

The second phase of our study allowed us to document the opinions of health workers, especially nurses. According to their answers, the problem of NRS is due to the loss of samples on the way to the laboratory. According to the authors, however, it is more probable that samples are not collected because they are considered unnecessary; this hypothesis is supported by the fact that the other laboratory exams were regularly performed in every case and the results were sent to the wards. Moreover, the health personnel affirmed that the second most frequent cause of NRS was that samples were not collected for various reasons, denoting a probable problem of incorrect/useless exam requests.

We tried to clarify these doubts in Phase 3, from which it emerged that "sample loss" was a relatively rare event.

The three points of observation (those of the laboratory, health workers and medical direction) constitute the main strength of this study, as they provided a complete overview of the phenomenon of NRS. Admittedly, the methodology used (especially in phase 2) was a weak point, as it was based only on the memory of the personnel interviewed; however, this approach was unavoidable, given the lack of an electronic system (with barcodes) for tracing the single steps (collection, storage, transport, arrival at the laboratory).

Although the "sample loss" is a relatively infrequent event, our study highlighted an economic problem, i.e. the need to manually update the database daily in order to distinguish between "lost sample" and "wrong request". We would like to extend our study to a larger sample and we encourage other colleagues to use this multiple approach in order to investigate the phenomenon of NRS in their own environments. Finally, sensitizing health workers to this problem may result in more careful and appropriate exam requests.

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Authors' contributions

GT, AF had the idea of the study, wrote the article; CD, GP contributed to data collection; NN, GMR, PP, PB, BP, MLR, TT, FN helped to conceptualize the ideas.

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ORIGINAL ARTICLE

Comparison of knowledge, attitudes and hand hygiene behavioral intention in medical and nursing students

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Keywords

Hand hygiene • Healthcare occupations students • Training

Summary

Introduction. *Hand hygiene is crucial to prevent cross infection. Healthcare students are in a prime position to learn hand hygiene skills. The aim of this study was to analyze hand hygiene behavioral intentions of healthcare students before and after contact with the patient and to compare the knowledge of and attitude towards hand hygiene between medical and nursing students.*

Methods. *In a descriptive survey research design, convenience selection of a sample of medical students (n=657) and nursing students (n=303) was done from modules taught by the Department of Preventive Medicine and Public Health in both Medicine and Nursing undergraduate degrees in four Spanish universities. The hand hygiene Questionnaire, a validated instrument to evaluate behavior, knowledge, and attitudes, was used.*

Results. *A significantly lower percentage of students reported always or almost always carrying out hand hygiene before contact with the patient or invasive procedures in comparison to the percentage complying after contact with secretions or with the patient. Although hand hygiene knowledge appears acceptable, its importance is not sufficiently valued.*

Conclusions. *There are deficiencies in behavioral intention, knowledge, and attitudes related to hand hygiene in medical and nursing students. Better results are observed among nursing students, especially those who have received specific training.*

Introduction

Hand hygiene (HH) is one of the most important measures to prevent the transmission of infectious diseases [1]. It is a key mechanism for controlling hospital infection [2, 3], one of the most common healthcare-related adverse effects [4, 5]. The WHO launched a program against healthcare-associated infection called "*Save lives: clean your hands"* with the slogan "*Clean care is safe care*" [6, 7]. This initiative led to considerable action worldwide to implement the WHO Multimodal Hand Hygiene Improvement Strategy, which includes: the ready availability of sinks and alcohol-based hand rub dispensers; the display of HH reminders in the workplace; increased training and education of healthcare professionals on this issue; evaluation and feedback on their knowledge, attitudes, and practices; and the promotion of an institutional climate of safety [7-12]. Despite these efforts, subsequent studies generally found that the average compliance of healthcare professionals with these guidelines is less than 50 per cent [13-19]. Health workers have expressed some resistance to any change of previously learned behaviors [20], and interventional studies have also generally demonstrated a limited efficacy [13, 21]. The formation of future professionals is therefore of major importance [22], but it has been reported that medical students are not acquiring the knowledge and understanding of HH required by physicians to prevent nosocomial infections [23-26]. Various approaches have proven effective to improve knowledge, attitudes, and practices in the development of healthcare professionals [15, 27, 28]. It has been suggested that students can act as role models for healthcare professionals by complying with HH protocols [3, 29].

The objectives of this study in a sample of medical and nursing students from four Spanish universities were: to analyze their HH behavioral intention before and after contact with the patient; to compare the knowledge of and attitude towards HH between medical and nursing students; and to explore differences between the universities.

Materials and methods

Design

An observational, cross-sectional, and multicenter study was conducted in students enrolled in second- or third-year Public Health modules at the Schools of Medi-

cine and Nursing of four universities (Universities of Granada, Valladolid, La Laguna, and Oviedo) during the academic year 2011-12. These centers were chosen for convenience sampling to ensure a broad geographical distribution.

Procedure

Questionnaires were administered to the students by a researcher during a normal class. The researcher gave a formal presentation of the general aim of the study and the department responsible and then read the questionnaire instructions. The questionnaire took 12 - 18 minutes to complete. The researcher did not respond to any queries from the students, who were asked to write any suggestions at the end of the questionnaire. A convenience sample of 960 students agreed to complete the questionnaire.

Instrument

The questionnaire gathered sociodemographic data and recorded whether the student had or had not received formal education/training on HH. It incorporated the WHO Hand Hygiene Questionnaire, which has demonstrated adequate validity and reliability to measure behavioral intentions (before and after contact with the patient), knowledge, and attitudes [30]. It contains 50 items measuring 4 dimensions related to HH: behavioral intention before and after patient care, HH knowledge, and attitudes. The first dimension contains 34 items, and the second and third dimensions contain 8 items each. Responses to items are recorded on a Likert scale from 0 = "completely disagree" or "never" to 6 = "completely agree" or "always".

Ethical considerations

Participants were informed of the purpose of the study, their freedom to volunteer, and the absence of negative consequences for non-participants. The act of filling out the questionnaire and returning it to key personnel was considered to imply consent to study participation. Data collection was conducted after the examination period, ruling out any possible influence on grades.

Data analysis

SPSS version 16.0 was used for the statistical analyses. Means with standard deviation (SD) and frequencies were calculated, and the normality of data distribution and the homoscedasticity of variance were tested with Levene's test. Comparisons were performed using the Student's t-test for independent samples or Analysis of Variance (ANOVA) with *post-hoc* Bonferroni's correction for multiple comparisons (assuming equal variances). $P < 0.05$ was considered significant.

Results

The study included 960 participants, 657 (68.4%) medical students and 303 (31.6%) nursing students. Their mean (SD) age was 21.91 (3.15) years, ranging from 18 to 46 years; 731 participants were female (76.1%); 431 students (44.9%) were from the University of Granada, 98 (10.2%) from the University of Valladolid, 328 (34.2%) from the University of La Laguna, and 103 (10.7%) from the University of Oviedo.

Table I shows some examples of the responses on HH behavior intention for some of the Five Moments for Hand Hygiene according to the WHO. A significantly

Tab. I. Declarative intention of hand hygiene behavior for some examples of the 5 moments for hand hygiene by WHO (N = 960).

Percentages of response to the question "how often would you wash your hands before or after ...?	Never or very rarely (response 0-1)	Sometimes (response 2-4)	Quite often or always (response 5-6)
Before patient contact			
Placing cables for cardiac monitoring	21.7	47.6	30.7
Mobilizing a patient	15.8	47.5	36.7
Measuring blood pressure	33.5	52.7	13.8
Before invasive procedures			
Administering medication using a three-way stopcock	7.4	38.3	54.3
Cannulating	0.9	10.4	88.7
After contact with secretions			
Assisting bronchial mucus aspiration	0.9	13.2	85.9
Intramuscular injection of medication	3.2	24.8	72.0
After patient contact			
Connecting parenteral nutrition	4.8	29.2	66.0
Patient hygiene	1.0	10.9	88.1
Adjusting glasses or oxygen mask	13.2	45.7	41.1
After contact with patient surroundings			
Adjusting the perfusion rate	33.8	45.6	20.6
Raising the bed of the patient	39.6	39.2	21.2

lower percentage of students reported always or almost always carrying out HH before contact with the patient, before invasive procedures, and after contact with the environment in comparison to the percentage complying with good HH practices after contact with secretions or the patient.

Table II gives the results for HH knowledge, which can be considered acceptable, with more than 65% of participants responding correctly to the items "hand hygiene is unnecessary when gloves are worn" and "rubbing hands with alcohol-based handrub before patient contact reduces the risk of infection transmission". The mean (standard deviation) score for knowledge was 4.59 (0.72) out of six, with only 4.69% of respondents scoring 3 or less and 80% scoring above 4 points.

Table II also summarizes the scores for attitudes toward HH, with 44% of respondents agreeing that peer pressure would improve their behavior. The results suggest that the importance of HH is not sufficiently valued, with over 50% agreeing that they would wash their hands more often if it really was so important. Only 28.1% completely or highly agreed that they would improve their HH practice if asked about their compliance by patients or their families.

The comparative results in Table III show that higher mean scores were obtained in all four dimensions by the nursing students in comparison to the medical students ($p < 0.001$). Mean scores were also higher ($p < 0.001$) in students who had received previous education/training in HH in comparison to those who had not (Tab. IV).

Tab. II. Some examples of responses to items on knowledge and attitudes in relation to hand hygiene (Percentage response to the question "Express your level of agreement with each of the following statements ...") (n = 960).

	Completely or highly disagree (response 0-1)	Somewhat agree (response 2-4)	Completely or highly agree (response 5-6)
Declarative knowledge			
Hand hygiene is unnecessary when gloves are worn	71.7	20.3	6.6
Hand hygiene is unnecessary after touching the vital signs monitor	23.4	62.4	14.2
Rubbing hands with alcohol-based handrub before patient contact reduces the risk of infection transmission	4.0	30.0	66.0
Attitudes			
I would wash my hands more often if the nurses and / or healthcare professionals did so when we start an activity	28.2	30.7	41.1
I would wash my hands more often if my colleagues called me out for not doing so	24.7	31.3	44.0
I would wash my hands more often if it really was so important	23.8	23.6	52.6
Patients and / or their companions should ask me if I've washed my hands before performing any activity	33.4	38.5	28.1

Tab. III. Comparison between medical and nursing students in dimensions of hand hygiene behavioral intention before/after patient contact, knowledge, and attitudes.

	Medicine (N = 657)		Nursing (N = 303)		T	p value
	Mean	Standard deviation	Mean	Standard deviation		
Mean of the dimension formed by items on **behavior intention before** patient contact	3.79	0.85	4.07	0.97	-4.53	< 0.001
Mean of the dimension formed by items on **behavior intention after** patient contact	4.00	0.90	4.38	0.94	-5.96	< 0.001
Mean of the dimension formed by items on **knowledge** of hand hygiene	4.49	0.71	4.78	0.69	-5.91	< 0.001
Mean of the dimension formed by items on **attitude** towards hand hygiene	2.66	0.46	3.24	0.98	-8.65	< 0.001

Tab. IV. Comparison between students who reported previous specific training in hand hygiene and those did not in dimensions of behavior intention before/after patient contact, knowledge, and attitudes.

	With training (n = 712)		Without training (n = 247)			
	Mean	Standard deviation	Mean	Standard deviation	T-student	p value
Mean of the dimension formed by items on behavior intention before patient contact	4.00	0.89	3.64	0.86	5.17	< 0.001
Mean of the dimension formed by the items on behavior intention after patient contact	4.24	0.92	3.88	0.92	4.63	< 0.001
Mean of the dimension formed by items on knowledge of hand hygiene	4.65	0.71	4.40	0.70	4.65	< 0.001
Mean of the dimension formed by items on attitude towards hand hygiene	2.90	0.99	2.68	0.86	3.01	< 0.005

Table V shows the results of comparing the data among the universities. For HH behavioral intention before patient contact, scores were significantly higher for students in universities 1 and 3 *versus* universities 2 and 4. For HH behavioral intention after patient contact, scores were significantly higher for students in university 4 versus university 1. For knowledge and attitudes, scores were significantly lower for students from university 1 *versus* university 4 for knowledge and *versus* university 3 for attitudes.

Discussion

In this study, medical and nursing students revealed poor compliance with correct HH behavioral intention for each of the five moments specified in WHO guidelines, especially in regard to HH behavior before contact with patients, before invasive procedures, and after contact with the patient's surroundings, when less than half of the students reported washing their hands always or almost always. Their responses to the questionnaire reveal a greater concern for HH after than before contact with patients, in line with direct observations of the behavior of healthcare professionals [25, 31-34]. This finding suggests that the principles learned by students are largely directed at self-protection rather than patient protection, as also reported in healthcare professionals [16, 17, 35, 36].

Knowledge of HH principles appears to be generally good, although an intermediate or ambiguous score (of 2-4) was given for many items that should have received a more robust response, indicating that basic knowledge has not been properly assimilated by many of the participants, as observed by other researchers [23, 37-43]. One widely held mistaken belief is that HH is unnecessary when gloves are used. Weaknesses in the knowledge of participants were also detected in relation to intended HH behavior. Thus, low scores were obtained for the administration of medication using a three-way stopcock, suggesting that this intervention is not considered an invasive procedure. These deficits in knowledge support the need for improvements in HH training in medical and nursing degree courses, as advocated by the WHO [23, 42-44].

The results obtained for attitudes were less conclusive, and no specific trends were observed. However, the responses indicate that a significant percentage of subjects react favorably to behavioral interventions based on external reinforcement and suggest that reference figures may be important for the implementation of correct HH behavior. This is an extremely important factor, because interventions conducted in collaboration with the students can shape positive behaviors and avoid erroneous habits that are later very difficult to change.

Major differences in behavior, knowledge, and attitudes were observed between the medical and nursing students. The nursing students obtained higher scores for the two dimensions of behavior, displayed greater knowledge of HH and, perhaps most importantly, a better attitude. This is consistent with findings by observational studies that compliance rates are worse for medical than nursing staff [23, 42, 43, 45], and it underscores the need for an emphasis on the importance of HH and related indications and techniques in the curriculum of medical students. A higher mean score was obtained for all dimensions from students reporting a previous specific training on HH in medical or nursing programs, although this result should be treated with caution due to possible recall bias.

Significant differences in all dimensions were observed among students from the different universities, with a lesser divergence in knowledge. The training of students on HH is heterogeneous among universities and highly influenced by the units used for clinical placements. Other studies highlighted the need for common guidelines across centers/departments, especially in relation to HH indications, procedures, and skills in healthcare professionals [35, 46, 47].

The study population is a convenience sample and cannot be considered representative, although the universities selected are widely distributed in the North, Center and South of Spain and in the Canary Islands.

In conclusion, there are deficiencies in behavioral intention, knowledge, and attitudes related to hand hygiene in medical and nursing students. Better results are ob-

served among nursing students, especially those who have received specific training in HH, suggesting that current weaknesses can be overcome by appropriate training strategies, which should be a priority issue.

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Conflict of interest statement

The authors declare no conflict of interest.

Authors' contributions

JC-M and AB-C are responsible for the design of the study. They analyzed the data and wrote the paper. MF-P and JG-C designed and validated the questionnaire. CR-L, AA-G, AL-P and AB-C dealt with the collection of information respectively in the medical and nursing faculties of the universities of La Laguna, Valladolid, Oviedo and Granada.
All authors reviewed and approved the final version of the manuscript.

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Original article

Nursing knowledge, attitude, and practice to influenza vaccination at suburban hospital in West Java, Indonesia

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Keywords

Attitude • Influenza vaccination • Knowledge • Nurses • Practice

Summary

Background. *High epidemiology of influenza in the world and Indonesia causes some groups to have high risk for getting infected with influenza, one of which is healthcare workers. The low rates of influenza vaccination among healthcare workers, especially in nurses, raise the need for an educational strategy to prevent influenza. This study aimed to measure the level of knowledge, attitude and practice among nurses in suburban hospital in West Java.*
Method. *This was a cross-sectional study with a random sampling method which started on July-August 2018 at Annisa Medical Center General Hospital. Knowledge, attitude, and practice of research subjects were measured using questionnaire containing 37 items. The questionnaire was the result of adaptation of several questionnaires and a validity test has been was conducted. The data obtained was then analyzed descriptively by the proportion of the score of knowledge, attitude, and practice.*
Results. *Of 104 respondents, 19% respondents had a low level, 74% respondents had a moderate level and 7% had a high level of knowledge toward influenza vaccination. For attitude, 67% of the respondents had a positive attitude and 33% respondents had a negative attitude. The study also showed that 58% of the respondents had a positive practice and 42% respondents had negative attitude.*
Conclusions. *Nurses possess adequate knowledge and showed a positive attitude and practice toward influenza vaccination. A continous educational strategy was needed to improve nurses' knowledge, attitude and practice about influenza vaccination.*

Introduction

The influenza virus is one of the main contributors to the increased morbidity and mortality due to respiratory disorders [1]. The World Health Organization (WHO) stated that there are 3-5 million cases of influenza in the world every year [2]. The data in Indonesia shows that from > 10 samples with respiratory diseases examined, 30% were influenza positive [3]. The groups with a high risk of influenza includes pregnant women, children under 5 years old, people with chronic diseases, and health professionals [1, 4].
A study conducted by Kuster et al. [5] in Toronto Ontario, Canada on the incidence of influenza in healthy adults and health professionals suggested that health professionals are exposed to a higher risk of influenza compared to non-health professionals. It is indicated by the fact that approximately 50% of health facilities experience influenza outbreaks every year. Health professionals may transmit back the influenza virus to their patients, thus leading to the increased rate of nosocomial infections in hospitals.
The incidence of influenza among health professionals should be prevented by administrating the influenza vaccine. Some studies suggest that vaccination for health professionals can reduce patient mortality rate up to 55% [6]. A study conducted by Loulergue [7] in Paris, France, concerning vaccination related to health professions stated that the coverage of the influenza vaccine administration in health professionals is still low. Health professionals who work in suburban and rural areas have lower vaccination rates compared to those who live in urban area [8]. Nurses have the lowest vaccination rates among other health professionals, although they are the ones who spend most time in contact with patients [9].
The low rate of vaccine administration in health professionals, especially nurses is due to several factors. A research conducted by James et al. [10] in Sierra Leone from February to April 2016 on the knowledge and attitude of health professionals related to the influenza vaccine suggested that influenza vaccination coverage is highly correlated with knowledge about influenza and influenza vaccine. Some nurses are still afraid of the side effects resulting from the administration of influenza vaccine, and unaware of the importance of vaccination [11].
The high risk of health professionals exposed to influenza and the low rate of influenza vaccination, especially in nurses, has led to the need for educational strategies for the prevention of influenza. The study of knowledge, attitudes, and practices are the most commonly researched

to develop educational strategies in the disease prevention stage [12]. The research of knowledge, attitudes, and practices (KAP) in a population can describe what has been known, believed, and done related to particular topic [13]. From here, the level of knowledge, attitudes, and practices of a population can be identified, which are useful in developing programs for the control, education, and prevention of a disease [14].
Data on the level of knowledge, attitudes, and practices is important in the treatment and prevention of a disease [12]. No research has been conducted so far on nurses in Indonesia about their level of knowledge, attitudes, and practices regarding influenza vaccine. So, this study aimed to identify the level of knowledge, attitude and practice of nurses in our setting associated with influenza vaccine.

Methods

This study was conducted between July-August 2018 at the *Annisa Medical Center* (AMC) General Hospital using a descriptive cross-sectional study design. The subjects of the study were all nurses working at the AMC General Hospital, Cileunyi, Bandung. Nurses who were unwilling or refused to sign the informed consent were excluded. Samples were taken by simple random sampling method using a random figure table. The minimum sample number required in this study was 97, determined on the basis of the categorical descriptive formula of the study.
The data in the present study were obtained from the responses given to the 37 items of the questionnaire. The questionnaire was adapted from several questionnaires and was subject to the validation test process. The questionnaire consists of items about the characteristics of the respondents and questions about knowledge, attitudes, and practices of nurses regarding influenza vaccine. The knowledge questions consisted of 19 items about the definition, epidemiology, etiology, risk factors, classification, transmission, clinical manifestations, treatment, and prevention of influenza as well as the objectives, benefits, recommendation-giving, contraindications, and influenza vaccination schedule. Questions on attitude consisted of 10 items, and the questions on the practice consisted of 8 items, both in the form of Likert scale. Five point Likert scale was used to assess attitude (5 = Strongly agree, 4 = agree, 3 = neutral, 2= disagree, 1 = strongly disagree for positive attitudes statements, while 5 = strongly disagree, 4 = disagree, 3 = neutral, 2 = agree, 1 = strongly agree for negative attitudes statements) and practice (5 = very frequently, 4 = frequently, 3 = occasionally, 2 = rarely, 1 = never for positive practices statements, while 5 = never, 4 = rarely, 3 = occasionally, 2 = frequently, 1 = very frequently for negative practices statements) related to influenza vaccination.
The validity and reliability test of the questionnaire was conducted between June-July 2018 and repeated twice. The first validity and reliability test of the questionnaire was carried out in clinics and health centers in Jatinangor on 20 subjects in accordance with the inclusion and exclusion criteria, while the second test was carried out in a private hospital in Jakarta on 35 subjects in accordance with the inclusion and exclusion criteria.
There were 26 questions on knowledge, 9 questions on attitudes and 8 questions on practices, which then became 31 questions on knowledge, 10 questions on attitudes, and 8 questions on practices after passing the first validity and reliability test phase. These questions were then reduced to 19 questions on knowledge, 10 questions on attitudes, and 8 questions on practices after going through the second validity and reliability test phase. The reliability test used α-Cronbach value, namely a reliability coefficient to see the consistency of a variable. In this study, $\alpha = 0621$ was for knowledge and $\alpha = 0778$ for attitudes and practices. Valid questionnaires were then given to the head nurse at the AMC General Hospital for distribution in accordance with the names of the nurses listed in the table of random numbers that had been given.
The data obtained were then analyzed descriptively according to the proportion of the scores obtained for knowledge, attitude, and practice. The scores of knowledge, attitudes, and practices obtained were then categorized. The level of knowledge was categorized as good, fair, and poor. It was included in a good category if > 75%, fair if 50-75%, and poor if < 50%. The attitude of the respondents was categorized as positive (percentage ≥ median) and negative (percentage < median). The practice of the respondents was categorized as positive (percentage ≥ median) or as negative (percentage < median).

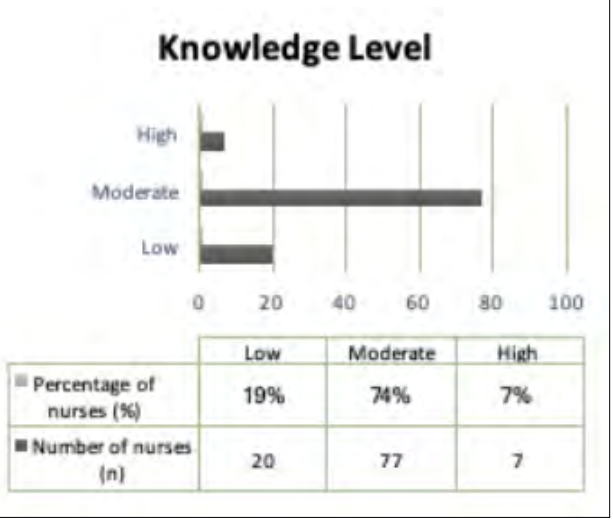
Results

In our setting, there were 104 nurses, who fully completed the questionnaires and all agreed to provide their informed consent. Of the 104 respondents, 64.4% (37) were females, and 35.6% (67) were males; 69 (66.3%) respondents were aged between 20-29 years, 31 (29.8%) 30-39 years, 3 (2.9%) 40-49 years, and 1 (1.0%) respondent was aged between 60-69 years. By education, 96 respondents (92.3%) held a D3 diploma, and by working hours, 76 respondents (73.1%) worked for a duration of ≤ 8 hours. Of the 104 respondents, 86 (82.7%) respondents had served for ≤ 9 years (Tab. I).
The responses to the knowledge questions instrument were about influenza vaccine (Tab. II). With regard to the question about knowledge, the majority of the respondents answered incorrectly to the following items: to item 8, 99 respondents (95.2%) gave the wrong answer; to item 16, 97 respondents (93.3%) gave the wrong answer; to items 17 and 19, respectively 76 and 75 respondents (73.1% and 72.1%) gave the wrong answer.
The respondents' knowledge about influenza vaccine showed that 20 respondents (19%) had a poor level of knowledge, 77 respondents (74%) had a fair level of knowledge, and only 7 respondents (7%) had a good level of knowledge (Fig. 1).

Tab. I. Characteristics of respondents.

Characteristics	Number (n)	Percentage (%)
Gender		
Male	37	35.6
Female	67	64.4
Age (years)		
20-29	69	66.3
30-39	31	29.8
40-49	3	2.9
50-59	0	0.0
60-69	1	1.0
Education		
D3 Nursing	96	92.3
S1 Nursing	8	7.7
Service term		
≤ 9 years	86	82.7
10-29 years	18	17.3
Total	104	100

Fig. 1. Distribution of subject by knowledge level.

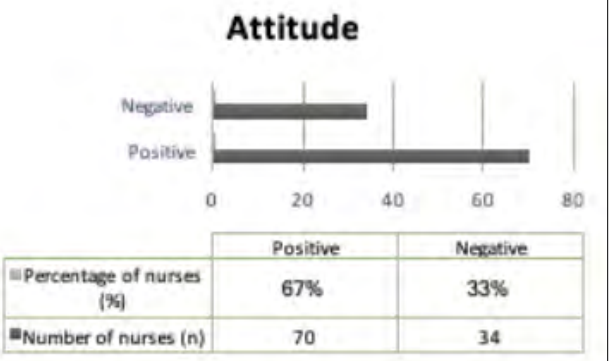


With regard to the questions regarding attitude towards the influenza vaccine (Tab. III), 31 respondents (29.8%) and 66 respondents (63.5%) respectively answered strongly agree and agree on item 6 about influenza vaccines.

The distribution of subjects according to the results of attitudes scores (Fig. 2), in showed that the median value of the questions on attitudes was 37 (range between 30 and 48). The results showed that 70 respondents (67%) had a positive attitude and 34 (33%) a negative attitude.

With regard to the practice, questions instrument about influenza and the influenza vaccine (Tab. IV), 94 respondents (90.4%) answered never to item 6 regarding

Fig. 2. Distribution of subject by attitude.



Tab. II. Responses to knowledge question instrument on influenza vaccine.

No.		True	False
		(n, %)	(n, %)
1.	The pathogen that causes influenza is divided into three types: A, B, and C.	99, 95.2	5, 4.8
2.	Influenza is a respiratory disease that attacks the upper and/or lower respiratory tract	85, 91.7	19, 18.3
3.	Influenza is an acute respiratory infection	94, 90.4	10 9.6
4.	Nurses have a small chance of of transmitting influenza to patients.	53, 51.0	51, 49.0
5.	Influenza virus can be spread through contact with hands or surfaces of people who have influenza	81, 77.9	23, 22.1
6.	Influenza vaccine can prevent influenza disease	101, 97.1	3, 2.9
7.	Mortality due to influenza globally is low	32, 30.8	72, 69.2
8.	Children, adults, and the elderly have the same risk of influenza infection	5, 4.8	99, 95.2
9.	Influenza vaccination in pregnant women can protect babies from the flu at birth	46, 44.2	58, 55.8
10.	The influenza virus can cause severe disease	88, 84.6	16, 15.4
11.	Severe influenza requires care in the Intensive Care Unit (ICU)	51, 49.0	53, 51.0
12.	Influenza vaccine for health professionals (nurses) is provided in the Regulatory of Minister of Health	89, 85.6	15, 14.4
13.	Influenza vaccine is safe to be given to people aged ≥ 65 years	67, 64.4	37, 35.6
14.	Influenza vaccination can save medical costs	79, 76.0	25, 24.0
15.	World Health Organization (WHO) gives recommendations for influenza vaccination of health professionals (nurses)	91, 87.5	13, 12.5
16.	Influenza is caused by infection with Haemophilus influenza	7, 6.7	97, 93.3
17.	A history of allergy to influenza vaccine is an indication of the next influenza vaccination.	28, 26.9	76, 73.1
18.	Adults can be infected with the influenza virus that usually affects animals	73, 70.2	31, 29.8
19.	Influenza vaccination in healthy adults should be done twice a year	29, 27.9	75, 72.1

Tab. III. Responses to attitude questions instrument on influenza vaccine.

No.		SA	A	N	D	SD
		(n, %)	(n, %)	(n, %)	(n, %)	(n, %)
1.	As a health professional, I am susceptible to influenza	42, 40.4	30, 28.8	26, 25.0	6, 5.8	0, 0.0
2.	I work in an environment that can increase the risk of influenza disease	38, 36.5	35, 33.7	26, 25.0	5, 4.8	0, 0.0
3.	In my opinion, influenza is not contagious disease	6 5.8	11, 10.6	5, 4.8	65, 62.5	17, 16.3
4.	I cannot transmit influenza virus to a patient, and vice versa	2, 1.9	10 9.6	11, 10.6	63, 60.6	18, 17.3
5.	In my opinion, influenza is not a dangerous disease	5, 4.8	23, 22.1	15, 14.4	50, 48.1	11, 10.6
6.	Influenza vaccine can protect me from being exposed to influenza	31, 29.8	66, 63.5	7 6.7	0, 0.0	0, 0.0
7.	In my opinion, the influenza vaccine can save medical costs	17, 16.3	57, 54.8	13, 12.5	16, 15.4	1, 1,0
8.	I'm afraid if there are side effects that arise after influenza vaccination	8 7.7	30, 28.8	25, 24.0	38. 36.5	3, 2.9
9.	I do not have influenza vaccination for fear of the contents therein do not correspond to my beliefs	2, 1.9	16, 15.4	25, 24.0	56, 53.8	5, 4.8
10.	I will go to the health facility if I feel symptoms such as fever, muscle aches, cough, runny nose and sore throat	25, 24.0	70, 67.3	6 5.8	3, 2.9	0, 0.0

SA = Strongly Agree; A = Agree; N = Neutral; D = Disagree; SD = Strongly Disagree

Tab. IV. Responses to practice questions instrument about influenza and influenza vaccine.

No.		VF	F	O	R	N
		(n, %)	(n, %)	(n, %)	(n, %)	(n, %)
1.	Do you go to a health facility when you have signs of cough, colds, and sore throat?	25, 24.0	31, 29.8	41, 39., 4	6 5.8	1, 1,0
2.	Do you use a mask when having signs of cough and cold?	33, 31.7	61, 58.7	8 7.7	2, 1.9	0, 0.0
3.	Do you wash your hands before and after contact with patients?	66, 63.5	34, 32.7	2, 1.9	0, 0.0	2, 1.9
4.	Have you ever recommended to have influenza vaccination?	6 5.8	28, 26.9	8 7.7	12, 11.5	50, 48.1
5.	Have you ever had *) influenza vaccination?	5, 4.8	4, 3.8	3, 2.9	5, 4.8	87, 83.7
6.	Do you have *) influenza vaccinations on a regular basis?	2, 1.9	2, 1.9	1, 1,0	5, 4.8	94, 90.4
7.	Have you ever taken your family to have regular influenza vaccination?	6 5.8	3, 2.9	3, 2.9	7 6.7	85, 81.7
8.	Have you ever read or attended an educational program about influenza and influenza vaccine?	6 5.8	12, 11.5	8 7.7	40. 38.5	38, 36.5

VF = Very Frequently; F = Frequently; O= Occasionally; R = Rarely; N= Never; * had/have = for yourself

the practice of influenza vaccine, and 85 respondents (81.7%) had never taken the family to regularly have an influenza vaccination.

With regard to the results of the practice of respondents, the median value in the practice question was 19 (range between 12 and 40); 60 respondents (58%) had positive practices and 44 respondents (42%) had negative practices (Fig. 3).

Fig. 3. Distribution of subject by practice.

Discussion

This study aimed to describe the knowledge, attitudes, and practices of nurses regarding the influenza vaccine. In this study, 77 nurses (74%) had a sufficient level of knowledge, 20 (19%) had a poor level of knowledge and 7 (7%) had a good level of knowledge. These results were similar to those obtained by James et al. [10] showing that the knowledge scores of health professionals are still lacking. Instead, our results did not agree with those obtained by Smith et al. [15], who found that nurses' level of knowledge about influenza and influenza vaccine was good.

Regarding the question about knowledge on influenza risk factors, 51% of respondents knew that nurses as health professionals could transmit influenza to patients. This result was lower than a study conducted in Bali [16] which found that 95% of respondents knew that influenza could be transmitted to the patient. The study also showed that 84.6% of respondents knew that influenza virus can cause severe illness. This is consistent with the results of the study conducted in Bali [16] where 84.7% of respondents agreed.

The results showed that 67% of the respondents had a positive attitude and 33% had a negative attitude. These results were consistent with the research conducted by Mojamamy et al. [17] concerning the prevalence, knowledge, attitudes, and practices related to health professionals regarding influenza vaccine, which showed that 65.2% of the respondents had a positive attitude. Of the respondents, 69.2% believed that health professionals are vulnerable to influenza, these results were lower than the results obtained by Mojamamy et al. [17] indicating that 91.2% of respondents agreed. In this study, 93.3% of the respondents agreed that influenza vaccine can prevent influenza, these results were higher than the results of research conducted by Mojamamy et al. [17] showing that 62.5% of respondents agreed. In this study, 26.5% of the respondents feared side effects caused by the vaccine.

The present study showed that 60 respondents (58%) had positive practices and 44 respondents (42%) had negative practices; 83.7% of the respondents had never had an influenza vaccine and 90.4% of respondents had never had it regularly. This result was much lower than the one obtained by Smith et al. [15], which showed that 78.8% of the nurses had influenza vaccination.

The study conducted by Zhang et al. [11] on knowledge and perceptions related to the influenza vaccine on nurses reported that the vaccination rate is influenced by the respondents' knowledge. The level of knowledge has a relationship in the action/education of the respondents [11]. Education is necessary for nurses to further improve the level of their knowledge and increase the level of influenza vaccination.

The limitation of this study is the existence of information bias at the time of completing the questionnaire and the results of this study cannot be generalized to describe the condition of the knowledge, attitude and practice of nurses working in all the suburbs in Indonesia because the study was only conducted in one hospital in the suburbs.

Conclusions and recommendations

Although there were gaps in their knowledge, attitude and practice, the nurses in this study were well informed about influenza vaccination, but 83.7% of respondents had never had influenza vaccine, and 90.4% of the respondents had never had a regular influenza vaccination. These results call for the development of institutional frameworks and policy guidelines to empower nurses' actions regarding influenza disease. The results of this study are also expected to become an input for hospitals, especially in our setting, to provide free influenza vaccination for health professionals.

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Conflict of interest statement

The authors declare no conflict of interest.

Authors' contributions

BPR was mainly responsible for data collection, with the contribution of LER. BPR was responsible for data analysis, with the contribution of AYS, HS, and LER. BPR, AYS, HS, and LER contributed to the preparation of the manuscript.

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ORIGINAL ARTICLE

Socio-economic inequality and risk of loneliness by personality traits in girl students

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Keywords

Loneliness • Personality traits • Socio-economic factors • Inequality

Summary

Objective. *Personality traits can affect humans' mental health. In the present study, we aimed to assess the relation of loneliness to personality traits and also to inequality in socio-economic status in girl students.*
Methods. *In a cross-sectional study, investigated the relations of personality traits to loneliness in girl students in Ilam from 2014 to 2015. A multistage cluster random sampling method was used to select the participants. The NEO-FFI and University of California, and Los Angeles questionnaires were used for data collection. Data were analyzed by IBM SPSS and Distributive Analysis Stata Package (DASP).*
Results. *Among 400 recruited participants, 149 (37.2%) were categorized as having loneliness. The concentration index (CI) for loneliness was 0.19 (95 % confidence interval CI] 0.07, 0.27), which indicated that loneliness was observed more in persons with high socioeconomic status. The risk of loneliness was 38% lower in persons with higher scores in neuroticism (adjusted odds ratio (AOR) = 0.62, 95% CI: 0.48, 0.91).*
Conclusion. *We found that socio-economic inequality was observed in relation to loneliness with girls of higher socioeconomic status reporting more loneliness. Therefore, more attention should be directed by policymakers to determining the main contributors to inequality contributors and loneliness in advantaged societies.*

Introduction

Public health considers the most fundamental issues in each country in physical, mental and social dimensions [1]. According to the World Health Organization (WHO), mental disorders are serious and frequently occurring disorders throughout the world [2]. In fact, these disorders constitute a large proportion of all patients admitted to medical centers [3]. Personality traits are distinct characteristics that include physical, psychological and behavioral aspects in each person, which distinguishes each individual from others [4]. Most of humans' behaviors are derived from their personalities [5]. Psychologists believe that the personality is shaped and developed constantly from birth to death. In fact, we cannot consider a constant personality in all stages of life [6]. Aging, environment, genetics and family have importance roles in the formation of human personality [7, 8]. Personality traits and mental health are significantly related. Some personality traits put individuals at risk for mental health disorders indirectly by unhealthy behaviors, such as smoking, substance abuse, sleep deprivation, and malnutrition [9, 10].
The NEO Five-Factor Inventory (NEO-FFI) [11] is a most respected and one of the best-known instruments for assessing personality patterns, including: a) neuroticism personality, which is the general tendency to experience negative emotions, such as fear, feeling guilty, anxiety, hatred and nervous; b) extraversion, which refers to the willingness of a person to be energetic, happy and sociable; c) openness, which refers to a person's willingness to be non-traditional, imaginative and have an interest in art; d) agreeableness, indicating the person's willingness to confide and helpothers, and generosity; e) and conscientiousness, which is an intention to be reliable, and be diligent and disciplined.
Extraversion and conscientiousness are believed to be the strongest predictors of happiness. In addition, the neuroticism and conscientiousness are the strongest predictors for life satisfaction. Actually, the happiness is associated with high extraversion and low neuroticism [12]. Also, socio-economic-factors can have an effect on mental health in women [13]. Therefore, in this current study we aimed to assess the relation of loneliness to personality traits and determine the relation of socio-economic inequality to loneliness in girl students.

Materials and methods

Participants

Using a cross-sectional study, we investigated the relations of personality traits to loneliness in 400 teenage participants in high schools. The study was conducted in Iran (Ilam Province) during 2014 to 2015. We applied a multistage cluster random sampling method to select participants. The participants were aged 12-18 years old. To select participants in first step, we selected eight high schools by random clustering sampling, and then, five classes in each school were identified. In the final step, participants enrolled in

each class were sampled systematically. Among 409 selected participants 400 (97.7%) responded to the questionnaires. The inclusion criteria were female students with no history of known physical or mental disorders or with recent acute stress (during the prior six months).
The study was approved by the Psychosocial Injuries Research Center, Ilam University of Medical Sciences Ethics Committee, and informed consent was signed by all participants.

Socio-economic status (SES)

In current study, we have put participants in SES categories (low, middle, and high) by applying principal component analysis (PCA). The 4 items were enrolled to PCA to prediction of SES, including; family income, the educational level of parents (five levels: illiterate, primary school, high school, diploma, university), location of residence (urban/rural), occupation of parents. Therefore according to Friesen study in 2016 we used arbitrary cut-off points are classification of the lowest 40% of households into 'poor', the highest 20% as 'rich' and the rest as the 'middle' group. Eventually, we classified households into quintiles and calculated the mean socio-economic score for each group [14].

Assessment tools

The NEO-FFI and University of California and Los Angeles (UCLA) questionnaires were used for data collection. Also, the demographic portion of the questionnaire was created using scientific books and similar research and taking into consideration the social and cultural environment. The demographic questionnaire included age, education field and level of parents' location, occupation, family income and educational level.
The NEO-FFI included 60 items which measure the students personality in five dimensions including: neuroticism (items: 1,6,11,16,21,26,31,36,41,46,51,56), extraversion (items: 2,7,12,17,22,27,32,37,42,47,52,57), openness to experience (items: 3,8,13,18,23,28,33,38,43,48,53,58), agreeableness (items: 4, 9,14,19, 24, 29, 34, 39, 44,49, 54, 59) and conscientiousness (items: 5,10,15,20,25,30,35,40, 45,50,55,60). The scores were: totally agree = 4, agree = 3, no comment = 2, disagree = 1 and strongly disagree = 0. The final score was obtained by summing the scores for all questions. The questionnaire scores ranged from 0 to 48 for each dimension. Based on the total score achieved for each dimension, participants were divided into one of three groups (less than 25% represented poor, 25%-75% moderate and more than 75% represented good condition) [15].
The UCLA questionnaire (1978): This questionnaire included 20 items and used a four distinct score scale to measure feelings of social isolation. The scores were: 1 = "I never feel this way", 2 = "I rarely feel this way", 3 = "I sometimes feel this way" and 4 = "I often feel this way". The questionnaire consists of 11 positive and 9 negative items. All negative items including 1-5-6-9-10-15-16-19 and 20, were scored inversely [16]. The lowest total possible score is 20, which represented no loneliness and scores more than 80 represented severe loneliness [17].

Statistical analysis

Data analyses were conducted using IBM SPSS for Windows ver. 20.0 (IBM Co., Armonk, NY, USA). Descriptive and inferential statistics and the Distributive Analysis Stata Package (DASP) were used to obtain an inequality index (II)) for loneliness. The amount of CI is obtained by a Concentration Curve (CC) in which the y-axis is the cumulative percentage of loneliness, and the x-axis is the cumulative percentage of the participants ranked by socioeconomic status. The value of II ranged from -1 to +1; the negative value indicated that the health variable is more concentrated in the poor population, and the positive value indicates more concentration in the rich population [18]. The x^2 test was used to test categorical variables. Univariate and multivariate logistic regression models were applied to compute Odds Ratios (OR) with 95% Confidence Intervals (95% CI). Confounding factors that were adjusted in multivariate logistic regression models were age, education field and level, parents' educational level and parents 'occupation, based on changing the effect by at least 10%. The Hosmer-Lemeshow statistic was evaluated for fit of the models, indicating well fit if the significance value was less than 0.05.

Results

Overall 400 girl students were recruited ranging in age from 14 to 18 years. Participants were in the first to third grade of high school students, with an equal distribution across grades. The mean ± SD scores in neuroticism, extraversion, and agreeableness traits were significantly higher in non-lonely persons, but no significant differences in loneliness were observed in relation to openness to experience and conscientiousness traits (Tab. I).
Inequality in loneliness by socioeconomic status was calculated using the II. The II for loneliness was 0.19 (95% CI 0.07, 0.27), which indicated a positive inequality in loneliness according to socioeconomic factors; therefore, loneliness was observed more in persons with a high socioeconomic status (Fig. 1).
In this study, multiple logistic regressions were conducted to examine the association between personality traits and loneliness in girl students (Tab. II). In our model, age and other socio-economic factors were covariates and adjusted. The odds of loneliness in girl students was 38% in those with a higher score for the neuroticism trait (adjusted odds ratio (AOR) = 0.62, 95% CI 0.48, 0.91). The odds of loneliness in persons with a higher score for the extraversion trait was lower (AOR) = 0.82, 95% CI 0.63, 0.91). Also, the odds of loneliness was lower for those with higher agreeableness trait (AOR) = 0.90, 95% CI 0.84, 0.96).

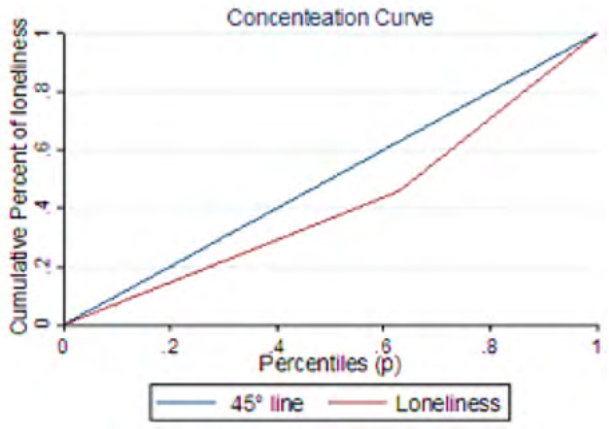
Discussion

In this study, we analyzed of the odds of loneliness by personality traits and socio-economic status in girl students. Some personality traits have shown significant associations with physical and mental human health [19, 20].

Tab. I. The Mean ± SD scores of personality traits and its relationship with loneliness (non-lonely and lonely).

Personality traits	Groups				P-value
	Non-lonely, N = 251		Lonely, N = 149		
	Mean	SD	Mean	SD	
Neuroticism	26.25	6.33	22.03	6.54	<0. 001
Extraversion	16.75	5.18	14.68	5.06	0. 008
Openness to experience	21.21	4.21	21.23	4.62	0. 256
Agreeableness	23	4.65	21.74	3.75	0. 011
Conscientiousness	18.32	3.22	17.02	3.9	0. 134

Fig. 1. Concentration curve of the inequality index for loneliness according to socioeconomic-factors in girl students.



Our results showed that personality traits, including neuroticism, extraversion, and agreeableness, were significantly associated with loneliness when compared to girls assessed to be non-lonely, but we did not find significant associations of loneliness with the openness to experience and conscientiousness traits. The Mean ± SD of neuroticism trait scores in non-lonely and lonely girls were 26.25 ± 6.33 and 22.03 ± 6.54, respectively. This finding is in line with the results of other studies [20] that have demonstrated a strong correlation between neuroticism and mental health conditions, such as depressive symptoms, anxiety and mental disorder [20]. Also, one study has shown an increased risk of depression in Chinese women with neurotic personality [21].

In this study, inequality in loneliness by socioeconomic factors was calculated using the II. Loneliness was observed more in persons with a high socioeconomic status. The important reasons for inequality in loneliness by socioeconomic -factors can be related to issues of illiteracy and low levels of literacy in Iranian woman. Illiterate persons and families with low levels of literacy have lower income and less leisure time to spend with their family members. The Behrouzi et al. study (2015) found a significant relationship between family leisure time and family closeness in females [22].

In the present study, we adjusted for confounding factors and based on our results, the odds of loneliness in participants with higher scores for neuroticism, extraversion, and agreeableness trait were lower. Most participants (97%) had moderate flexibility. The basic question is why does openness increase the odds of loneliness among girls so much? We may identify the reason in coping strategies that individuals choose. Most coping strategies reflect individual effort, such as task-oriented coping, emotion-oriented coping and avoidance-oriented coping to improve difficult situations [23].

Some limitations should be mentioned that were present in this study. First, the socioeconomic-factors were limited to educational levels of participants and that of their parents, age, residence, and job of parents. This accounted for 62% of the variance. Second, significant relationships in this cross-sectional study should be interpreted with caution due to the concurrency in of variables assessed in this study so that the temporal relations of variables could not be determined.

In summary, we found that the odds of loneliness differed by personality traits and by socioeconomic status with loneliness observed more in persons with high socioeconomic status.

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Tab. II. The result of multiple logistic regression analysis the association between type of personality and loneliness in girl students.

Personality dimensions	Unadjusted OR (95% CI)	P-value*	Adjusted OR† (95% CI)	P-value‡
Neuroticism	0.67(0.58- 0.88)	0.035	0.62(0.48 - 0.91)	0.002
Extraversion	0.85 (0.68- 0.93)	0.007	0.82(0.63 - 0.91)	0.003
Openness to experience	0.97(0.91- 1.06)	0.353	0.95(0.90 -1.03)	0.270
Agreeableness	0.91(0.83- 0.98)	0.003	0.90(0.84- 0.96)	0.002
Conscientiousness	0.96(0.89-1.10)	0.351	0.93(0.88- 1.07)	0.232

*Calculated by univariate logistic regression analysis; †Adjusting for age, education field and level, parents' educational level and parents 'occupation as confounding factors; ‡Calculated by multivariate logistic regression analysis the outcome variable was non-lonely and lonely groups.

Conflict of interest statement

The authors declare no conflict of interest.

Authors' contributions

AD-M and YV carried out the study, participated in the analysis and manuscript drafting. AD-M participated in analysis and manuscript drafting. AH collaborated in collecting the raw data. YV coordinated the study and participated in the analysis and manuscript drafting. All authors read and approved the final manuscript.

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ORIGINAL ARTICLE

Effect of student's empowerment program on brucellosis prevention: an application of extended health belief model

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Keywords

Brucellosis • Health education • Health belief model • Self-efficacy • Rural community

Summary

Background. *To determine the effect of student's empowerment program using the extended health belief model on the brucellosis prevention in rural high school in Divandarreh, Kurdistan province, Iran.*
Materials and methods. *Quasi-experimental study with repeated measure (pre-test, post-test and at 2-month follow-up). In all 220 rural high school students were selected using a cluster sampling method. The data collection tool was a questionnaire based on the Health Belief Model (HBM). Five 1.5 hours sessions using lecture, group discussion, inquiry method, leaflet delivery, and the use of slides with Overhead projector and PowerPoints slide show, designed according to the Systematic Comprehensive Health Education and Promotion Model (SHEP), was presented for intervention group twice a week in schools. Data were analyzed by SPSS 18, using descriptive statistics as well as Chi-square, independent t-test and repeated measures at a significant level less than 0.05.*
Results. *The total mean age of participants was 14.6 ± 2.3. The intervention and control groups had no significant differences in terms of age, gender, and other demographic variables. There was no significant differences in the intervention and control groups before the intervention in terms of awareness, severity, benefits, barriers and self-efficacy. After educational program scores of awareness, severity, susceptibility, benefits, barriers and self-efficacy, and performance were higher in the intervention group compared to the control group.*
Conclusion. *Overall, implementation of the educational intervention based on theories and models had good effects on people that are in the risk of infection and zoonotic disease.*

Introduction

Brucellosis is a zoonotic disease in which a pathogen is transmitted to humans body through direct contact with infected animals, or indirectly through the consumption of contaminated animal products [1]. It affects both sexes in all age groups. Treatment of brucellosis may even last for several months, which is why it is considered as a chronic disease [2]. Brucellosis control programs have been implemented in most countries of the world, but due to animal resistance, consumption of non-pasteurized and domestic dairy, traditional livestock, no regular vaccination of livestock, and inadequate health education programs for livestock farmers disease remains in most countries and causes animal and human infection [1-4]. Hundreds of thousands of cases are reported annually in the Mediterranean countries of Europe, North and East Africa, the Middle East, North Asia, Central Asia and South America [4]. Attention to the economic burden of this disease is very important because of the long recovery of the disease in humans, the development of disability in humans, abortion in livestock, and the reduction of production and productivity in livestock [5]. Brucellosis can be considered as a potential bioterrorism agent due to its ability to develop and also its economic burden [6]. The disease has been eradicated in a few countries, but even there are still cases in those among the travelers to the countries in the disease is most common [7-9]. The spread of traditional animal husbandry, lack of efficient and appropriate veterinary systems, and the use of traditional foods especially dairy products, have caused the brucellosis to be one of the serious health risks in developing countries, especially Iran [5, 6]. Livestock trafficking has led to a rise in the trend of disease in recent years in the border provinces of Iran [10]. The first major factor in reducing and eliminating the disease is the control of disease in the livestock. In the absence of control of disease in livestock, the implementation of appropriate training programs by the health system can partly prevent the spread of disease in humans [3].
The effect of education depends on the proper use of the models and theories of behavioral science, so selecting a model for health education is the first step in the educational planning process [11]. Health Belief Model (HBM) is a model that can be used at the individual level to explain the health behaviors change [12]. This model treats behavior as a function of the individual's knowledge and attitudes and guides people towards health behaviors according to its structures HBM can raise the

perceived sensitivity and severity of individuals to brucellosis, and depending on the perceived barriers and benefits, guide the person to preventative behaviors. In other words, the Health Belief Model is a comprehensive model that is more effective in preventing disease and is based on motivating people to act on health behavior [13]. The Health Belief Model was established as a health behavioral model at the individual level in the United States in the early 1950s, and later was modified and expanded to improve its effectiveness [13, 14]. This model has been used by various experts in different domains of behavioral sciences to design and evaluate interventions for changing behavior. Based on this model, the preventive health behavior will be implemented by Based on this model, the preventive health behavior will be implemented by an individual depending on a number of factors [15]. These factors include perceived susceptibility: the perception and belief that a person is at risk of developing the brucellosis. Perceived severity: understanding and believing that brucellosis is a serious problem and can lead to serious complications or death. Perceived barriers: physical, psychological or financial barriers that prevent the person from behavior change. Perceived benefits: individual belief in adopting behavior or compliance with health recommendations that prevent or reduce the severity or Complications of brucellosis [12-15]. In addition to the correct use of theories and models, the impact of an educational program is related to selecting the appropriate target group. Due to their large population, their ability to train, and the capability to transfer information to other people such as family members, students are the target group of researchers for increasing the effectiveness of education and establishing appropriate health behaviors [16]. The present study therefore aimed to determine the effect of educational intervention among rural high school students in Divandarreh County, Iran, on brucellosis prevention, using the Extended Health Belief Model.

Method

This quasi-experimental study was conducted on 220 rural high school students in the Divandarreh County, Iran who were selected by cluster sampling method. Its need to notify that; education system in Iran is divided into two main levels: primary education and high-school education. All children spend six years of their lives at primary level from age's six to 12 and attend high school from ages 12 to 18. There are three section in Divandarreh (Central, Saral, and Karaftou). Four schools were randomly selected from each section and then all the third grade students from the first high school (ninth grade) entered the study. The study was held from February to July 2018. In each section, two schools were considered as a control group and two other schools were considered as intervention groups. The data collection tool was a questionnaire based on the Health Belief Model [17]. The reliability of the questionnaire was (Cronbach's alpha = 0.882) which were ranged about 0.762 to 0.948 for different parts of the questionnaire. The questionnaire contains; demographic awareness, perceived susceptibility, perceived barriers, perceived benefits, performance, subjective norm, normative beliefs, attitude about the behavioral outcome and seven questions about the attitude of behavioral changes. For scoring the responses, the five choices Likert scale (with strongly disagree as score of 1 and strongly agree as score of 5) was used [17].

In this study, the effect of educational intervention on the constructs of health belief model and behavior change was studied. In order to determine the effect of intervention, in both intervention and control groups, pretest was performed in equal conditions. The educational content used in this program includes introductions, overview, communicable diseases, zoonosis, general features of brucellosis, pathogens, symptoms, complications, prevention methods, and brief treatment, which are included in 'Prevention, Control and Treatment of the Brucellosis: A Guide to Trainer (the people's target group), a book adapted to the comprehensive health education and health promotion program of the Ministry of Health and Medical Education (MOH) of Iran. Educational intervention was conducted for all of students in the intervention group by two public health experts, with supervision of zoonotic diseases expert. Five sessions using lecture, group discussion, inquiry method, leaflet delivery, and the use of slides with Overhead projector and PowerPoints, designed according to the Systematic Comprehensive Health Education and Promotion Model (SHEP), approved by MOH of Iran, and conducted twice a week and every session for an hour and a half. The training program lasted a total of one month. Data were collected from the two groups before intervention, immediately after training, and two months after the intervention. Data were analyzed by SPSS 18 software and using descriptive statistics as well as Chi-square, independent t-test and repeated measures at a significant level less than 0.05. In this research, ethical issues were addressed. These included freedom and discretion to participate in research, confidentiality of information, and explanation of the steps and objectives of the program for the participants at the beginning of the research. Also, the informed consent form was obtained from all participants. Also, after completing the intervention and collecting the final questionnaire, training on brucellosis and distribution of educational materials in the control group were performed.

Results

In this study, In this study, the effect of education on brucellosis preventive behaviors, designed based on the Extended HBM, has been investigated among 220 rural high school students of Divandarreh, with112 and 108 students in the intervention and control groups, respectively. One hundred and twelve students were in the intervention group and 108 in the control group. The mean age of respondents in the intervention and control

groups were 14.3 ± 2.4 and 14.8 ± 2.3 years, respectively. Independent t-test showed no statistically significant difference between the ages of the groups. Chi-square test showed that there were no significant differences between study groups in terms of age, sex, number of family members, parental education, parent's job, livestock at home, history of brucellosis training, and history of brucellosis in family members (Tab. I).

For all constructs in the intervention group, there was a significant difference in the mean score obtained for the three time periods, such that there was a significant increase in all the structures immediately after the intervention compared to the before intervention. However, except for barriers, no statistically significant difference was observed between the mean score obtained immediately after the intervention and those obtained two months after the intervention (Tab. II). In the control group, the knowledge and behavior score increased significantly during the three time periods, but in other constructs, there was no significant difference in mean scores during the three periods (Tab. II). Results of comparison of the two groups before educational intervention, based on independent t-test, showed that they did not differ significantly in terms of knowledge, severity, benefits, barriers, and self-efficacy, but the mean scores for all structures in the intervention group were significantly higher than those of the control group immediately and two months after the intervention (Tab. II). Sources of information on brucellosis were distributed as follows: 68.0% through radio and television, 23.0% through health care personnel, 6.5% through relatives and friends, 5.0% through family members, 4.5% from books, 2.1% from the internet, 0.5% from magazines and newspapers, and 1.0% from other resources

Tab. I. Demographic characteristics, frequency distribution and statistical difference in the studied groups.

Variables	Control group	Intervention group	P-value
Gender			
Male	58 (53.7)	61 (54.4)	0.09
Female	50 (46.3)	51 (45.6)	
Mother's job			
Housewife	101 (93.5)	103 (92)	0.73
Employed	7 (6.5)	9 (8)	
Mother's education			
Illiterate	5 (4.6)	8 (7.1)	0.68
Elementary	39 (36.1)	44 (39.3)	
Guidance	47 (43.5)	42 (37.5)	
Diploma	13 (12)	13 (11.6)	
Academic	3 (3.8)	5 (4.5)	
Father's education			
Illiterate	3 (3.8)	5 (4.5)	0.93
Elementary	26 (24)	25 (22.3)	
Guidance	30 (27.8)	28 (25)	
Diploma	38 (35.2)	40 (35.7)	
Academic	11 (10.2)	14 (12.5)	
Father's job			
Livestock breeder	46 (42.7)	49 (43.7)	0.96
Farmer	26 (24)	25 (22.3)	
Employee	13 (12)	14 (12.5)	
Free job	23 (21.3)	24 (21.5)	
Keeping livestock			
Yes	73 (67.6)	81 (72.3)	0.53
No	35 (32.4)	31 (27.7)	
Education on brucellosis			
Yes	17 (15.7)	23 (20.3)	0.84
No	91 (84.3)	89 (79.77)	
History of brucellosis in subject or family members			
Yes	13 (12)	16 (14.3)	0.51
No	95 (88)	96 (85.7)	

Discussion

This study investigated the effect of educational interventions on prevention of brucellosis-related behaviors, based on health belief model education program. Results obtained revealed that the design and implementation of the program produced significant changes in levels of adoption of preventive behaviors related to brucellosis, which is consistent with previous studies [18-20]. Regarding the increase in awareness in the control group, it can be noted that there was no control over the information acquisition of individuals from other sources during the study. In this study, students obtained 45% of the maximum knowledge score before the intervention. In the similar study, the results indicated that knowledge of both groups before the intervention was low [18], but reported by another, the subjects had half of the knowledge score before the intervention [19]. This rate immediately after the intervention and two months later increased to 95% which is consistent with similar studies [20, 21]. Studies have shown that the success of disease prevention programs requires knowledge of the causative agent, transmission pathways, risk factors associated, levels of vulnerability of target populations, and early detection of the disease [22]. In this study, in the intervention group, the scores obtained for perceived susceptibility and perceived severity structures increased immediately and two months after intervention. Also, the high scores in the control group before and after the intervention indicate the sensitivity of the residents of the study area, which is consistent with similar studies [18, 19]. In this study, before intervention the score of the perceived benefits of preventive behaviors in both intervention and control groups was 8.4 and 9.3, respectively. After implementing the educational interventions, the score of perceived benefits in the intervention group increased significantly. These findings are akin to results of some previous studies [19, 20, 23]. The score of perceived barriers in the intervention group

Tab. II. Comparison of the mean changes in the score of knowledge and constructs of the health belief model at defined intervals of intervention in the study groups.

Variable	Intervention time intervals	Intervention group (n = 112)	Control group (n = 108)	RM ANNOVA
		Mean ± SD	Mean ± SD	
Awareness	Before	21.2 ± 4.2	20.4 ± 4.11	P < 0.001
	Immediately after	45.3 ± 6.3	22.4 ± 4.7	
	Two months after	43.6 ± 5.6	21.1 ± 5.3	
	T-test	P < 0.001	P < 0.39	
Perceived susceptibility	Before	11.7 ± 3.7	13.2 ± 3.5	P < 0.001
	Immediately after	23.6 ± 4.1	14.3 ± 3.1	
	Two months after	22.5 ± 3.3	14.6 ± 4.7	
	T-test	P < 0.001	P < 0.64	
Perceived severity	Before	13.3 ± 2.9	11.9 ± 3.8	P < 0.001
	Immediately after	24.3 ± 3.4	13.2 ± 4.5	
	Two months after	24.1 ± 3.5	12.6 ± 4.3	
	T-test	P < 0.001	P < 0.36	
Perceived barriers	Before	9.6 ± 5.3	9 ± 4.6	P < 0.001
	Immediately after	28 ± 4.2	11.1 ± 5.3	
	Two months after	26.5 ± 5.3	11 ± 5.1	
	T-test	P < 0.001	P < 0.57	
Perceived benefits	Before	8.4 ± 2.3	9.3 ± 2.8	P < 0.001
	Immediately after	17.3 ± 2.1	10.6 ± 3.3	
	Two months after	16.8 ± 2.9	10.8 ± 3.5	
	T-test	P < 0.001	P < 0.41	
Performance	Before	3.4 ± 0.6	3.9 ± 0.8	P < 0.001
	Immediately after	8.3 ± 0.7	3.1 ± 1.2	
	Two months after	8.1 ± 0.6	3.3 ± 1.5	
	T-test	P < 0.001	P < 0.46	
Subjective norm	Before	7.1 ± 1.6	6.6 ± 1.3	P < 0.001
	Immediately after	17.3 ± 2.3	7.3 ± 1.1	
	Two months after	16.4 ± 3.1	7 ± 1.6	
	T-test	P < 0.001	P < 0.32	
Normative beliefs	Before	12.8 ± 4.8	13.7 ± 4.3	P < 0.001
	Immediately after	23.3 ± 3.7	15.1 ± 5.8	
	Two months after	22 ± 5.1	13.9 ± 4.9	
	T-test	P < 0.001	P < 0.52	
Attitude about the behavioral results	Before	11.2 ± 5.5	12.8 ± 6.1	P < 0.001
	Immediately after	23.3 ± 1.7	14.2 ± 5.3	
	Two months after	23.4 ± 2.1	13.8 ± 5.8	
	T-test	P < 0.001	P < 0.42	
Attitude of behavioral changes	Before	13.7 ± 6.3	13 ± 5.4	P < 0.001
	Immediately after	31 ± 4.5	14.9 ± 6.1	
	Two months after	30.2 ± 4.8	15.2 ± 6.3	
	T-test	P < 0.001	P < 0.23	

indicated that there was no significant increase in mean score immediately after the intervention compared to the previous one. The measurements of this variable in the control group were not significantly different at all three times. In the study of Aligol et al., all three times (before, immediately and one month after intervention), had a significant difference, which is similar to findings of Karimi et al. before and six months after intervention. The performance score increased after intervention. In the study of Ghofranipour, the intervention group also had less perceived barriers to brucellosis prevention after educational intervention [19, 20, 23]. The performance score has increased after intervention.

Studies have shown that performance has a great effect on health behaviors, and increased awareness of this structure increases the ability to create preventive behaviors in the transmission of diseases [16]. In this study, the score of attitude about behavioral outcomes and attitudes toward changing behavior of brucellosis prevention in intervention group immediately increased significantly to 93% and 88.5% respectively, and two months later rose to 92% and 86%. These scores increased slightly in the control group (55% and 43% respectively) and there was no statistically

significant difference. These findings are akin to results of some previous studies [18-20]. According to the findings of this study, 94.5% of the respondents stated that cues to action enhanced adherence to preventive behaviors against brucellosis. The most frequent sources of information were radio and television (68.0%), followed by health care personnel (23.0%). This is in line with findings of a previous study which showed that among the components of the health belief model, cue to action is the strongest predictor of behavioral changes among livestock breeders [24].
The limitations of this research include the length of the questionnaire and difficulty of measuring behavior using self-reported techniques that can affect the quality of data However, the present study was able to examine the effect of model-based intervention on the behavior and beliefs associated with the prevention of brucellosis. Given the large population of students and their effective role in the transfer of health literacy to the community, this study can be considered as a successful experience in preventing brucellosis in school health education programs.

Conclusion

Brucellosis is one of the most important zoonotic diseases, which annually imposes huge costs on the health system of Iran. Learning to prevent this disease in rural areas is the best and most effective way to prevent the disease. The results of this study showed that using a suitable educational model based on a regular structure can be an effective factor in increasing awareness, knowledge and attitude of the individual towards preventing the disease and increase the adoption of preventive behaviors in the individual. All of the constructs of the health belief model after education in the students had significantly higher scores in the intervention group than the control group. These findings suggest that the use of theory and educational model can be important in identifying the factors influencing behavioral changes. In particular, this study showed that health belief model can be a good model for predicting the prevention of brucellosis in rural students. Therefore, health belief model can be used as a suitable model for prevention of disease in planning and designing educational interventions. Considering the positive effect of educational program based on health belief model and low cost preventive activities, and also considering the importance of empowerment of students and their impact on increasing the health and social well-being of the family through the use of educational programs and improving self-efficacy, the necessity of generalizations of such educational programs in health system programs, especially rural health centers and health houses, seems necessary.

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Conflict of interest statement

The authors declare no conflict of interest.

Authors' contributions

KK conducted the statistical data analyses and wrote the manuscript. AL contributed to the study design, interpretation of results and writing the manuscript, MKH participated in designing the study protocol and wrote the manuscript. All authors gave substantial contribution to manuscript revising and editing.

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ORIGINAL ARTICLE

Evaluation of radon exposure risk and lung cancer incidence/mortality in South-eastern Italy

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Keywords

Radon concentrations • Incidence • Mortality • Lung cancer • *Kriging*

Summary

Introduction. *Radon and its decay products may cause substantial health damage after long-term exposure. The aim of the study was to perform a spatial analysis of radon concentration in the Salento peninsula, province of Lecce (South-eastern Italy) in order to better characterize possible risk for human health, with specific focus on lung cancer.*

Methods. *Based on previous radon monitoring campaigns carried out in 2006 on behalf of the Local Health Authority (ASL Lecce) involving 419 schools and through the application of kriging estimation method, a radon risk map was obtained for the province of Lecce, in order to determine if areas with higher radon concentrations were overlapping with those characterized by the highest pulmonary cancer incidence and mortality rates.*

Results. *According to our data, areas at higher radon concentrations seem to overlap with those characterized by the highest pulmonary cancer mortality and incidence rates, thus indicating that human exposure to radon could possibly enhance other individual or environmental pro-carcinogenic risk factors (i.e. cigarette smoking, air pollution and other exposures).*

Conclusions. *The radon risk should be further assessed in the evaluation of the causes resulting in higher mortality and incidence rates for pulmonary cancer in Salento area vs Italian average national data. For these reasons, ASL Lecce in cooperation with ARPA Puglia and CNR-IFC has included the monitoring of individual indoor radon concentrations in the protocol of PROTOS case-control Study, aimed at investigating the role of different personal and environmental risk factors for lung cancer in Salento.*

Introduction

Radon (^{222}Rn) is a colorless, tasteless and odorless radioactive noble gas. It is constantly generated by some rocks of the earth's crust following the decay of radium (^{226}Ra), which in turn is progeny of uranium (^{238}U). There are two other radon isotopes (^{220}Rn and ^{219}Rn) resulting from the decay of elements ^{232}Th and ^{235}U, respectively. Although ^{220}Rn and ^{219}Rn are irrelevant, as determined by their short decay times, ^{222}Rn is more important from a radioactive point of view. Radon (^{222}Rn) has a half-life of 3.8 days and decays, emitting alpha particles, and generates a chain of unstable nuclei (radioactive lead, bismuth, and polonium), called "radon decay products". In particular, Polonium isotopes are alpha emitters and the particles emitted directly in contact with the lung tissues can contribute to radiation damage, even in the long-term (in particular the ^{210}Po has an average life of 140 days). Lead and bismuth are beta-emitters and their danger is lower, although ^{210}Pb (half- life 22 years) continues to be a continuous source of the most harmful ^{210}Po [1]. Radon emission is influenced by the geology (properties of rocks and soils) of a given region [2]. The amount of radon exhaled from the rocks depends essentially on two factors: their content in uranium and radio and their permeability [3-5]. As radon is a gas, outside it will then rapidly disperse in the atmosphere, but indoor (dwellings, schools and workplaces), radon can accumulate and results, in some instances, dangerous for human health, most notably causing lung cancer [6-8]. In 1988, radon and in particular its decay products (Polonium 218 and 214) are been assigned, by the World Health Organization's International Agency for Research on Cancer (WHO-IARC), in Group 1, as carcinogenic to humans [9]. Besides, the United States Environmental Protection Agency (US EPA) has classified radon as the second leading cause of lung cancer after cigarette smoking, and exposure to this gas is able to exponentially enhance the effect of other individual (smoking) or environmental exposures [10, 11].

Since radon leak up out of the ground and can enter buildings, the European Commission has required on Member States to establish a national action plan addressing long-term risks from radon exposures. They had to be identify "*radon prone areas*", zones where there is a high probability of finding high indoor radon concentrations [12, 13]. The European countries have defined the "*radon prone areas*" by developing different approaches: indoor radon measurements campaign-based approach, geology-based approach and integrated

ones. Currently the most used is the last one, that integrates forecasts of radon exhalation related to the local geology, with the indoor radon measurements [14-17]. Over the last few decades, national indoor radon survey has been performed in Italy; in particular, a national survey to assess the indoor exposure of the Italian population was conducted by ISS (National Institute of Health) and ENEA (Italian National agency for new technologies, Energy and sustainable economic development), actually ISPRA (Higher Institute for the Protection and Environmental Research). The survey was organized by statistical areas of sampling to obtain representative samples of houses. Based on the average values found in 5,000 dwellings throughout national territory, Italy was assigned an average radon concentration of 77 Bq/m^3 and in particular Apulia region, a value of 52 Bq/m^3. More recent valuations assigned Italy an average radon concentration equal to 70 Bq/m^3 [18-20]. Considering that estimated world average radon value in 2000 was equal to 40 Bq/m^3, and the European average radon value is equal to 59 Bq/m^3, the average radon concentration of Apulia region can be considered medium-high, as well as the Italian one [21]. Therefore, in 2006, ASL (Local Health Authority) of the province of Lecce, in collaboration with INAIL (Italian Workers Compensation Authority), formerly ISPESL (National Institute for Occupational Prevention and Safety), Province of Lecce and University of Salento, in order to evaluate the radon concentrations in the Salento area (Apulia, South-eastern Italy), has performed a monitoring campaign in 91 municipalities of the province [22]. This monitoring was started because it was assumed that value radon concentration in Salento area could be higher than estimated average radon value for Apulia because of its karst features.

The aim of this paper was to perform a spatial analysis of the distribution of indoor radon concentration in the Province of Lecce (Apulia region, Italy), using data already available from the previous sampling campaign.

An ecological study was conducted to verify any overlap between the areas with the highest radon concentration and lung cancer mortality maps provided by Regional Epidemiological Observatory (OER) and incidence data published by Cancer Registry of ASL Lecce, accredited AIRTUM (Italian Association of Cancer Registries).

This in order to provide the public administrations with data useful for assessing the health risk attributable to radon for the resident population, taking into account that Salento area is characterized by an higher incidence of lung cancer in the male population (in the period 2003-2006: 88/100.000 inhabitant vs. an average rate of 73/100.000 and 64/100.000 in Northern and Southern Italian regions, respectively) [23].

Methods

In 2006 the ASL Lecce with INAIL, Province of Lecce and University of Salento has conducted a huge monitoring campaign to assess the indoor radon levels in schools. The present study starts from the results obtained by that survey.

Indoor radon concentration was investigated as activity of its radioisotope ^{222}Rn and expressed in Bq/m^3 (Becquerel per cubic meter), using NRPB/SSI type passive radon dosimeters with CR-39 TASTRAK plastics (TASL, UK) as nuclear track detectors. After exposure, passive devices were returned to the INAIL laboratory by express mail for analysis [22].

In this paper were considered only the schools in which the measure had been carried out on the ground floor, owing to their high exposure to radon sources (direct contact with the soil and, thus, with a natural radon source).

A total of 419 schools were monitored: 332 schools were monitored for two consecutive six-month periods in order to obtain the average annual radon concentration; while, in 87 schools, the results of only a single six-month period were available. In the last case, the radon concentration measured was corrected using the "seasonal correction factor", estimated equal at 1.23, as described by Trevisi et al., 2012 [22].

Starting from this radon monitoring campaign, an ecological study was conducted, and the radon concentration values were grouped by macro-areas corresponding to the boundaries of the Social-Health Districts, considering that the report published by the Cancer Registry of ASL Lecce grouped the incidence of lung cancer by district, while the mortality data were made available for each municipality by the OER.

The study was divided into three distinct phases:

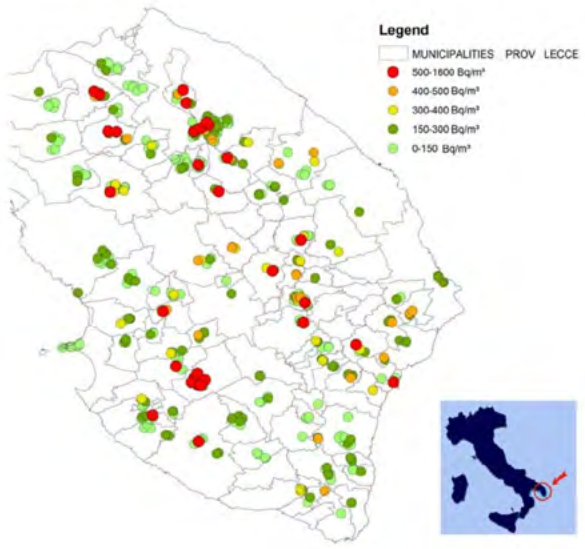
a. analysis of the distribution of indoor radon concentration and its possible spatial representation;
b. analysis of lung cancer incidence data, published by Cancer Registry of ASL Lecce, and lung cancer mortality data provided by Regional Epidemiological Observatory, in order to verify possible overlaps between health data and geographical areas with higher concentrations of radon;
c. analysis of the correlation of geological parameters with the distribution of indoor radon concentration.

To represent the data, conventional maps and thematic maps were used in four main types:

1. maps of points that allow to represent discrete or observed quantities at different points, with dimensions proportional to the value of the quantity. Different colors and shapes have been used to represent qualitative differences;
2. maps of lines, which represent quantities distributed along linear elements, using different thickness, colour and type of the lines;
3. maps of areas, which represent variables in two dimensions, and use different texture and colour to discriminate qualitative differences;
4. maps of values, to represent numerical quantities that vary depending on the position (i.e. elevation, temperature, density), using more intense colours and/or denser textures for the higher values.

According to this methodology, have been indicated on the map the radon concentrations measured in the sam-

Fig. 1. Spatial distribution of samples on the territory of the Province of Lecce, classified according to radon concentration.



pling campaign in 2006 in the province of Lecce. The spatial distribution of data was not organized according to a regular grid, revealing areas of the Province with low density of points (rural areas) and others, characterized by an high density of point (typically urban areas). Furthermore, were present isolated points, in the areas with low density, not usable for the geostatistical analysis. On other hand, in the monitored area, the density of data was sufficient for highlight any significant variations of concentrations in regional territory and the analysis of these data could be useful for a future set up of maps, with the aim of define "*radon prone areas*", implemented with data collected according to a regular grid.

A spatial distribution of the data, based on the radon concentration, was performed (Fig. 1). In this map, there is a spatial continuity in the data related to the indoor radon concentration, as observed in most of the environmental phenomena. Neighbouring samples are more likely to have similar values than samples that are distant: low values tend to be close to other low values and high values to other high values.

Finally, was done an overlap of radon concentrations measured in 2006 and the geological map of Province of Lecce, showing formations of carbonate rocks.

Aimed to interpolate the radon concentration values on the provincial territory, it was used the *kriging* estimation method (already used for the estimation of mineral deposits or hydrocarbons in the subsoil). The advantages of *kriging* method of interpolation are principally: possibility of a prediction on a regular grid even where there aren't values; modelling anisotropy (directionality) and estimation of measurement error variance [24]. For that purpose, it was necessary to observe the spatial distribution of the samples and to consider the descriptive statistics indexes calculated on the data. As already highlighted, some areas are clustered, and this aspect should be taken into consideration to carry out the interpolation of data for its implications in the parameter estimation: high clustering is the cause of the "nugget effect", source of short-term variability and readable in the variogram like a discontinuity at the origin, with a leap from zero to the a first value of function.

For the calculation of *kriging*, a search radius of 7000m was used and the interpolation grid was fixed in meshes of 200 m x 200 m. Therefore, a radon risk map was obtained for the province of Lecce, where subsequently were highlighted the boundaries of the municipalities (for which the mortality data provided by the OER were available) and the boundaries of the social-health districts of the ASL (for which the incidence data published by the Cancer Registry of ASL Lecce were available). Radon risk map was overlapped with maps reporting the standardized incidence and mortality rates per 100,000 persons (in the resident population aged 0-74).

Results

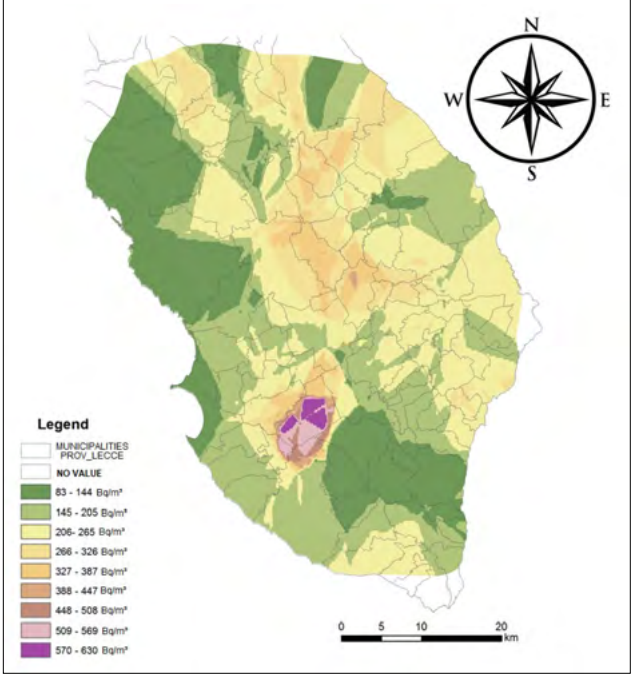
The annual average concentrations of radon, measured in 419 schools of the province of Lecce, were in a very wide range, with values from a minimum of 21 Bq/m³ to a maximum of 1608 Bq/m³. On 419 school buildings, 28 schools presented annual values between 400 and 500 Bq/m³ (equal to about 6.7% of the schools involved) and 32 had values higher than 500 Bq/m³ (equal to about 7,6%). About 86% of school buildings had average annual radon values below 400 Bq/m³. The arithmetic mean of radon concentrations in the schools analysed was 214 Bq/m³ ± 191 S.D., with a median equivalent to 155 Bq/m³. The schools of the municipalities of Casarano, Barbarano, Galugnano, Corigliano d'Otranto, Giorgilorio, Melpignano and San Donato di Lecce had higher overall radon levels than others.

Using the *kriging* method, was obtained a radon risk map for the province of Lecce. In Figure 2, with different shades of colours (from less to more intense), the trend of the radon risk level in the Province of Lecce was represented, calculated using data related to the average annual radon concentrations measured in each municipal territory on the ground floors of school buildings in 91 of the 97 municipalities. From the interpolation map, some areas with the highest radon concentration are highlighted.

Figure 3 shows on maps, detailed at the municipal level, respectively, the radon concentrations and the lung cancer mortality rates per 100,000 person, from 2000 to 2005, the latest data available at the time of this study. The mortality data were obtained from the Regional Nominative Causes of Death Register (ReNCaM) of Apulia and made available from the Regional Epidemiological Observatory (OER) [25]. So there would be overlap between areas with a higher radon concentration and areas with higher Mortality Rates for lung cancer.

Similarly, data on incidence of lung cancer in the Province of Lecce, collected by the AIRTUM Cancer Registry of ASL Lecce (Report 2010, latest one available

Fig. 2. Radon risk map for the province of Lecce.



at the time of the study) highlight interesting aspects to be examined (Tab. I). Data refer to incidence during the period 2003-2004, grouped by macro-areas corresponding to the Social-Health Districts of the Province [26].
Graphic representation of the areas with highest radon concentration (red and orange areas) shows a possible overlap with the Local Health Districts that have the highest incidence of lung cancer (respectively Galatina, Casarano, Poggiardo and Maglie); while the four Districts with low incidence of lung cancer (Martano, Nardò, Gallipoli and Gagliano del Capo) coincide with the green areas that have a lower radon concentration (Fig. 4).
Finally, from dataset of the measurements related to the ground floor of the sampling schools, 60 values of average annual radon concentration have been extrapolated, of which 28 between 400 and 500 Bq/m³ and 32 higher than 500 Bq/m³ (data with the higher contribution of exhalation from soil). To correlate the spatial data distribution of radon concentrations with the geological characteristics of the territory (presence of faults facilitating radon emissions from the depths of the karst subsurface of Salento), the geological data were overlapped with

Tab. I. Standardized lung cancer Incidence Rates, for the Local Health Districts of Province of Lecce, from 2003 to 2004, per 100,000 person, in the resident population of age 0-74 years.

Local Health Districts (Province of Lecce)	Standardized incidence rates
Galatina	114
Casarano	93
Poggiardo	91
Maglie	90
Campi Salentina	86
Lecce	83
Gagliano del Capo	80
Gallipoli	72
Nardò	69
Martano	56

Fig. 3. Standardized lung cancer Mortality Rates for the Province of Lecce during the years 2000-2005 (A) and the map of radon concentrations (B).

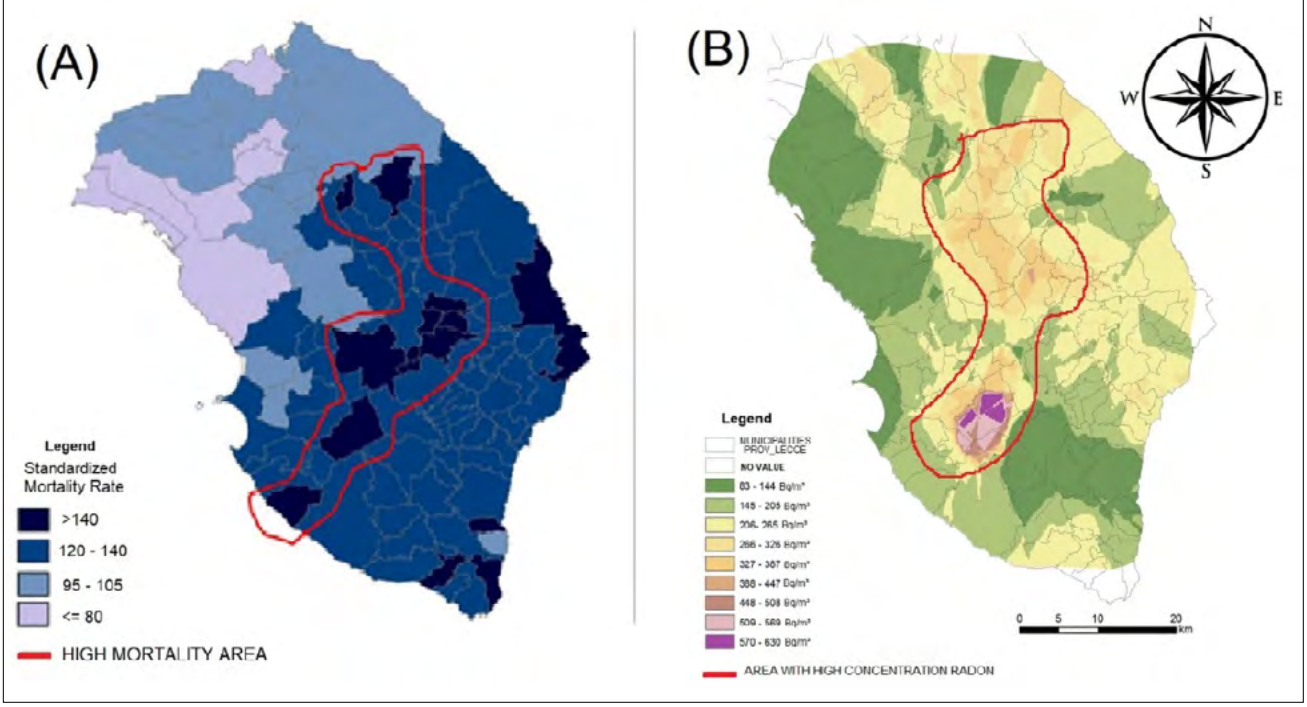
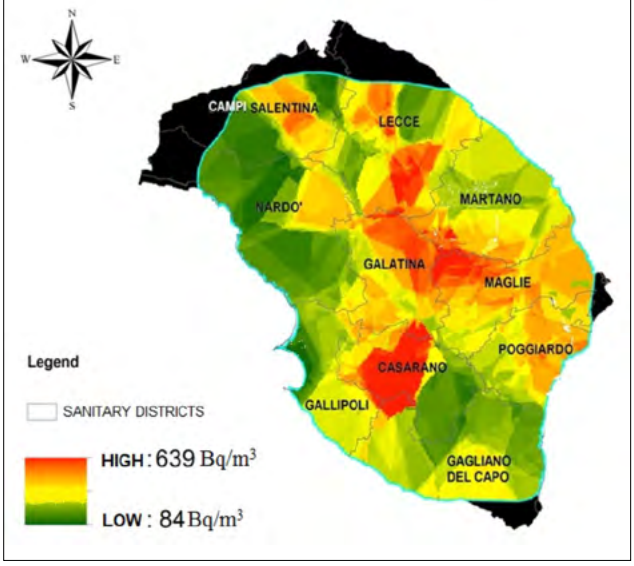


Fig. 4. Map of Radon Concentrations for Local Health Districts: in the red and orange areas radon concentrations exceed 400 Bq/m³.



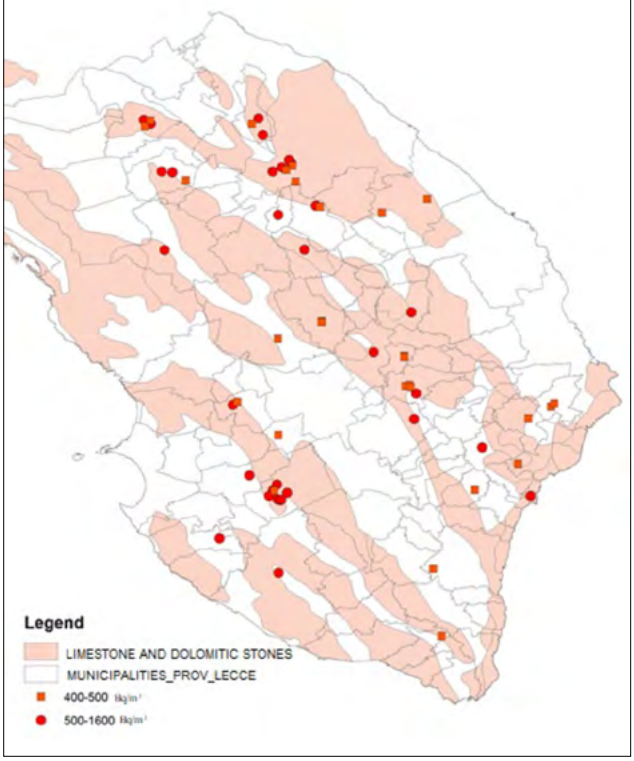
georeferencing data of average annual radon concentrations between 400 and 500 Bq/m³ (indicated with orange squares) and above 500 Bq/m³ (indicated with red circles). Figure 5 shows 44 points of colours orange and red (73.3% of the total 60) that are located on the borders of formations of carbonate rocks (at the foot of the "serre") where, due to karst phenomena, there is a high probability of structural discontinuity; in fact, there are faults and fractures conveying large quantities of radon gas from considerable depth.

Discussion

In addition to the presence of uranium in the subsoil, radon concentrations in the air also depend on numerous physical or meteorological parameters, such as site geomorphology, atmospheric pressure, temperature, humidity and the season of year. Radon is released from the ground in gaseous form, reaches the surface and mixes quickly with atmosphere, in a concentration of 10 Bq/m³. On the other hand, the situation for buildings is different, where higher values are normally obtained. Of course, it is not possible to build buildings totally protected by radon, while it's possible to design buildings with characteristics that minimize the radon entry or make the monitoring of the radon presence in already existing buildings in order to plan any interventions [27-29]. Relevant has been the national indoor radon survey performed in Italy in the last few decades, that attributed to Apulia an average radon concentration value of 52 Bq/m^3 (average value in Italy: 70 Bq/m^3; average value in Europe: 59 Bq/m^3). The same survey identified a geographically very different situation for Italy, with extremely variable average regional concentrations: the highest averages were attributed to Lombardy (111 Bq/m^3), Lazio (119 Bq/m^3), Friuli Venezia Giulia (99 Bq/m^3) and Campania (95 Bq/m^3) [19, 20]. Literature has always confirmed that the soil is the main source of indoor radon, while the influence of building materials, as well as the water, has often been completely negligible [30, 31]. Therefore the limit of the national survey could consist in the approximation to regional medium situations of any specific territorial particularities. In fact, from the geological point of view, Salento peninsula is a karst territory [32-34], consisting of a series of carbonatic formations which, due to their solubility, facilitate the instauration of fractures and faults in the rocks favouring exhalation of radon from the subsoil [35]. This research through the spatial distribution of radon concentrations and the correlation with the geology of the study area, provides more information to better understanding of the phenomenon. Radon exhalation is not related just to the local soil lithology, but also to other factors, such as geological structure, porosity and the presence of faults and fractures in the territory. It is evident that the high radon concentrations detected are influenced by the particular geological situation of the subsoil and the karst phenomena influences significantly the process of radon exhalation. In fact, the radon transported in the underground karst networks by water and gases, can travel great distances and be directed outside by the presence of numerous faults, as shown also in other regions [36]. Therefore, also calcareous rocks, characterized by a relatively low content of uranium, can release significant amounts of radon.

Overall, the average annual radon levels measured in schools were in a wide range, with values between 21-1608 Bq/m³. Furthermore, of a total of 419 school build-

Fig. 5. Georeferencing data of average annual radon concentrations between 400 and 500 Bq/m³ and above 500 Bq/m³ correlated with the geomorphological characteristics of the province of Lecce.



ings, 28 schools showed annual values between 400 and 500 Bq/m³ (about 6.7% of the sampling schools) and 32 schools (equal to about 7.6%) had higher values than 500 Bq/m³, the Italian action level for workplaces (Leg. Decree n. 241/00) [12].
The results reported in this paper represents the prerequisites for continuing the study of radon spatial distribution, which requires uniform measurement method throughout the national territory, in order to compare the data of different surveys on the same territory. Moreover, in this study a comparison was performed between areas with highest radon concentration and the health data related to incidence and mortality due to lung cancer and according to our data, areas at higher radon concentrations seem to overlap with those characterized by the highest pulmonary cancer mortality and incidence rates. Certainly, the study presents the limits of an ecological study, due to not being able to measure individual exposures to radon and to control for individual lifestyles or habits, history of disease, socioeconomic status, etc. [37]. Therefore, radon risk should be further assess in the evaluation of the causes resulting in higher mortality and incidence rates for pulmonary cancer in Salento area vs. Italian average national data.

Conclusions

The identification of areas with great probability of high concentrations of radon in confined spaces play a crucial role for a right control strategy for existing buildings and for prevention policies. The average radon concentration in monitored schools of the province of Lecce is equal to 214 Bq/m³, a value greater than four times of the Regional average (52 Bq/m³) and greater than three times of the National average (70 Bq/m³). According to new European Directive 2013/59/Euratom and to Apulia Regional Law no. 30/2016, that identify the reference value of 300 Bq/m³ for home and public buildings [13, 38], many of the schools monitored, on the basis of the data resulting from this research, exceeded the limit of radon concentration and the relative Municipalities should therefore provide for further monitoring measures for evaluate the radon indoor concentration, for possible remediation measures and new building regulations. The georeferencing of 60 values, higher than 400 Bq/m³, highlighted a strong correlation with the geology of the Salento territory. It was found that the 73,3% of georeferenced values are placed on the sites characterized by karst phenomena, important faults and fractures, potentially favouring the exhalation of radon from the subsoil. The overlap between map of the radon concentrations and map of incidence and mortality for lung cancer in province of Lecce give information on which it is opportune to investigate in more detail, as human exposure to radon could possibly enhance other individual or environmental pro-carcinogenic risk factors (i.e. cigarette smoking, air pollution and other exposures).
Further studies are needed, given the intrinsic limitations of ecological studies; for these reasons, ASL Lecce, in cooperation with Regional Agency for Environmental Prevention and Protection (ARPA Puglia) and National Research Council-Institute of Clinical Physiology (CNR-IFC), has included the monitoring of individual indoor radon concentrations in the PROTOS Study, a huge case-control study on the risks factors for lung cancer in Salento, involving about 2000 people (420 pulmonary cancer cases and 1500 controls), whose results will soon be available.

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Conflict of interest statement

The authors declare no conflict of interest.

Authors' contributions

GM, PP, AI, FS, IFC, ADD, GDF contributed to conceive, write and revise the paper. TT, BT, MM, APC participated in the analyses and interpretation of the findings. AM, BV, AR were involved in critically revising the article. All authors have read and approved the final version of manuscript.

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ORIGINAL ARTICLE

Predictors of the usage of contraceptive implants among women of reproductive age in Ondo State, Southwest Nigeria

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Keywords

Birth control • Contraceptive implant utilization • Counseling • Women • Nigeria

Summary

Background. *A major characteristic of all developing countries is rapid population growth which is due to high fertility, birth rates and poor utilization of contraceptive methods. This study therefore assessed the predictors of contraceptive implants utilization among women of reproductive age in Ondo State, Nigeria.*
Methods. *A descriptive cross-sectional study design was used and a total of 230 women were selected by multi-stage sampling technique. Questionnaire administration was interviewer-based majority of the women could not read. Data analysis was conducted using SPSS version 23. Research questions and hypotheses were answered and tested with descriptive statistics (frequency, percentages), chi-square test of significance and binary logistic regression. Levels of significance was set at $p \leq 0.05$.*
Results. *The prevalence of contraceptive utilization (any method) and contraceptive implant utilization were 92.2% and 31.1% respectively. Variables such as education ($\chi 2 = 6.91$, $p = 0.03$) and lack of counseling from providers ($\chi 2 = 5.05$, $p = 0.03$) were significantly associated with the utilization of contraceptive implant. These two variables were also the predictors of contraceptive implant utilization. Women with secondary and tertiary education have higher odds of utilizing contraceptive implants (OR = 1.21, 95% CI = 1.01-7.82, p = 0.04) and (OR = 2.53, 95% CI = 1.49-11.47, p = 0.03) compared to women who had primary or no education while those who claimed to be adequately counseled by providers are about two times more likely to use contraceptive implants (OR = 2.33, 95% CI = 1.08-5.51)*
Conclusion. *This study showed the important role of education and health workers in providing information about contraceptive implants. Therefore, health workers' knowledge of family planning counseling and services should be constantly upgraded so as to improve their roles in educating, mobilizing, counseling the women regarding contraceptive implant insertion.*

Introduction

Contraceptive implants are one of the most effective family planning methods available, well-accepted worldwide [1]. According to worldwide estimates, some 600,000 women die each year of pregnancy-related causes, and 75,000 die following unsafe abortions. At least 200,000 of these maternal deaths are attributable to the failure or lack of contraceptive services [2]. Maternal Mortality is a challenge in developing countries linked with high fertility, birth rates and poor utilization of contraceptive methods. In Nigeria, maternal and infant mortality is still high. The unmet need for contraception is the leading cause of death among women of reproductive age (15-49) [3]. Findings revealed introduction of implants because women have reported various suitable contraceptive methods but not effective [4].
These implants have become popular and in high demand in many countries including sub-Saharan Africa because of their advantages such as being less conspicuous, easier to insert and remove. Contraceptive Implants such as Implanon and Jadelle are long term hormonal contraceptive implants and a better option for women due to its effectiveness and convenience [5]. This is because of its numerous health benefits to women and their families such as preventing unintended pregnancies, promoting healthy birth spacing, reducing lifetime risk of maternal deaths, and enhancing attainments of goals [6]. Also, Contraception is immediate if inserted within the first seven days of menstrual cycle, or within the first five days for Implanon. There is no delay in return to fertility. They offer continuous, long-term protection. Also, effective within 24 hours of insertion. Implants do not affect breastfeeding [1].
There are research evidences identifying the various factors that contribute to the low utilization of contraceptive use in Nigeria, with the most common factor being the myth about the side effects of modern contraceptives [7]. However, studies have revealed persistent low coverage and observed wide variations for contraceptive use, despite the increasing adoption of contraceptives in Nigeria. The use of contraceptives especially implant utilization though is most accepted worldwide is not well utilized in developing countries. According to Gebre-Egziabher et al. [8] study revealed Health extension workers were the primary source of information on Implanon, a significant number of women had incorrect information regarding Implanon. Hence, it was recommended that health extension workers and other health professionals should provide appropriate counseling and

education regarding Implanon and other contraceptives in which they play a major role in information and service provision of Implanon. The Federal Government of Nigeria has a target of 36% contraceptive prevalence rate in 2018 [7]. The use of contraceptive implant may help to achieve this target as the duration of effectiveness is quite long. Also, due to inadequate utilization of implants in developing countries, there is an urgent need to determine factors influencing contraceptive implants utilization among childbearing women in Ondo State Nigeria. Also, this study was designed to examine the predictors of contraceptive Implants utilization among women of reproductive age in the Selected Local Government Areas of Ondo State.

Materials and methods

This cross-sectional study was conducted in Ondo State, Nigeria, study period was from November 2017 to August 2018, data collection took place from July to August 2018. Sample size was calculated at the 0.95 confidence level (1.96), and given that, the prevalence of contraceptive implant utilization is 16% (7) as well as 5% chance of loss, a total of 230 participants were selected after adjusting for no-response rate. Women aged between 15-49 years who were attending family planning clinics in the State during the study period were invited to participate. Participants' selection was by the multi-stage sampling technique. First, six out of the 18 LGAs in the State were randomly selected. All the facilities rendering family planning services in each the 6 LGAs were listed and second-stage selection was done through systematic random sampling. The number of participants from each facility was determined proportionally to the population it covers.

The questionnaire was validated by scrutinizing for face and content validity. This was achieved through the use of relevant literature and by presenting the questionnaire to researcher's supervisor, statistician and other research experts who help to review the items on the questionnaire in order to improve sentence construction, clarity and the suitability of items.

Reliability

The reliability of this instrument was done conducting a pre-test method whereby few questionnaires were distributed to participants in the family planning clinic of Akure North primary health care Local Government Area of Ondo State in which 10% of sample size respondent was selected. Informed consent was taken and data from the retrieved questionnaire was coded, organized and analyzed to determine the internal consistency of the instrument. The Cronbach Alpha was calculated. A reliability of greater than or equal to 0.7 was considered satisfactory or acceptable for this instrument. The values of correlation coefficients of the questionnaire were 0.79. Participants who consented to participate in the study were allowed to fill the questionnaire (Appendix 1). The questionnaire consisted of two sections, the first collected information on the participants' sociodemographic characteristics (9 items) while the second section included questions about the utilization of contraceptive implants (20 items). Statistical analysis of the data collected was done through SPSS version 23. The mean and standard deviation (SD) were calculated for quantitative variables (e.g. age) while frequencies and percentages were obtained for categorical variables. The women were asked about the types of family planning they have ever used. Those who stated to have used contraceptive implants were coded as 'yes' meaning utilization of contraceptive implants while those who used other methods were coded as no'. Possible associations between utilization of contraceptive implants and the socio-demographic/economic and other explanatory variables were tested by means of the chi-square method. Variables that were significant at 20% with Chi-square were moved into the logistic regression model. Level of Statistical significance was set at $p \leq 0.05$ on two-tailed tests.

Results

A total of 230 women of child bearing age assessing family planning clinics in Ondo State were selected for this study. The mean age was 30.9 ± 6.8 years. More than 80% were married and belonged to the Yoruba tribe. About two-third (63.9%) were Christians while others practiced Islamic religion (36.1%). The educational status of the respondents was moderately high with 45.7% and 40.4% having completed secondary and tertiary levels respectively. Occupation-wise, majority were traders (60.0%), civil servants (23.0%) or students (10.4%). About 40.0% have had 1-2 children, 45.8% had 3-4 children and 14.4% have previously had more than 4 children. The mean age at first delivery and marriage were 24.0 ± 4.2 and 23.0 ± 4.4 years respectively (Tab. I).

The major source of information about contraceptive implants were health workers (69.4%) friends (19.2%) and media (8.3%) (Fig.1)

The prevalence of contraceptive utilization (any method) and contraceptive implant utilization were 92.2% and

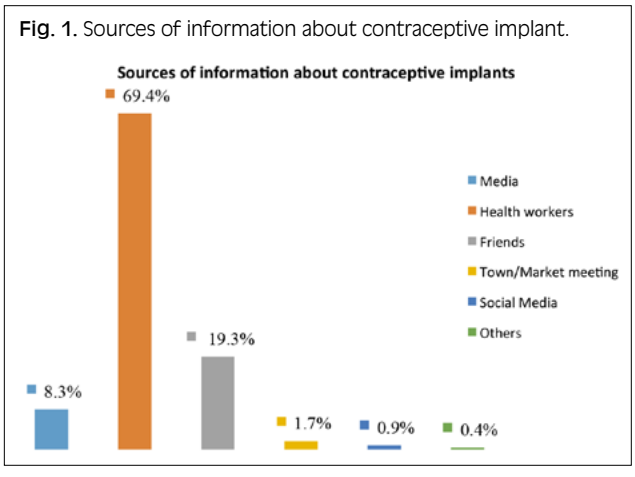

Fig. 1. Sources of information about contraceptive implant.

Tab. I. Socio-demographic characteristics of the respondents.

Variables	Frequency	Percentage
Age (years)		
≤ 29	106	46.1
30-39	90	39.1
40-49	34	14.8
Mean ± SD		30.9 ± 6.8
Tribe		
Yoruba	185	80.4
Hausa	16	7.0
Ibo	29	12.6
Marital status		
Single	16	7.0
Married	199	86.5
Divorced	15	6.5
Religion		
Christianity	147	63.9
Islam	83	36.1
Education		
Primary/None	32	13.9
Secondary	105	45.7
Tertiary	93	40.4
Occupation		
Civil servant	53	23.0
Student	24	10.4
Trading	138	60.0
Others	15	6.6
Number of children		
1-2	86	39.8
3-4	99	45.8
> 4	31	14.4
Age at first delivery (years)		
≤ 24	111	52.6
25-29	80	37.9
≥ 30	20	9.5
Mean ± SD		24.0 ± 4.2
Age at marriage (years)		
≤ 24	138	65.4
25-29	56	26.5
≥ 30	17	8.1
Mean ± SD		23.0 ± 4.4

Tab. II. Utilization of contraceptive methods.

Variables	Frequency	Percentage
Contraceptive method ever utilized		
Pills	42	19.8
Injectable	34	16.0
Implants	66	31.1
Condom	59	27.8
Female sterilization	11	5.2
Duration of use of the method		
One month	24	11.9
Two months	42	20.8
Three months	44	21.8
Three years	51	25.3
Five years	41	20.3
Reason for changing contraceptive method		
Side effects	57	28.2
Husband disapproval	91	45.1
Others	54	26.7
Reason for stopping contraceptive use		
Expensive	18	8.9
Side effects	114	56.4
Others	70	34.7
Reason for contraceptive use		
Reversible	32	15.8
Effective and long term protection	110	54.5
Easily available	26	12.9
Convenient to use	34	16.8

31.1% respectively. Other types of contraceptive methods that had been used by the participants were condom (27.8%), pills (19.8%), injectables (16.0%) and female sterilization. About two-thirds have been using contraceptives for the past three months. The major reasons for changing or stopping contraceptive use were husband's disapproval (45.1%) and side effects (56.4%) respectively while the major reasons for current usage of any contraceptive implants were its effectiveness in offering long term protection (54.5%) (Tab. II), the desire to have good maternal health and satisfaction with information given on insertion procedure and services rendered by the healthcare provider. However, some (< 45%) were afraid of pain, side effects and menstrual abnormalities, and have husbands who disapproves it's use (Tab. III).

Education was significantly associated with the utilization of contraceptive implant. Utilization of contraceptive implants was significantly lower in women with primary or no education (18.8%) compared with those who had secondary (37.1%) and tertiary (22.6%) education ($\chi^2 = 6.91$, p = 0.03) (Tab. IV). Also, significant relationship was found to exist between the lack of counseling from providers and utilization of contraceptive implant. Women who were counseled by health care providers (33.7%) utilized contraceptive implants more than those who did not get counseling (17.9%) and this association was statistically significant ($\chi^2 = 5.05$, p = 0.03) (Tab. V). Multivariable analysis also revealed that only education and lack of counseling from providers were significant predictors of contraceptive implant utilization. Women with secondary and tertiary education have higher odds of utilizing contraceptive implants (OR = 1.21, 95% CI = 1.01-7.82, p = 0.04) and (OR = 2.53, 95% CI = 1.49-11.47, p = 0.03) compared to women who had primary or no education while those who claimed to be adequately counseled by providers are about are about two times more likely to use contraceptive implants (OR = 2.33, 95% CI = 1.08-5.51) as shown in Table VI.

Discussion

This study therefore assessed the predictors of contraceptive implant utilization among women of reproductive age group in Ondo State, South-West Nigeria, with a view to make appropriate recommendations that will enhance the uptake of family planning services.

This study carried out among the women of reproductive age group in Ondo State showed that the highest

Tab. III. Reason for Utilization of contraceptive implants.

Items	Yes (%)	No (%)
I need motivation to accept contraceptive implant	131 (59.0)	91 (41.0)
I need to inform my husband to enhance acceptance	125 (56.3)	97 (43.7)
I desire good maternal health	187 (84.2)	35 (15.8)
I am satisfied with information on procedure of insertion	204 (92.7)	16 (7.3)
I am satisfied with services rendered by the healthcare provider	185 (83.3)	37 (16.7)
I desire to stop child bearing by considering contraceptive implant	145 (65.3)	77 (34.7)
Fear of side effects	108 (48.6)	113 (51.4)
I am not willing to use contraceptive Implant	73 (32.9)	149 (67.1)
Desire to have more children	101 (45.5)	121 (54.5)
Afraid of pain	100 (45.0)	122 (55.0)
Menstrual abnormalities	98 (44.1)	124 (55.9)
Need to change contraceptive methods	87 (44.1)	135 (60.8)

Tab. IV. Associations between socio-demographic characteristics and utilization of contraceptive implants.

Variable	Utilization		χ^2	p value
	Non users (%)	Users (%)		
Age (years)				
≤ 29	78 (73.6)	28 (26.4)		
30-39	64 (71.1)	26 (28.9)		
40-49	21 (63.3)	12 (36.4)	1.21	0.55
Tribe				
Yoruba	133 (71.9)	52 (28.1)		
Hausa	11 (68.8)	5 (31.3)		
Ibo	20 (69.0)	9 (31.0)	2.40	0.30
Marital status				
Never married	14 (87.5)	2 (12.5)		
Once married	150 (70.1)	64 (29.9)	2.20	0.16
Religion				
Christianity	102 (69.4)	45 (30.6)		
Islam	62 (74.7)	21 (25.3)	0.73	0.45
Education				
Primary/None	26 (81.3)	6 (18.8)		
Secondary	66 (62.9)	39 (37.1)		
Tertiary	72 (77.4)	21 (22.6)	6.91	0.03
Occupation				
Civil servant	37 (69.8)	16 (30.2)		
Student	16 (66.7)	8 (33.3)		
Trading	102 (73.9)	36 (26.1)		
Others	9 (60.0)	6 (40.0)	1.71	0.64
Number of children				
1-2	57 (66.3)	29 (33.7)		
3-4	75 (75.8)	24 (24.2)		
> 4	19 (61.3)	12 (38.7)	3.24	0.20
Age at first delivery (years)				
≤ 24	80 (72.1)	31 (27.9)		
25-29	53 (66.3)	27 (33.8)		
≥ 30	13 (65.0)	7 (35.0)	0.92	0.63
Age at marriage (years)				
≤ 24	98 (71.0)	40 (29.0)		
25-29	38 (67.9)	18 (32.1)		
≥ 30	10 (58.8)	7 (41.2)	1.12	0.57

age group of respondents was in the range 15-29 years. This trend was also found in a community-based study where about half of respondents surveyed were in this age range [13]. The mean age obtained in this study was also close to that obtained from a study conducted at Ibadan [14], another city in South-West, Nigeria. Approximately, eight out of every ten respondents in this study were married.

According to previous studies, contraception prevalence rate among women was in the range of six to seven for every ten respondents that were married [13-15]. However, other studies carried out among rural women

Tab. V. Associations between other explanatory variables and utilization of contraceptive implants.

Variable	Utilization		χ^2	p value
	No	Yes		
Lack of counseling from providers				
Yes	46 (82.1)	10 (17.9)		
No	110 (66.3)	56 (33.7)	5.05	0.03
Religious opposition				
Yes	63 (75.9)	20 (24.1)		
No	93 (66.9)	46 (33.1)	2.01	0.16
Cultural beliefs				
Yes	70 (75.3)	23 (24.7)		
No	86 (66.7)	43 (33.3)	1.91	0.17
Limited knowledge about methods				
Yes	60 (70.6)	25 (29.4)		
No	96 (70.1)	41 (29.9)	0.01	0.94
Desire for more children				
Yes	74 (71.8)	29 (28.2)		
No	82 (68.9)	37 (31.1)	0.23	0.63
Associated medical illness				
Yes	27 (81.8)	6 (18.2)		
No	129 (68.3)	60 (31.7)	2.47	0.12

Tab. VI. Predictors of the utilization of contraceptive implants.

Variables	Odds Ratio	95% CI	p-value
Marital status			
Never married	1		
Once married	2.74	0.96-7.82	0.06
Education			
Primary/Never	1		
Secondary	1.21	1.01-7.82	0.04
Tertiary	2.53	1.49-11.47	0.03
No of children			
1-2	1		
3-4	0.58	0.29-1.15	0.12
> 4	1.77	0.67-4.63	0.25
Lack of counseling from providers			
Yes	1		
No	2.33	1.08-5.51	0.05
Religious Opposition			
Yes	1		
No	0.92	0.34-2.47	0.87
Cultural beliefs			
Yes	1		
No	1.53	0.60-3.88	0.37
Associated medical illness			
Yes	1		
No	1.41	0.49-4.11	0.52

in Ikeji Arakeji, south-western part of Nigeria [16] and among women attending antenatal clinic in Uyo, southern part of Nigeria [17] showed a higher percentage of respondents to be married (97.1% and 93.7%, respectively). These higher percentages, compared to our study, may be due to the fact that the Ikeji Arakeji study was carried out among rural women, and the majority of women in the reproductive age group being married is an indicator of a rural environment [16] the Uyo study was carried out among antenatal attendees who were pregnant and were also expected to be married.

In this study the prevalence of contraceptive implant utilization was 31.1%, this was much higher than the 10.1% reported in a study conducted in Ethiopia [8] Contraceptive implant appears to be a less attractive option for a fairly large proportion of women in some other parts of Nigeria, Africa and the world compared to this current study. The overall prevalence use of Implanon was 18.6% in Southern Nigeria [18] 7% and 3.6% in Western Nigeria [19, 20] 16.0% in South Africa, 1.9% in Uganda [21], 4.8% in Singapore [22] and 22% in rural Pakistan [23]. The differences in the uptake of contraceptive implants in other research in contrast to this

study could be attributed to factors such as study settings, sample sizes, religions and marital status.
In this study, the major predictors of utilisation of contraceptive implants were education and lack of counselling from providers unlike in other studies where age, religion, residence, education, ethnicity, and media exposure to family planning [24] and number of living children and number of modern contraceptives known [8] as significant predictors of current use of contraceptive methods.
Participants with higher education preferred contraceptive implants and had higher odds of using it compared with those who had lower education. The potential reason for this finding may be that respondents with secondary and tertiary education levels were able to manage information correctly and are aware of the advantages of using implants as a contraceptive, namely its convenience, and that it does not require compliance and repeat visits to health facilities. We also found that proper counseling by health workers led to higher odds of contraceptive implant utilization among the women. Therefore, health workers' knowledge of family planning counseling and services should be constantly upgraded to improve their roles in educating, mobilizing, counseling the women regarding contraceptive implant insertion.

Limitations

This study has important limitations. First, the design is cross sectional in nature. Therefore, it may be difficult to confirm a cause-effect relationship. Moreover, the women selected for this study were found in health facilities. Also this study may lack external validity and the findings may not be applicable to women in other geographical locations

Conclusions

This study showed implications for the development of effective family planning programs that encourage contraceptive adherence, especially targeting specific groups like the male partner and religious leaders. Programs should help build self-efficacy of women through multi-sectorial approaches that empower women to discuss their family planning concerns. This study also revealed the important role of health workers in providing information about contraception. Therefore, their knowledge of family planning counseling and services should be constantly upgraded to improve their roles in educating, mobilizing, counseling, and providing contraceptive implant insertion and this will ultimately improve its utilization by women. This study also revealed that high level of awareness did not translate to high contraceptive implant use. In light of the advantages associated with contraception use, there needs to be a conscious effort, especially among health care workers, to educate women about contraception and encourage its use.

Ethical statement

All the participants recruited gave consent. Participation in the study was voluntary and the participants were told they could withdraw from the study at any time if they feel so. Information gotten from the study participants were kept confidential. Also, the participants were not exposed to any form of harm. The study was approved by the Ethics Committee of the Ondo State Ministry of Health with protocol no OSHREC/09/07/18/054.

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Conflict of interest statement

The authors declare no conflict of interest.

Authors' contributions

OO, CN conceived and designed the study, OO collected data for the study, CN supervised the conduct of the study, PIA, contributed to the study design and sampling methodology, analyzed the data and presented its findings. All authors read and approved the last version.

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Appendix 1

QUESTIONNAIRE

PREDICTORS OF CONTRACEPTIVE IMPLANTS UTILIZATION AMONG WOMEN OF REPRODUCTIVE AGE IN ONDO STATE, SOUTHWEST NIGERIA

SECTION A: SOCIO - DEMOGRAPHIC CHARACTERISTICS

Instruction: Fill in or tick as appropriate in the spaces provided

1. Age **(at last birthday) :**_____ years
2. Tribe**: a**. Yoruba ( ) **b.** Hausa ( ) **c**. Ibo ( ) **d**. Others (specify) _____
3. Marital Status: **a.** Single ( ) **b**. Married ( ) **c**. Divorced ( ) **d**. Separated ( ) **e**. Widow ( )
4. Religion: **a**. Christianity ( ) **b**. Islam ( ) **c.** Others_____
5. Educational Qualification: **a**. No Formal Education ( ) **b**. Primary ( ) **c.** Secondary ( ) **d**. Tertiary ( ) **e**. Others (specify) _____
6. Occupation: **a**. Civil Servant ( ) **b**. Student ( ) **c**. Trading ( ) **d**. Others (specify)_____
7. Number of Children (Alive?)_____
8. Age at first delivery _____
9. Age at marriage _____

SECTION B: UTILIZATION OF CONTRACEPTIVE IMPLANTS

Instruction: Please tick as appropriate in the spaces provided.

10. Have you ever utilized any contraceptive methods, what type ever used **a**. Pills ( ) **b**. Injectable ( ) **c**. Implants ( ) **d**. Condom ( ) **e**. Female sterilization ( ) **f**. Vasectomy ( )
11. Duration of contraceptives methods ever used **a**. one month ( ) **b**. two months ( ) **c**. three months ( ) **d**. three years ( ) **e**. five years ( ) **f**. specify
12. Reason to change contraceptive method **a**. side effects ( ) **b**. husband disapproval ( ) **c**. specify other reasons_____

13. Reason to stop contraceptive use **a.** expensive ( ) **b**. side effects ( ) **c**. specify other reasons_____

14. Reason for contraceptive implant use **a**. reversible ( ) **b**. effective and long term protection ( ) **c**. easily available d. convenient to use ( )

15. Reason for preference of Contraceptive use **a**. expensive ( ) **b**. side effects ( ) **c**. specify_____

16. Reason for not currently using Contraceptive implants **a**. use of other methods ( ) **b**. desire for more children ( ) **c**. medical reason ( ) **d**. religion ( ) **e**. Unmarried

S/N	**ITEMS**	Yes	No
17	I need motivation to accept contraceptive implant		
18	My husband disapproves its use		
19	I desire good maternal health		
20	Fear of side effects		
21	I desire to stop child bearing by considering contraceptive implant		
22	I am satisfied with information on procedure of insertion		
23	I am satisfied with services rendered by the healthcare provider		
24	I am not willing to use contraceptive Implant		
25	I need to inform my husband to enhance acceptance		
26	Desire to have more children		
27	Afraid of pain		
28	Menstrual abnormalities		
29	Ever change contraceptive methods		

ORIGINAL ARTICLE

Risk perception of heat related disorders on the workplaces: a survey among health and safety representatives from the autonomous province of Trento, Northeastern Italy

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Keywords

Awareness • Heat Stress Disorders • Climate Changes. Occupational Health • Safety representatives • Cross-Sectional study

Summary

Introduction. *This study will investigate knowledge, attitude and practices towards heat-related health issues in a sample of safety representatives from Northern Italy (H&SRs).*
Methods. *A cross-sectional questionnaire survey was conducted in 2016-2017 among 298 H&SR. Knowledge status was measured both in general but as well and focusing on first-aid issues. Assessment of risk perception included severity and frequency of heat-related events. Multivariate logistic regression analysis assessed individual and work-related characteristics associated with H&SRs' risk perception.*
Results. *258 questionnaires were retrieved (participation rate 86.6%; mean age 48.2 ± 8.4 years). Knowledge status was relatively good on technical/preventive issues (62.3% ± 16.8) and first aid measures (72.6% ± 27.2), but a large share of respondents ignored the risk from exertional heat stroke (35.9%), and for heat strokes elicited by non-environmental heat (e.g. machineries, use of protective equipment, etc. 47.9%). The majority of respondents acknowledged the high frequency of extreme events like heat waves (62.0%), but only 44.6% agreed on their potential health threat, with an unsatisfying cumulative risk perception score (55.4% ± 23.5). A specific first-aid formation course was reported by 49.2% of respondents, while 10.9% had any previous interaction with heat-related disorders. Specific countermeasures for heat waves had been put in place by parent company in 20.1% of cases. Eventually, higher educational achievements (mOR 2.239, 95% CI 1.184-4.233) and a better general knowledge status (mOR 1.703, 95% CI 1.073-2.979) were positive predictors for higher risk perception.*
Conclusions. *Although H&SRs exhibited a good understanding of heat-related health issues, stakeholders should improve the implementation of specific countermeasures on the workplaces.*

Introduction

Over the past decades average temperatures have globally increased: as recently stated by the Intergovernmental Panel on Climate Change (IPCC), warming from pre-industrial levels to the decade 2006-2015 ranges between 0.75°C and 0.99°C [1-5]. Alpine areas of the Mediterranean region have been particularly affected, with an increased number of extreme events, such as heat wave (HW) time periods (i.e. period of excessively hot weather, which may be accompanied by high humidity) [6-8]. For example, Autonomous Province of Trento (APT) not only has experienced a 0.9°C increase in average temperatures from 1971-2000, but the number of "*warm days*", "*warm nights*" (i.e. days/nights having average temperatures > 90th percentile of the reference period), and "*tropical nights*" (i.e. nights with minimum air temperature above 20°C) during the summer season has nearly doubled since 1970-2000, with raising concerns regarding occupational exposures [6, 9, 10].

Global climate change may impact on outdoor workers as a summary of indirect (e.g. vector-borne, rodent-borne diseases, etc.) and direct effects through extreme weather-related health effects, air pollution-related health effects, and temperature-related illness and death [1, 5, 11-15]. More specifically, the excessive exposure to intense or prolonged heat, resulting from a combination of external thermal environment, heat sources in the workplace, and internal heat generation by strenuous muscular work, can induce a continuum of disorders usually defined as heat-related illnesses (HRI) [7, 9, 16, 17], ranging from minor syndromes (i.e. heat cramps, heat syncope, and heat exhaustion) to the life-threatening heat stroke [9, 17]. High-risk groups for HRI include both outdoor (e.g. construction workers, agriculture and forestry laborers, parks/gardens rangers, road workers and local service workers) and indoor workers, especially for tasks performed nearby heat-generating equipment, or where ventilation is poor or air conditioning is not available, in particular for people with preexisting cardiovascular and heart-dis-

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ease [18-21]. Employment in hot environments would also increases safety risks, with increased occurrence of occupational injuries in workers exposed to high and severe-high temperature [1-3, 17, 22]. Moreover, individuals working under heat stress actually tend to make adjustments by either reducing the intensity of physical activity and the amount of work undertaken during the hottest part of the day [6, 7, 9, 16, 18, 23], or increasing hourly rest periods [9, 16, 18, 23, 24], ultimately impairing work efficiency [1, 3, 6, 7, 9, 16, 18, 19, 23-25] and economic productivity [1, 2, 20]. The risk assessment of this physical hazard has therefore not only to focus on environmental (climatic conditions) or other general organizational factors (e.g. intensity of physical work, insufficient water consumption, inadequate cooling off or rest periods, and inappropriate clothing), but has to consider certain individual factors that may cause dehydration (e.g. poor diet, vomiting, diarrhea or alcohol and caffeine consumption), some medical conditions (e.g. heart problems, diabetes, hypertension, or assumption of drugs altering the body's temperature regulation), or the presence of physiological factors related to age (young and older workers) and general physical fitness or weight (e.g. obesity or overweight), which may increase susceptibility to heat stress-related conditions [5, 9, 11, 19, 26-28].

Even though HRI are largely preventable, our understanding of the countermeasures across the workplaces remains limited [1, 8, 22, 29-31], but evidence suggests that an appropriate approach requires comprehensive efforts and cooperation from a range of stakeholders, including government organizations, occupational health and safety service providers (including both healthcare and technical providers), employers, and workers themselves, either directly or through health and safety representatives (H&SRs) [1, 8, 22, 29-31].

H&SRs are employees elected or appointed to represent workers with regards to aspects concerning health and safety at work [32-34], receiving from the parent company and peer-sharing information about risk assessment (including any dangerous substances, machineries, equipment, organization and working environments), preventive measures, as well as occupational injuries and diseases [32, 34]. Empowerment of H&SRs in the management of occupational health and safety has been proven as a quite effective measure for reducing rates of occupational injuries, as well as sickness absences in workplaces [35-37]. Therefore, studies assessing their awareness of the health threats associated with climate change and HRI, understanding their actual risk perception, and addressing their knowledge gaps, have the potential to improve both quality and appropriateness of real-life countermeasures envisioned by parent companies. Moreover, as qualitative and quantitative assessment of the latter is obviously difficult and remains fragmentary, a survey based on H&SRs rather than on individual workers may allow their quicker and more factual appraisal. However, few studies from the Western Europe have specifically inquired H&SRs on this topic [3, 9, 29]. The purpose of the present study is therefore to answer the following research questions:

1. How high is the level of awareness and concern of H&SRs towards climate changes and HRI?
2. What are the determinants of the risk perception towards heat and severe heat in H&SRs?

Materials and methods

A questionnaire based on a cross-sectional survey was performed in August 2016-March 2017 in the APT. A convenience sample of 258 H&SRs was collected among the participants to a series of educational events on occupational health and safety (n = 298, participation rate 86.6%).

Settings

APT is located in the Alpine sector of North Eastern Italy, covers a total area of 6,214 km^2 (2,399 sq. mi) and has a population of 539,898, for a total workforce of 241,000 (2018 census). The territory is overwhelmingly mountainous (70% over 1,000 m, and 20% is over 2,000 m), and APT may be ultimately defined as a cluster of side valleys "*held together*" by the Adige river. Provincial economy is characterized by a large service sector (67.6% of total workforce), with a very large public sector (20% of the total workforce), while the remaining workforce is employed in large number of small private firms in the industrial and agricultural sectors, having an average size of 3.7 employees. Economic performances of APT have often outperformed that of Italy, with unemployment rates that remained significantly lower than national average (5.1 to 5.5% in 2018 *vs* 10.1 to 11.1% at national level) [38, 39].

Instruments

Shortly before the beginning of the courses, H&SRs who gave preliminary consent received by hand a structured questionnaire that inquired their KAP about heat-related risks on the workplaces. The questionnaire was developed after a comprehensive review of the literature on heat exposure and occupational health, and included the following items [1-3, 8, 14, 17, 18, 29, 30, 40-44]:

Basic information about the interviewee: i.e. gender, age, country of origin, seniority, educational level, preferred information sources on occupational health and safety, seniority as H&SR;

Aspects of working environments: participants were initially asked about the economic sector (i.e. agriculture and forestry, construction and mining, manufacturing, services and healthcare, public administration), overall size of the parent enterprise (categorized in: < 10 workers, 10 to 19, 20 to 249, 250 to 999, more than 1000), and the settings of working activities (i.e. mainly indoors, mainly outdoors, both indoors and outdoors). Participants were then asked to self-assess selected HRI risk factors on their workplaces: exposure and direct exposure to sunlight (yes/no), presence of heat sources (yes/no), requirement of strenuous physical activity (yes/no),

mandatory use of personal protective equipment (PPE; i.e. gloves, helmets, goggles, respirators, airways protection devices, and protective clothing impermeable or thick clothing). H&SR were then inquired trough a 5-point Likert scale (ranging from "*totally against*" to "*totally agree*") to report whether they perceived a high heat burden during the summer season, whether they felt overall heat burden as uncomfortable or not and whether previous episodes of HRI requiring first aid or medical intervention had been reported in the parent enterprise in the previous three years, including known work compensation claims. Implementation of preventive measures towards heat-related risks (i.e. provisions of cool drinking water; rescheduling of working time; implementing of controlled rest area; stopping work for air temperatures higher than 40.0°C) was ultimately retrieved, specifically focusing on formation courses about heat risk, first-aid procedures for HRI, and the availability of warnings/advices from the employer during HWs.

Knowledge of heat-related risks. Knowledge of heat-related risks was assessed by means of three subscales: (a) General Knowledge; (b) Knowledge of Clinical Features associated with HRI, (c) Knowledge of First Aid options. All subscales were calculated as follows. Firstly participants received a series of true-false statements (e.g. *Body temperature is usually higher than 38°C*"; FALSE) covering general typical misconceptions on heat exposure, heat-related disorders, and recommended countermeasures [23, 24, 45], and more precisely: 20 items defined a General Knowledge Score (GKS), 9 the knowledge of clinical features, and 9 of First Aid options. When the participant correctly answered, +1 was added to a sum score, whereas a wrong indication or a missing answer added 0 to the sum score. Potential scores ranged therefore 0 to 20 for GKS, and 0 to 9 for knowledge of clinical features, and first aid options.

Risk perception: risk perception has been defined as a function of the perceived probability of an event and its expected consequences, being assessed as the mathematical product of subjective probability and disease severity [46]. Therefore, participants were asked to rate perceived severity (HS) and frequency (HF) of work-related HRI through a fully labelled 5-point Likert scale ("almost zero", "low or rather low", "moderate", "high or rather high", "very high"; scored 1 to 5, respectively). A cumulative Risk Perception Score (RPS, potential range 1 to 25) was obtained through the formula

$$RPS = HS * HF$$

Ethical considerations

In accordance with the declaration of Helsinki, participants were adequately informed of the aims and institutional settings of the study, that participation was voluntary, that all collected information would be handled anonymously and confidentially, that the final examiners of professional course were blind regarding their status (i.e. whether they had participated or not to the survey). Participants were also guaranteed that they may withdraw from the survey in any time, simply not delivering the questionnaire. As the study design assured an adequate protection of study participants, being implausible that individual participants could be identified based on the presented material, and neither included clinical data about patients nor configured itself as a clinical trial, its preliminary assessment by Ethical Committee of the Provincial Agency of for Health Services (APSS) was not statutorily required.

Data analysis

Two independent researchers, one of whom read the responses from each questionnaire while the other researcher reviewed the entered data, ensured the accuracy of data entry. Doubtful cases (i.e. heterogeneous interpretation by researchers involved in data entry) and unclear responses were reviewed by the primary investigator in order to determine which answer had to be assumed as "correct". Questionnaire lacking basic information about the interviewee were excluded from the study. A preventive reliability test was performed on synthetic scores through determination of Cronbach's alpha.

All cumulative scores were normalized to percent values in order to more easily compare the scales (min 0.0%, max 100%). Continuous variables (i.e. age, synthetic scores) were expressed as mean ± standard deviation, and their distribution was preventively assessed by means of Kologomorov-Smirnov test. Bivariate correlation between continuous variables was assessed through calculation of the Pearson's correlation coefficient.

Univariate confrontations between proportions were performed through Chi-squared test (with continuity correction) in order to examine correlates of personal and occupational factors with the outcome variable RPS, assessed as as high (i.e. > median) and low (i.e. ≤ median) RPS. In the analyses, all knowledge subscores (i.e. GKS, knowledge of clinical features, and knowledge of First Aid Option) were similarly dichotomized by median value in high (> median) *vs* low (≤ median) score. In order to assess the relative influence of individual and occupational factors on the outcome variable represented by higher RPS, multivariate odds ratios (mOR) with the respective 95%CI were calculated through a multivariate regression model. The final model included all factors whose association with higher RPS in univariate analysis was significant, i.e. $p < 0.05$. All analyses were performed by means of SPSS 25 (IBM Corp. Armonk, NY).

Results

Demographics and characteristics of the working environment

As shown in Table I, the majority of participants were males (93.0%), with a mean age of 48.2 ± 8.4 years, of Italian origin (89.5%), reporting educational achievements equals (58.1%) or higher than high school (12.0%).

Tab. I. Characteristics of 258 Health and Safety Representatives participating to the survey.

	No./258, %	Mean ± SD
Gender		
Men	240, 93.0%	
Females	18, 7.0%	
Age group (years)		48.2 ± 8.4
20-29	6, 2.3%	
30-39	40, 15.5%	
40-49	93, 36.0%	
50-59	99, 38.4%	
≥ 60	20, 7.8%	
Migration background		
Yes (Foreign born people)	27, 10.5%	
No (Italian born people)	231, 89.5%	
Education level		
Primary/Secondary school (up to 8 years of formal education)	77, 29.8%	
High School (9-13 years of formal education)	150, 58.1%	
University or more	31, 12.0%	
Preferred information source on occupational health and safety		
Healthcare provider	89, 34.4%	
Professional courses	73, 28.2%	
Conventional media	37, 14.3%	
New Media	36, 13.9%	
Friend, relatives, Colleagues	23, 8.9%	
Seniority as health and safety representative		
< 10	26, 10.1%	
10 – 19	88, 34.1%	
20 or more	144, 55.8%	
Economic Sector		
Agriculture and forestry	48, 18.6%	
Construction and mining	56, 21.7%	
Manufacturing	70, 27.1%	
Services	45, 17.4%	
Public administration	39, 15.1%	
Workplace size (No. of workers)		
< 10	22, 8.5%	
10-249	139, 53.9%	
250-999	57, 22.1%	
1,000 or more	40, 15.5%	
Settings of working activities		
Indoors (mainly)	123, 47.7%	
Outdoors (mainly)	38, 14.7%	
Indoors and Outdoors	97, 37.6%	
Risk factors for heat stroke / heat illness in the workplaces		
Exposure to the sunlight	153, 59.3%	
Direct exposure to the sunlight	111, 43.0%	
Presence of heat sources (machineries, etc.)	142, 55.0%	
Job tasks requiring strenuous physical effort	127, 49.2%	
Use of insulating Personal Protective Equipment during job tasks	61, 23.6%	
Perceived Heat Stress on the workplace		
High heat burden (summer season, subjective)	157, 60.9%	
Uncomfortable heat burden	161, 62.4%	
Preventive measures towards excessive heat burden by parent company	157, 60.9%	
Do you receive warning and advice from your employer during heat waves?	47, 18.2%	
Previous episodes of heat related health disorders (previous 3 years)		
Any	28, 10.9%	
1 episode	9, 3.5%	
Up to 1 episode/year	13, 5.0%	

continues

Tab. I. *Follows.*

More than 1 episode/year	6, 2.3%	
Episode(s) considered heat-related compensation claim(s)	10, 3.9%	
Heat wave related preventive measures		
Any	52, 20.1%	
Increased number of pauses	30, 11.6%	
Rescheduling/Stop of working activities	18, 6.9%	
Free fresh water	18, 6.9%	
Climatized areas	16, 6.2%	
Multiple measures	18, 6.9%	
Somehow satisfied for the preventive measures of the parent company	136, 52.7%	
Received first-aid formation for Heat Stroke	127, 49.2%	
Knowledge status		
General knowledge score		62.3% ± 16.8
Knowledge of symptoms associated with Heat-related Illnesses		61.8% ± 30.1
Knowledge of first aid interventions for Heat-related Illnesses		72.6% ± 27.2
Risk perception		
High/very high severity of Heat-related Illnesses	115, 44.6%	
High/very high frequency of Heat-related Illnesses	160, 62.0%	
Risk perception score		55.4% ± 23.5

Around a third majority of respondents identified healthcare providers as their main information source (34.4%), followed by professional courses (28.2%), and conventional media (14.3%). More than half of H&SRs participating into the survey had a seniority of 20 years or more (55.8%), mainly from manufacturing (27.1%), construction/mining (21.7%), agriculture/forestry (18.6%) economic sectors, followed by services (17.4%) and public administration (15.1%). Eventually, the study population principally included enterprises having 10 to 249 employees (53.9%), or even larger companies (37.6%). Around half of the respondents (47.7%) reportedly worked indoors, while 37.6% of them distributed their working shift in indoor and outdoor activity. Sunlight exposure was reported by 59.3% of participants (direct exposure: 43.0%), while heat sources were referred by 55.0% of H&SRs, and around half of participants described their work as moderately or highly physically demanding (49.2%), with 23.6% of them reporting the use of insulating PPEs.

Overall, 60.9% agreed / totally agreed that their workplace was characterized by high heat burden, while 62.4% complained an uncomfortable heat burden. Less than a fifth (18.2%) of respondents received warning of advices from the employer in case of HW events.

A case of HRI that required first aid or medical intervention in previous 3 years was reported by 28 participants (10.49%): of them, 10 (35.7%) were considered heat-related compensation claims. Even though 60.9% of H&SRs reported some countermeasures for excessive heat in the workplace, and 52.7% were satisfied by the interventions issued by parent companies, preventive measures specifically designed for severe hot climate during warm season and HWs were reported only in 20.1% of cases: more specifically, the majority of enterprises had increased the number of daily pauses (11.6%), implemented rescheduling or stop of working activities (6.9%), provided free cool drinking water (6.9%), and installed climatized resting areas (6.2%). In 18 cases (6.9%) multiple measures were identified. Eventually, around half of H&SR participating to the survey (49.2%) had reportedly received some information on first aid procedures for serious heat illnesses.

Knowledge of heat-related risks

Internal consistency coefficient of the General Knowledge test amounted to Cronbach's alpha = 0.786. After percent normalization, GKS was quite good, being estimated in 62.3% ± 16.8 (actual range 0.0% to 90.0%, median 65.0%). However (Tab. II), when focusing on the single statements, some more uncertainties were scored on the meaning of shivering (59.8%), on the possible impairment of sweating in the elderly (52.1%) and more specifically on the meaning of blood flow in the heat dispersal (i.e. 47.9% were aware that reducing blood flow does not increase heat dispersal, while only 36.7% recognized the role of an increased blood flow). Interestingly enough, while 90.7% correctly recalled the moistening of the skin with fresh fluids for reducing body temperature, and around two thirds of participants were aware that energy drinks should be avoided in case of heat stroke (68.3%), only 57.9% of respondents identified fresh liquids as useful for maintaining a lower body temperature, and 37.1% recognized warm/hot fluids as useful in order to reduce body temperature. In this regard, H&SRs had a good understanding of body temperature, as 81.1% were aware that it is usually < 38°C, and 76.8% correctly recalled that very high body temperatures (i.e. > 39°C) are potentially lethal. A greater share of misbelieves was scored on the risk factors for heat stroke, as a third of respondents did not recognize among them physical activity (64.1% of correct answers), while around half of respondents understood

Tab. II. General Knowledge test: response distribution of presented item in the 258 Health and Safety Representatives participating to the survey.

Statements	Correct answer	No., %
1. Body temperature is usually higher than 38°C	False	210, 81.1%
2. Shivering reduces body temperature	True	155, 59.8%
3. Drinking warm/hot fluids is useful to reduce body temperature	False	97, 37.1%
4. Sweating is instrumental in dissipating excessive heat	True	206, 79.5%
5. A reduced blood flow to the skin enhances heat dispersal	False	124, 47.9%
6. An increased blood flow to the skin enhances heat dispersal	True	95, 36.7%
7. Wearing thicker working cloths is useful to maintain low body temperature	False	155, 59.8%
8. Wearing thinner working cloths is useful to maintain low body temperature	True	157, 60.6%
9. Drinking fresh liquids maintain low body temperature	True	150, 57.9%
10. Moistening the skin with fresh fluids reduces body temperature	True	235, 90.7%
11. Sweating is useful to reduce body temperature	True	185, 71.4%
12. Sweating may be impaired by drugs	True	181, 69.9%
13. In case of high environmental temperatures, sweating is always present	False	169, 65.3%
14. In elderly, sweating may be constitutively impaired	True	135, 52.1%
15. Working in hot, humid environments may cause severe health complaints	True	224, 86.5%
16. Heat stroke may follow severe physical activity	True	166, 64.1%
17. Heat stroke may take place only in warm and humid environments	False	135, 52.1%
18. Only children and elders are at health risk in case of high temperatures	False	220, 84.9%
19. Very high body temperatures (i.e. > 39°C) are potentially lethal	True	199, 76.8%
20. In case of heat stroke, drinking "energy drink" may be useful	False	177, 68.3%

heat stroke as taking place only in warm and humid environments (52.1%).

Also the overall knowledge of health issues was sufficient, as the understanding of HRI signs and symptoms was estimated in 61.8% ± 30.1 (actual range 0.0% to 100%, median 66.7%; Cronbach's alpha = 0.818). Still, some uncertainties were identified for vague symptoms such as nausea (47.3%) and fatigue and/or weakness (38.8%) (Fig. 1a).

First aid options were appropriately recalled by a large share of respondents (cumulative score, 72.6% ± 27.2; actual range 0.0 to 100%; median 77.8%; Cronbach's alpha = 0.798), and particularly the use of cool water (81.8% of correct answers), the opportunity to call local emergency number as soon as possible (78.7%), to and restrain the injured exposure to the heat sources, by moving him/her into a shady or air-conditioned place (if available, 79.5%), rapidly deactivating nearby working equipment (76.7%), and letting fresh air flow into the working environment (77.9%). On the contrary, some uncertainties were identified in the use of coffee and/or alcoholics (65.1%), as well as for the direct managing of the injured, i.e. the opportunity for removing tight or heavy clothing (70.2%%), and laying the person down, elevating legs and feet (i.e. Trendelenburg position) in order to improve blood flow (62.0%).

Risk perception

Less than half of respondents identified HRI in occupational settings as potentially severe or very severe (44.6%), while 62.0% reported them as frequent or very frequent. As a consequence, a cumulative RPS of 55.4% ± 23.5 was calculated, with an actual range of 16.0% to 100% (median, 60.0%).

Univariate analysis

A significant, negative correlation between RPS and knowledge of HRI symptoms was identified at univariate analysis ($r = -0.221$; $p < 0.001$), i.e. participants showing a better understanding of HRI health issues apparently had a lower risk perception, and vice versa. GKS was well correlated with knowledge of health issues ($r = 0.270$, $p < 0.001$) and of first aid interventions ($r = 0.319$, $p < 0.001$). In turn, cumulative knowledge scores for HRI symptoms and first aid interventions were similarly well correlated ($r = 0.543$, $p < 0.001$).

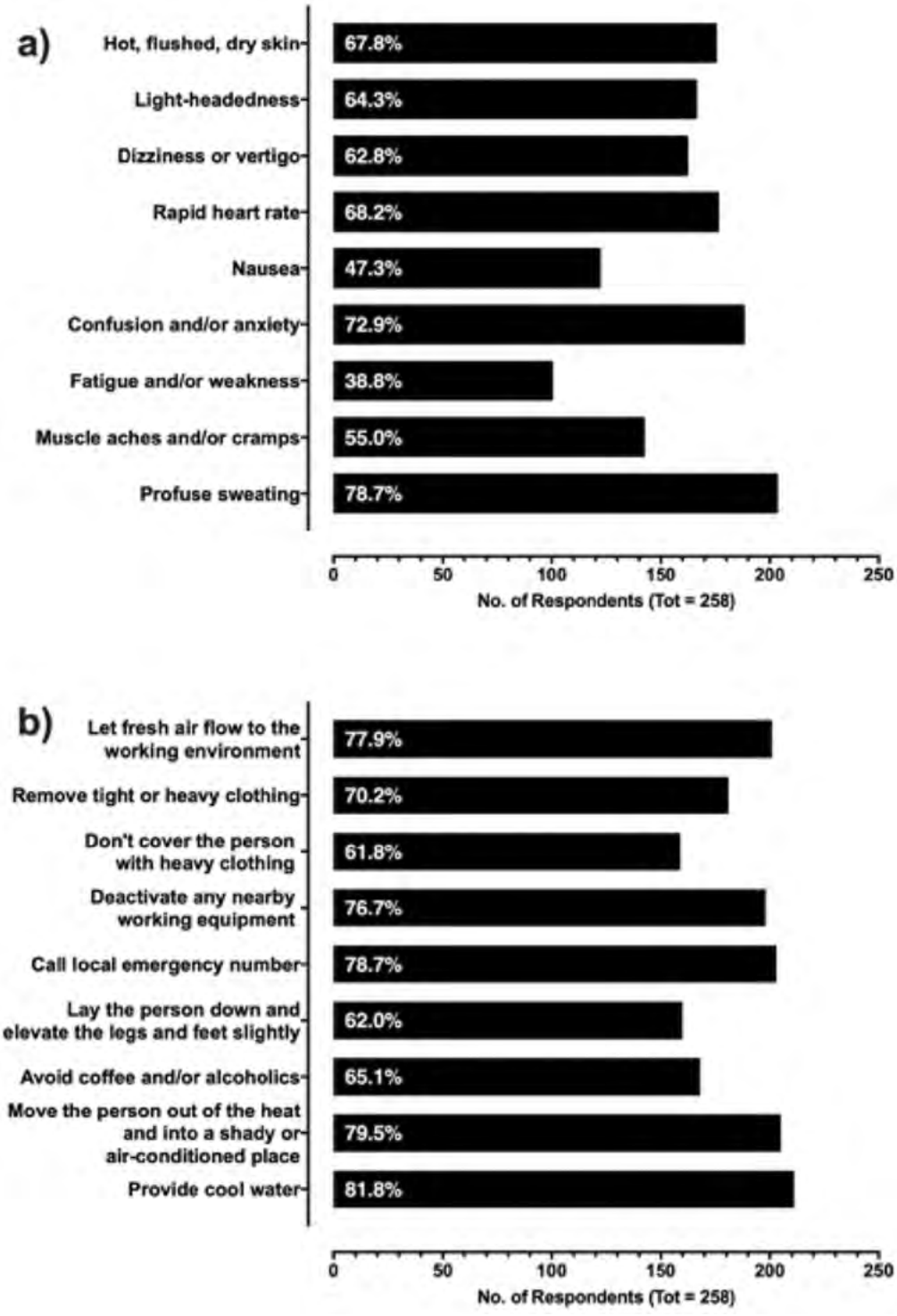
In univariate analyses (Tab. III), higher RPS (i.e. > median, 60.0%) was negatively associated with male sex (85.2% *vs* 98.7% of H&SRs scoring RPS ≤ 60.0%, $p < 0.001$), reporting a healthcare provider as main information source (26.9% *vs* 40.0%, $p = 0.028$), recalling the presence of heat sources on the workplace (47.2% *vs* 60.7%), and referring an uncomfortable heat burden (51.9% *vs* 69.3%, $p = 0.006$). On the contrary, it was positively associated with age ≥ 50 years (53.7% *vs* 40.7%, $p = 0.038$), higher educational status (82.4% *vs* 61.3%), and higher GKS (63.0% *vs* 44.7%, $p = 0.005$).

In binary regression analysis, a significantly negative association with the Risk Perception was confirmed only for male sex (mOR 0.083, 95% CI 0.018-0.393), whereas higher educational achievements (mOR 2.239, 95% CI 1.184-4.233) and scoring a better GKS (mOR 1.703, 95% CI 1.073-2.979) were positive predictors for higher RPS.

Discussion

In our study, we specifically inquired a sample of H&SRs from a highly developed region of Western Europe on

Fig. 1. Knowledge status of 258 Health and Safety Representatives (H&SRs) participating to the study (Autonomous Province of Trento, 2016-2017). Knowledge of symptoms associated with Heat-Related Illnesses (HRI, section A) and first aid interventions (section B) were specifically inquired.



their knowledge and risk perceptions towards heat risk and HRI in the workplaces. Despite the mixed acknowledgement of the threat represented by climate change, and particularly by the increased incidence and severity of HWs, our results suggest a quite good understanding of this theme, with relatively few knowledge gaps. Interestingly enough, risk perception was significantly associated with a better GKS and higher educational level, underlining the substantial impact of appropriate information and education of workers in the process of building up appropriate awareness towards health risks [31]. Such results have practical implication, as 2 of the 3

Tab. III. Association of individual characteristics of 258 Health and Safety Representatives (H&SR) participating to the survey with Risk Perception Score (RPS) > median value of 60.0%. Multivariate analysis was performed by means of a logistic regression model that included all factors associated with higher RPS in univariate analysis with $p < 0.05$ (note mOR = multivariated Odds Ratios; mOR; 95% CI = 95% confidence intervals).

Variable	RPS	Chi squared test p value	mOR	95%CI	
	> 60.0% (No./108, %)	≤ 60.0% (No./150, %)			
Male Sex	92, 85.2%	148, 98.7%	< 0.001	0.083	0.018; 0.393
Age ≥ 50 years	58, 53.7%	61, 40.7%	0.038	0.705	0.401; 1.241
Migration background	9, 8.3%	18, 12.0%	0.457	-	-
Education level > 8 years of formal education	89, 82.4%	92, 61.3%	< 0.001	2.239	1.184; 4.233
Healthcare provider as main information source	29, 26.9%	60, 40.0%	0.028	0.500	0.274; 2.997
Seniority as H&SR ≥ 20 years	51, 47.2%	93, 62.0%	0.571	-	-
Economic Sector			0.070	-	-
Agriculture and forestry	15, 13.9%	33, 22.0%			
Construction and mining	19, 17.6%	37, 24.7%			
Manufacturing	31, 28.7%	39, 26.0%			
Services	20, 18.5%	25, 16.7%			
Public administration	23, 21.3%	16, 10.7%			
Workplace size > 250 workers	38, 34.3%	60, 40.0%	0.419	-	-
Settings of working activities, mainly indoors	57, 52.8%	66, 44.0%	0.205	-	-
Risk factors for heat stroke / heat illness in the workplaces					
Exposure to the sunlight	59, 54.6%	94, 62.7%	0.243	-	-
Direct exposure to the sunlight	42, 38.9%	69, 46.0%	0.312	-	-
Presence of heat sources (machineries, etc.)	51, 47.2%	91, 60.7%	0.044	0.691	0.385; 1.240
Job tasks requiring strenuous physical effort	49, 45.4%	78, 52.0%	0.355	-	-
Use of insulating PPE during job tasks	25, 23.1%	36, 24.0%	0.874	-	-
Perceived Heat Stress on the workplace					
High heat burden (summer season, subjective)	61, 56.5%	96, 64.0%	0.275	-	-
Uncomfortable heat burden	56, 51.9%	104, 69.3%	0.006	0.616	0.338; 1.122
Preventive measures towards excessive heat burden by parent company	63, 58.3%	94, 62.7%	0.154	-	-
Do you receive warning and advice from your employer during heat waves?	24, 22.2%	23, 15.3%	0.211	-	-
Previous episodes of heat related health disorders (previous 3 years)					
Any	13, 12.0%	15, 10.0%	0.762	-	-
Episode(s) considered heat-related compensation claim(s)	4, 3.7%	6, 4.0%	0.837	-	-
Heat wave related preventive measures	61, 56.5%	96, 64.0%	0.222	-	-
Somehow satisfied for the preventive measures of the parent company	51, 47.2%	85, 56.7%	0.170	-	-
Received first-aid formation for Heat Stroke	53, 49.1%	74, 49.3%	0.932	-	-
Knowledge Status (> median)					
General Knowledge Score (> 65.0%)	68, 63.0%	67, 44.7%	0.005	1.703	1.073; 2.979
Knowledge of Symptoms associated with Heat-related Illnesses (> 66.7%)	49, 45.4%	65, 43.3%	0.843	-	-
Knowledge of First Aid interventions for Heat-related Illnesses (> 77.8%)	46, 42.6%	64, 42.7%	1.000	-	-

factors modeling the vulnerability to HRI (i.e. heat exposure, individual sensitivity, and the capacity to adapt) can be extensively (i.e. adaptation) or at least partially (i.e. actual heat exposure) influenced by risk perception and knowledge status [1, 9, 29, 47, 48], while a prompt identification of HRI cases followed by appropriate first aid measures are instrumental in avoiding their more severe outcomes [9, 29, 49, 50].

With the notable exception of some uncertainties on the immediate management of heat stroke, including its possible not-environmental etiology, and the diffuse but minor conceptual disbeliefs about thermal regulation, the comprehensively appropriate knowledge status of H&SRs was not unexpected. First of all, we instrumentally inquired a very qualified subset of workers: not only H&SRs are in fact highly qualified being the target specific training and formation courses, but they are also highly motivated and involved in carrying out the functions requested, even if the company rarely consults them regarding the health and safety at work regulations [33], but they often exhibit an understanding of workplace issues that exceed that of the employers themselves. As H&SRs are instrumental in both recognizing occupational health threats and disseminating appropriate practices across the workplaces [8, 9, 29], improving their knowledge status and filling knowledge gaps has the potential to improve heat prevention and management strategies on the workplaces [13, 17, 22, 31, 43, 49, 50]. Secondly, available studies have suggested that workers may display sufficient or even good awareness of the issues associated with climate changes and hot working environments [8, 50]. More specifically, while physicians find sometimes difficult to recognize early stages of HRI [9, 23, 51, 52], workers often exhibit a good knowledge of symptoms and possible outcomes of excessive heat exposure, particularly in high risk settings [3, 19, 29]. In facts, reports from people working outdoors (e.g. in agriculture and construction), in hot indoor or enclosed environments (e.g. drivers and miners), wearing heavy, insulating equipment (e.g. pesticide applicators), and whose jobs require considerable physical exertion (e.g. athletes, firefighters, and military personnel) have frequently recorded high rates symptoms such as muscle cramps, increased heart rate, light-headedness, dizziness and/or vertigo, whose association with heat exposures was well understood by study participants [18, 52, 53]. On this regard, it should be stressed that nearly half of respondents exhibited some complaints towards the actual heat burden in their workplaces, and that around 10% of them were able to recall for the previous three years at least one episode of possible work-related HRI. Even though no significant association between personal experiences with risk perception was eventually reported, their role in the building up of personal awareness is sound and well recognized, representing a cornerstone of the health belief model [49, 54]. It is possible that personal experiences have been involved also in modeling the moderate concerns towards HRI and high working temperatures we identified, whose assessment is otherwise conflicting with available reports [3, 9, 43]. For instance, in some studies up to 90% of participants are moderately or even very concerned about extreme heat resulting in increased hazards in the workplace [43]. Some explanations may be tantalizingly proposed.

Firstly, half of respondents were somehow satisfied with the preventive measures put in place by the employer towards working in high temperatures, while a fifth of responders were able to recall preventive measures specifically designed for severe-high environmental temperatures and HWs. In other words, the rational understanding of the actual heat-related risks was possibly battled by a complicated interplay of individual (e.g. previous experiences, confidence in the preventive measures, etc.) and external factors, including workplaces characteristics (e.g. availability of protective equipment, etc.), but also information sources [28, 55]. In fact, univariate analysis suggests that respondents reporting healthcare providers as the main information source have lower risk perception (26.9% *vs* 40.0%). These results may appear somehow inconsistent, but it should be stressed that while conventional media and new media frequently stress the emotional aspects of climate change, rising even inappropriately the concerns of their audience, more scientifically accurate information sources (e.g. professional courses, healthcare professionals, etc.) usually describe such phenomenon through a rational understanding that may be inappropriately understood as a sort of downgrading [1, 3, 29, 50, 55]. In this regard, a further iteration of our study will assess whether H&SRs participating to the index formation courses have retained or not a more appropriate approach towards climate changes and their health issues. A cofactor in downgrading estimates for risk perception was possibly represented by the final composition of our study population. Actually, we oversampled male workers, and not only male sex was associated with a general underestimation of the risk perception, but also in previous studies women usually did perceive risks more than men [1, 3, 44].

Notwithstanding their acknowledged appropriateness, reported countermeasures were only limitedly evidence based. Such report is of particular interest, allowing a sort of rough but extensive assessment on the factual reactions of employers to the climate changes. In fact, parent companies preferentially opted for simpler and cheaper interventions such as increasing the number of pauses or even "stopping work" when the air temperature was extremely hot. Even though such policies are both diffusely applied and apparently cost-effective [43, 56], their actual implementation in workplaces has proved to be difficult, as many preventable deaths continue to occur throughout the world during the summer months. Interventions for adapting workplace to the climate change through climatization or improved ventilation plants were reported only by few respondents (6.2%): this not surprising, as redesigning workplaces in order to avoid or minimize heat exposure of the workers may be sometimes difficult, or largely exceeding the available resources [1, 6, 29]. However, it is noteworthy that simple, effective but relatively cheap interventions such as increasing availability of fresh drinking water and rescheduling daily activities in order to avoid hottest hours of the day were reported only be few H&SRs, underlying their inappropriate diffusion.

Despite its potential interest, our report is affected by several limitations. More precisely, while H&SRs represent a key feature role in the management of occupational health and safety, their knowledge and risk per-

ception should be only cautiously interpreted as proxies for general working population [34]. Not only the sensibility of H&SRs towards occupational health and safety issues may be significantly higher than that of workers not included in the safety representatives [33-35], but H&SRs are often involved in the design of countermeasures towards heat risks, with a consequently significant self-confidence in preventive interventions that we cannot rule out [6, 7, 9, 29, 52, 56].
Secondly, our sample was of limited size, with a regional basis, and Italy has been repetitively acknowledged as highly heterogeneous in terms of socioeconomically development, education level, and also occupational health practices are strikingly regionalized [57-59]. Furthermore, the majority of participants were employed in enterprises of medium or even large size, while around 90.0% of the firms in APT has less than 10 employees, and more than two-fifths (43.5%) of employees work in firms with less than 10 employees [38, 39]. As a consequence, the sample we presented may limitedly representative, and further generalization of our results may be inappropriate.
Thirdly, the participation rate was quite high (> 80% of the original population), and participating voluntarily could be caused by a proactive attitude or due to a greater perceived knowledge about the assessed topics, while the fact of not participating could be related to a negative attitude or a lack of knowledge, and that supposedly inflated the knowledge assessment [9, 24]. Similarly, it is possible that the results of the three subscores of the knowledge tests had been inflated by participants reporting "*socially appropriated*" rather than their authentic answers (i.e. *social desirability bias*) [52, 60, 61].

Conclusions

In summary, we described knowledge and risk perceptions of H&SRs towards heat-associated risk in the workplaces, specifically focusing on HRI. At the same time, we identified the main countermeasures that were put in place by parent companies. Even though our results may be only cautiously generalized to the general working population, we were able to identify a good understanding of such themes that were otherwise associated with unsatisfying risk perception. In particular, our results stress the importance of interventions aimed to improve the knowledge of workers on the occupational safety in hot climates, specifically focusing on the actual efficacy of available preventive countermeasures. In fact, it is possible that we ultimately assessed an overconfidence in assessed countermeasures, whose actual efficacy in reducing morbidity and mortality of severe heat has been repetitively questioned. As climate changes could increase the yet significant relevance of heat exposure on the workplaces, the inappropriate risk perception of study participants demonstrates an urgent need to raise the level of awareness of workers, and particularly H&SRs, towards heat-related risks and pros and cons of adaptive measures.

Furthermore, in consideration of the principles of European OHS legislation requiring a global evaluation of occupational hazards by the employers, it is urgently needed that policymakers implement OHS European directives to consider outdoor workers at risk due to climate change in their respective national laws [11, 15].

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Conflict of interest statement

All persons who meet authorship criteria are listed as authors, and all authors certify that they have no affiliation with or involvement in any organization or entity with any financial interest, or non-financial interest (such as personal or professional relationship, affiliation, knowledge of beliefs) in the subject matter or material discussed in the manuscript.

Authors' contributions

MR and CP conceived the study. MR, BR, LP, CP contributed to data acquisition and performed the data entry. MR, AGM, FB contributed to the interpretation of the results. MR, BR, FB and AGM wrote the manuscript, with input from all authors

Disclosures

The facts, conclusions, and opinions stated in the article represent the authors' research, conclusions, and opinions and are believed to be substantiated, accurate, valid, and reliable. However, as this article includes the results of personal researches of the Authors, presenting correspondent, personal conclusions and opinions, parent employers are not forced in any way to endorse or share its content and its potential implications.

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ORIGINAL ARTICLE

Attitudes and thoughts of medical practitioners towards their profession in the era of financial crisis in Greece

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Keywords

Medical doctors • Occupational relations • Quality of life • Workload

Summary

Introduction. *The financial crisis which started in Greece about 10 years ago has affected the income of citizens, their quality of life, as well as social and occupational relationships. Aim of the present study was to assess the attitudes towards working conditions and personal life and to explore quality of life, as well as disorders in physical condition, sleep, mood and their predictors, among doctors working or being trained in a tertiary hospital of NE Greece.*
Methods. *Included were 133 medical students and doctors of all ranks (61.7% males) practicing medicine in a university tertiary hospital in Greece. All of them answered a 31-item questionnaire regarding their working conditions, and personal life, daytime activities and sleeping habits.*
Results. *In general, the majority reported dissatisfaction with the work environment, the salary and they rated their quality of life worse than that of the general population. Weekly workload exceeded 60 hours for the majority. No difference between sexes was revealed, with the exception of use of energy drinks which was more prevalent in males (70.7% vs. 51%, p = 0.022). Comparison between ranks revealed that medical students performed better in everyday activities and socialization, although prevalence of reported fatigue was higher in them. Finally, it was demonstrated that surgeons used more frequently medication to achieve sleep promotion (80.4% vs. 36%, p < 0.001) and daily energy (78.4% vs. 44%, p < 0.001).*
Conclusions. *An overall dissatisfaction regarding workload, salary and quality of life is recorded among doctors of a tertiary hospital in Greece, with different coping strategies among subgroups.*

Inroduction

The ongoing financial crisis in Greece, which started about 10 years ago, has affected not only the income of citizens in the country, but also quality of life, social and occupational relationships. Several studies have reported the adverse impact of the current financial crisis on healthcare and population health [1]. It is actually suggested that the current situation led not only to a decrease in self-rated health status, but to general difficulties on public health policies regarding health promotion. In addition, the provided healthcare services have been adversely affected [2-4].
In this context, working conditions can be severely affected, especially since employees experience job insecurity [5]. In addition, and due to the applied policies towards hiring fewer personnel, usually under temporary terms, greater work intensity is observed, accompanied often by occupational stress and burn-out. Moreover, changes in attitudes towards the profession itself, towards colleagues and personal life are reported among healthcare workers with a significant deterioration in the already affected by other factors, such as shift work, work- life balance and sleep quality [6, 7].
Aim of the study was to assess attitudes towards working conditions and personal life and to record quality of life, positive or negative attitude, as well as disorders in sleep, mood, and physical condition and to explore independent variables that predict those among doctors working or being trained in a tertiary hospital of NE Greece.

Methods

Study design, population and questionnaire

Included were doctors practicing medicine in a tertiary university hospital in the area of Alexandroupolis, NE Greece. More specifically inclusion criteria were the following: individuals studying medicine exclusively at the last (sixth) year of undergraduate studies with certain duties in the clinics and licensed doctors (medical residents or specialty holders) with clinical practice duties with medical or surgical specialties. Doctors practicing laboratory or diagnostic specialties were not included in the study. All participants were asked to participate voluntarily by answering to questionnaire comprising 31 questions about their demographics (age, sex, marital status), their working conditions (medical specialty, rank, workload, etc.), their quality of life, symptoms (anxiety, change in body weight, etc.) and sleep habits (use of sleep promoting medication, daytime sleepiness

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etc.). Most questions were answered in a 5-point Likert scale. The distributed questionnaire was based on that used by Bohrer et al. [8], modified after a pilot study on 10 doctors, so as to better depict the conditions in a Greek hospital environment. More specifically, the questionnaire was translated from German to Greek and back-translated to German by two independent bilingual individuals. The initially enrolled participants (n = 10) answered the questionnaires in the presence of two members of the research team, to whom they reported their comments and suggestions, regarding the inclusion or exclusion of certain items. The survey took place between January and October 2016. The study protocol received approval of the Ethics Committee of our Institution.

Statistical analysis

Statistical analysis of the data was performed using IBM Statistical Package for the Social Sciences (SPSS), version 19.0 (IBM Corp., Armonk, NY, USA). Descriptive statistics (expressed as % percentages for qualitative values and as mean ± SD for quantitative values) were used. Comparisons between different subgroups, depending on sex, occupational rank, and medical specialty were performed using t-test and ANOVA. Multivariate stepwise linear and logistic regression models were constructed to explore the independent association of general and demographic characteristics of the participants on their attitudes. Standardized beta regression coefficients, coefficients of determination R2 and adjusted odds ratios (OR) with their 95% confidence intervals (CI) were estimated as the measure of the above associations. Cronbach's α coefficient was used to evaluate the internal consistency of the questionnaire. This was found to be 0.77, which indicates a very high internal consistency of the questionnaire. All tests were two tailed and statistical significance was considered for p values < 0.05.

Results

Out of the 198 initially approached, 140 medical doctors consented to participate and received the questionnaire with the obligation to deliver it the next day to members of the research team. (Fig. 1) Finally 133 questionnaires were gathered (response rate 67.2%).

Participants' general characteristics

Mean (± SD) age of participants was 36 ± 12.5 years, ranging between 23 and 63 years. No difference was observed in terms of age, between males and females (36 ± 12 vs. 36 ± 13 years respectively, p = 0.847), nor between holders of internal medicine or surgical specialties (40 ± 11 vs. 40 ± 12 years respectively, p = 0.749). The rest of the participants' general characteristics are being displayed in Table I. As seen, the majority (64.7%) works for more than 60 hours/week, with a 24.1% of them reporting weekly workload exceeding 80 hours.
Attitudes towards their work, personal life and satisfaction are summarized in Table II. As seen in this Table,

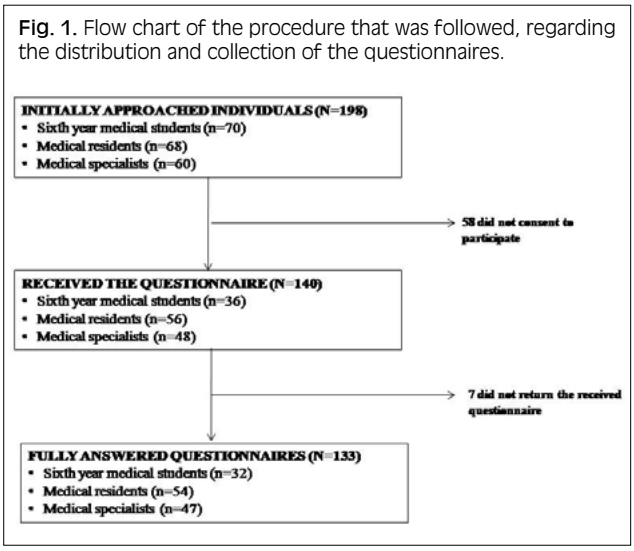

Fig. 1. Flow chart of the procedure that was followed, regarding the distribution and collection of the questionnaires.

Tab. I. General and demographic characteristics of the participants.

	N	%
Sex		
Male	82	61.7
Female	51	38.3
Family status		
Married	50	37.6
Single or divorced	83	62.4
Occupational rank		
Medical student	32	24.1
Medical resident	54	40.6
Specialist	47	35.3
Medical specialty		
Surgical	51	50.5
Medical	50	49.5
Weekly workload		
< 40 hour	0	0
40-49 hours	22	16.5
50-59 hours	25	18.8
60-79 hours	54	40.6
≥ 80 hours	32	24.1

the majority (68.4%) characterized their weekly workload as excessive, while they are neither satisfied with the working environment (satisfaction was reported by 32.3%), nor with the salary (satisfied were only 198%). Participants also consider their quality of life worse than that of the general population, as well as their patients'. The only positive finding was that the majority (54.9%) believes that there are still opportunities for continuous medical education. Moreover, in a 5-point Likert scale, the mean (± SD) value of the importance of personal life was high among participants, i.e. 4.01(±0.95), however mean (± SD) time for personal life was lower 2.34 (± 1.10).

Comparison between males-females

Tables III and IV both display the comparison in prevalence of different symptoms between sexes. As seen in

Tab. II. Attitudes towards their life and profession (whole sample, unless otherwise indicated).

	N	%
Experience excessive workload	91	68.4
Satisfied with their work environment	43	32.3
Satisfied with their salary (students excluded)	20	19.8
Have the opportunity for continuous medical education	60	59.4
Believe that their quality of life is worse than that of general population	73	54.9
Believe that their quality of life is worse than that of patients	61	45.9

Table III, a significantly larger proportion of men reported using energy-promoting medication. No other statistically significant difference was observed. Additionally, comparison of sleep quantity ranking, in a 5-point Likert scale: (0 = no sleep, 5 =excessive sleep time), did not revealed any difference [1.96 ± 0.94 for females and 1.72 ± 0.99 or males (p = 0.164)].

Comparison between ranks

As a further step, an analysis comprising comparison between occupational ranks was performed and is displayed in Table V. As seen in Table V, students scored significantly better in terms of everyday activities, ability to be satisfied, socialization and team work. Moreover, a significant difference was observed regarding the use of sleep-promoting medication, which was more common among specialists, and less common among medical students. Additionally, a statistically significant difference was observed in reports of fatigue and/or weakness, with medical students reporting the higher. Sleep quantity was rated as better in students in comparison to both residents and specialists, as seen in section 5b of the Table.

Effect of age

The impact of age on attitudes of the participants was also explored. Pearson's correlation analysis revealed a significant association between age and negative mood (i.e older age is associated with negative feelings) with r = 0.209, p = 0.016. A negative association pattern was revealed between age and socialization (i.e. older participants report at a lesser level the will to socialize) with r = -0.245, p = 0.053.

Comparison between medical/ surgical specialties

The next step involved the exclusion of medical students, and the analysis of the same answers between doctors of medical and surgical specialties, as seen in Table VI. As displayed in this Table, doctors practicing internal medicine reported sleeping more in a 5-point Likert scale (< 0.001), and they rated better their ability to perform in everyday activities (< 0.001), their positive attitude (p = 0.023), socialization (p = 0.030). On the other hand, surgeons reported using more frequently

Tab. III. Comparison between males and females in rating with a 5-point Likert scale, activities, feelings and attitudes (0 = not at all - 5 = totally).

	Females	Males	p
Everyday activities	2.49 ± 1.22	2.15 ± 1.23	0.118
Ability to be satisfied	2.80 ± 1.22	2.88 ± 1.34	0.743
Positive feelings	2.55 ± 1.32	2.57 ± 1.47	0.924
Negative feelings	2.84 ± 1.12	2.73 ± 1.28	0.611
Socialization	2.82 ± 1.49	2.72 ± 1.24	0.665
Team work	2.98 ± 1.17	2.88 ± 1.26	0.641

Tab. IV. Comparison between males and females in reported symptoms and medication use.

	Females	Males	p
	N (%)	N(%)	
Excessive daytime sleepiness	25 (49%)	45 (54.9%)	0.511
Use of medication to be more energetic and fulfill daily activities	26 (51%)	58 (70.7%)	0.022
Use of sleep-promoting medication	25 (49%)	48 (58.5%)	0.284
Experienced anxiety in an intense way	30 (58.8%)	40 (48.8%)	0.259
Headache or other physical pain	24 (47.1%)	32 (39%)	0.362
Fatigue, weakness	28 (54.9%)	47 (57.3%)	0.785
Change in body weight	20 (39.2%)	37 (45.1%)	0.503
Normal sex life	22 (43.1%)	29 (35.4%)	0.370

medication to stay active (< 0.001) or to promote sleep (< 0.001). However, surgeons rated better their feeling of belonging in a team (p = 0.003).

Factors that predict attitudes/thoughts towards the profession

Finally, multivariate linear regression analyses, which were performed with participants' attitude as the dependent variable, revealed the following:

- Independent determinants of the ability to perform in everyday activities were: a) being resident (standardized coefficient beta = -0.332, p = 0.002, R2 change = 4.0%) and b) being specialist (beta = -0.217, p = 0.045, R2 change = 2.9%).
- Independent determinant of the ability to be satisfied was being a resident (beta = -0.341, p < 0.001, R2 change = 11.6%).
- Independent determinant of negative feelings was age (beta = -0.209, p = 0.016, R2 change = 4.4%).
- Independent determinants of socialization were a) being α resident (beta = -0.344, p = 0.001, R2 change = 3.3%) and b) being α specialist (beta = -0.431, p < 0.001, R2 change = 3.0%).
- Independent determinants of shorter sleep duration were a) being α resident (beta = -0.457, p < 0.001, R2 change = 5.5%) and b) being α specialist (beta = -0.364, p = 0.001, R2 change = 8.3%).

Tab. V. Comparison between occupational ranks rating with a 5-point Likert scale activities, feelings and attitudes. (0 = not at all - 5 = totally).

5a: Comparison in activities, feelings and attitudes				
	Student	Resident	Specialist	p
Everyday activities	2.81 ± 1.03	1.98 ± 1.31	2.26 ± 1.17	0.009
Ability to be satisfied	3.31 ± 1.12	2.33 ± 1.34	3.13 ± 1.04	< 0.001
Positive feelings	2.31 ± 1.47	2.59 ± 1.57	2.70 ± 1.16	0.478
Negative feelings	2.88 ± 1.26	2.94 ± 1.12	2.51 ± 1.28	0.179
Socialization	3.56 ± 1.52	2.63 ± 1.41	2.36 ± 0.82	< 0.001
Team work	3.13 ± 1.07	2.93 ± 1.34	2.77 ± 1.18	0.444
5b: Comparison in reported symptoms and medication use				
	N (%)	N(%)	N(%)	
Excessive daytime sleepiness	19 (59.4%)	32 (59.3%)	19 (40.4%)	0.114
Use of medication to be more energetic and fulfill daily activities	22 (68.8%)	35 (64.8%)	27 (57.4%)	0.562
Use of sleep-promoting medication	14 (43.8%)	27 (50%)	32 (68.1%)	0.026
Experienced anxiety in an intense way	16 (50%)	29 (53.7%)	25 (53.2%)	0.942
Headache or other physical pain	17 (53.1%)	16 (29.6%)	23 (48.9%)	0.051
Fatigue, weakness	25 (78.1%)	24 (44.4%)	26 (55.3%)	0.010
Change in body weight	11 (34.4%)	24 (44.4%)	22 (46.8%)	0.523
Normal sex life	14 (43.8%)	21 (38.9%)	16 934%)	0.680
How do you rank the quantity of your sleep? (In a 5-point Likert scale: 0 = no sleep, 5 = too much)				
	2.44 ± 0.62	1.54 ± 0.97	1.7 ± 0.99	0.001
	Student vs. resident			< 0.001
	Student vs. specialist			0.002
	Resident vs. specialist			0.634

Tab. VI. Comparison between doctors practicing medical vs. surgical specialties in rating with a 5-point Likert scale (0 = not at all - 5 = totally) in activities, feelings and attitudes (6a) and in reported symptoms and medication use (6b).

	Medical	Surgical	p
6a:			
Everyday activities	2.56 ± 1.07	1.67 ± 1.26	< 0.001
Ability to be satisfied	2.46 ± 1.16	2.94 ± 1.33	0.056
Positive feelings	2.96 ± 1.38	2.33 ± 1.34	0.023
Negative feelings	2.96 ± 1.26	2.73 ± 1.28	0.611
Socialization	2.76 ± 1.28	2.25 ± 1.00	0.030
Team work	2.48 ± 1.29	3.22 ± 1.14	0.003
6b			
Excessive daytime sleepiness	28 (56%)	23 (45%)	0.273
Used a medication to be more energetic and to fulfill your daily activities	22 (44%)	40 (78.4%)	< 0.001
Used sleep-promoting medication	18 (36%)	41 (80.4%)	< 0.001
Experienced anxiety in an intense way	28 (56%)	26 (51%)	0.613
Headache or other physical pain	19 (38%)	20 (39.2%)	0.900
Fatigue, weakness	22 (44%)	28 (54.9%)	0.273
Change in body weight	25 (50%)	21 (41.2%)	0.373
Normal sex life	19 (38%)	18 (35.3%)	0.778
How do you rank the quantity of your sleep? (In a 5-point Likert scale: 0 = no sleep, 5 = too much)			
	2.08 ± 0.90	1.16 ± 0.83	< 0.001

- Independent determinants of higher use medication to be more energetic and fulfill daily activities were a) male gender (aOR = 2.58, 95% CI = 1.22-5.48, p = 0.013) and b) being single or divorced (aOR = 2.14, 95% CI = 1.01-4.54, p = 0.049).
- Independent determinant of higher use of sleep-promoting medication was being married (aOR = 2.40, 95% CI = 1.15-5.00, p = 0.020).
- Independent determinant of higher prevalence of headache or other physical pain was a) being student or b)specialist (aOR = 2.44, 95% CI = 1.17-5.06, p = 0.017).
- Independent determinant of higher prevalence of fatigue and/or weakness was being student (aOR = 3.64, 95% CI = 1.45-9.18, p = 0.006).

Multivariate linear regression analysis revealed also that surgical specialty remained an independent determinant of a) lower ability to perform in everyday activities (be-

ta = -0.360, p < 0.001, R2 change = 12.9%), b) of lower ability of positive attitude (beta = -0.227, p = 0.023, R2 change = 5.1%), c) of lower ability of socialization (beta = -0.217, p = 0.030, R2 change = 4.7%), d) of shorter sleep duration (beta = -0.474, p < 0.001, R2 change = 22.4%), a e) of better feeling of belonging in a team (beta = 0.337, p < 0.001, R2 change = 8.5%).
Finally, after controlling for all potential confounders, multivariate logistic regression analysis, revealed that surgical specialty remained an independent determinant of a) higher use medication to be more energetic and fulfill daily activities (aOR = 4.63, 95% CI = 1.94-11.05, p = 0.001) and of b) higher use of sleep-promoting medication (aOR = 7.86, 95% CI = 3.08-20.02, p < 0.001).

Discussion

The present study provides a view of the current situation in Greece regarding the attitudes and opinions of doctors towards their professional life and their quality of life in general. Literature in this topic is scarce, especially among doctors in Greece [9].
A study conducted in the early years of crisis aiming at investigating the prevalence and different associations of medical residents' burnout reported the following: a substantial proportion of medical residents were dissatisfied with the overall quality of training, as well as with menial tasks accompanying their medical duties [10]. As shown also in our study, older age was an important parameter which affected attitude towards peer interactions and excessive workload of menial tasks (scutwork). In the work of Msaouel et al, surgical residents were less likely to report satisfaction with peer interactions compared to other groups. On the contrary, in our study sample, surgeons ranked better in team work, in comparison to doctors practicing internal medicine. Still, they rated their ability to socialize and their positive attitude with lower.
Participants in our study reported increased workload, which is a significant hindrance in practicing medicine, especially for surgical specialties [11] and is strongly associated with burnout [12]. Indeed, all participants reported that their weekly workload exceeded 40 hours, while 64.75 of the participants reported working more than 60 hours/ week.
No difference was observed between males and females in the reported answers. In fact, males reported at a higher degree the use of energy promoting medication. This finding is in contrast with previous publications, where female gender, along with childcare, was found to be associated less with career advancement [11].
Certainly, there are limitations in the present study. For example, no data was available regarding marital status and child care. Additionally, burnout syndrome was not explored in depth with the use of a validated questionnaire. Finally, although participants were divided into medical and surgical specialists, no further information regarding their sub-specialty is available.
Nevertheless, this study depicts the current views of students and doctors practicing medicine in a tertiary hospital in Greece in the context of financial crisis , demonstrating a more negative attitude from the residents and specialist and a more positive and optimistic attitude from the medical students.

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Conflict of interest statement

The authors declare no conflict of interest.

Authors' contributions

EN drafted the manuscript, ZF and EK conceived and designed the study protocol, GT and TCC critically revised the manuscript all authors gave their final approval for the submission.

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ORIGINAL ARTICLE

Pertussis immunization in healthcare workers working in pediatric settings: Knowledge, Attitudes and Practices (KAP) of Occupational Physicians. Preliminary results from a web-based survey (2017)

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Keywords

Healthcare workers • Pertussis vaccine • Diptheria-Tetanus-acellular Pertussis Vaccines • Occupational physicians

Summary

Introduction. *The present study aims to characterize knowledge, attitudes and practices in a sample of occupational physicians (OPh) towards pertussis immunization in healthcare workers (HCWs) from pediatric settings.*

Material and methods. *A total of 148 OPh (45.9% males, mean age of 40.3 ± 13.2 years) compiled a web questionnaire including a knowledge test on Italian recommendations for HCWs, epidemiology and pathology of pertussis infection, being then investigated about risk perceptions and vaccination practices. A General Knowledge Score (GKS) and a Risk Perception Score (RPS) were calculated. Multivariate odds ratios (OR) for predictors of vaccine propensity were calculated through regression analysis.*

Results. *78 participants regularly recalled pertussis vaccination status and/or performed pertussis vaccination in HCWs (52.7%). Proactive status was correlated with the aim to avoid pertussis infection in HCWs and its diffusion to other adults ($p < 0.001$, both statements). GKS was satisfying (72.4% ± 14.9), but participants underestimated the clinical issues of pertussis infection (RPS 60.8% ± 9.5) when confronted with influenza (73.9% ± 10.9) and HBV infection (68.1% ± 10.1). GKS and RPS were well correlated ($r = 0.244$, $p = 0.003$). Eventually, a better GKS and the aim to avoid pertussis infection in HCWs were predictive of a proactive status for pertussis vaccination (OR 4.186 95%CI 1.809-9.685 and OR 11.459, 95%CI 3.312-39.651, respectively).*

Conclusions. *Adherence of OPh to HCWs pertussis vaccination was unsatisfying. As knowledge status was predictive for vaccine propensity, information programs for OPh should be more appropriately designed, stressing that HCWs may represent a significant reservoir for pertussis infection in high risk groups (e.g. children/newborns, frail elderly).*

Introduction

Pertussis is a highly contagious respiratory illness, caused by Gram Negative pathogen *Bordetella pertussis,* that can have serious, life-threatening consequences, including pneumonia, convulsions, apnea, encephalopathy, acute respiratory distress and even death [1-4]. Prognosis is particularly poor among infants < 6 months of age, a group too young to have completed the primary vaccination schedule. With 51.6 cases per 100,000 population in 2014, infants < 1 year-old are also characterized by highest age-specific rates, followed by the age group 10 to 14 year-old (24.4) [2]. However, pertussis is no longer and not solely a pediatric disease [5, 6]. On the one hand, individuals are believed to become susceptible to pertussis approximately 6 to 10 years after childhood vaccination [4]. On the other hand, because of a mixture of more awareness, better diagnostic, bacterial changes in the circulating pertussis strains, and more frequent vaccine hesitancy, an increasing incidence has also been reported in adolescents and adults [7-10]. Unfortunately, in older age groups the disease is often unrecognized, undiagnosed, and eventually unreported [4, 11, 12].

Due to their occupational contacts and poor vaccination rates, healthcare workers (HCWs) have become a significant reservoir to vulnerable patients in their care, stressing the importance for appropriate immunization programs [13, 14].

Implementation of immunization policies in workplaces is a main issue for Occupational Physicians (OPh), the medical professionals responsible for health promotion and prevention on the workplace [15]. OPh contribute to immunizations programs tailoring and applying official recommendations (i.e., National Immunization Plan or *Piano Nazionale della Prevenzione Vaccinale*, PNPV, in Italy; Standing Committee on Vaccination or *Ständigen Impfkommission*, STIKO, in Germany, etc.) [16-18]. Moreover, OPh are directly involved in the communication of risk, participating to the information and education of the workers [15, 19-21]: in Italy, Occupational Health and Safety Legislation requires that the Occupational physicians inquiry vaccination history, recall the

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vaccination status, and inform the workers about the pros and cons of recommended vaccinations [15-21]. More specifically, PNPV 2017-2019 identifies adult pertussis vaccination, included in tetanus-diphtheria-acellular pertussis (Tdap) formulate, as strongly recommended for all professionals working with newborns or infants: as a consequence, assessing the knowledge, attitudes and practices (collectively, KAP) of OPh on vaccinations of HCWs working in pediatric settings can be useful in order to tailor vaccination campaigns and improving vaccination rates, ultimately improving the patient safety profile [22]. The aim of this study is, therefore, to assess a sample of OPh about KAP on pertussis and relative vaccination policies for HCWs, and how KAP relate to these recommendations. Eventually, we attempted to identify areas that may be targeted for improvement through specific informative and educative campaigns dedicated to OPh.

Materials and methods

Study design. A cross-sectional questionnaire-based study was performed in the first half of 2017, involving OPh participating to six different private Facebook group pages and four closed forums focusing on occupational medicine, whose application was officially limited to OPh. As in Italy the only commercially available vaccine against pertussis in adulthood is the combined formulation Tdap, the invitation text was formulated as "*What do you think about Tdap vaccine*?". In total, the group pages had approximately 1,034 unique members (14.4% of all Italian OPh), but no information could be obtained regarding how many of these members were actively using Facebook. To post the study invitation on the closed (non-public) Facebook pages, the principal researcher contacted the group administrator and asked to be invited. Facebook users who clicked on the invitation text were provided with the full study information, an opportunity to give their informed consent, and a web link to the survey (Google Forms; Google LLC; Menlo Park, Carlifornia, USA). The survey was conducted in Italian. To be included in the sample, the OPh was supposed to be living and working in Italy in 2017, and to assist at least one healthcare provider that offers assistance to newborns and/or pediatric age (i.e. age < 14 years) patients: if a potential participant was found not to match the inclusion criteria, the survey closed down. The survey was anonymous, and no personal data such name, IP address, email address, or personal information unnecessary to the survey was requested, saved or tracked. No monetary or other compensation was offered to the participants.

Questionnaire

The questionnaire was formulated in Italian, and its test-retest reliability was preventively assessed through a survey on 10 OPh completing the questionnaire at two different points in time. The testing questionnaires were ultimately excluded from the final analyses. All questions were self-reported, and not externally validated. The final questionnaire comprised the following areas of inquiry:

1. **Individual characteristics.** Included: age, working age, sex, and medical specialization (i.e. in Italy, qualification as OPh is primarily obtained through specialization in occupational medicine, but also specialists in Hygiene and Public Health and in Legal/Forensic Medicine are legally authorized to work as OPh, if they complete a specific master's course, as well as all physicians who were operating as OPh before 1991). Finally, household characteristics were recalled (i.e. any children *vs* no children), and whether they had any previous professional interaction with cases of pertussis (yes *vs* no).
2. **General knowledge.** The questionnaire included a general knowledge test that contained a set of 12 true-false statements, elaborated through extensive literature review, covering typical misconceptions on Tdap (e.g. "*Vaccinating an adult against pertussis is useless"*; FALSE) [5, 9, 23-30]. A General Knowledge Score (GKS) was then calculated as the sum of correctly and incorrectly marked recommendations: when the participants correctly answered, +1 was added to a sum score, whereas a wrong indication or a missing "*don't know*" answer added 0 to the sum score.
3. **Risk perception.** Perceived risk has been defined as a function of the perceived probability of an event and its expected consequences, and therefore assessed as the mathematical product of subjective probability and disease severity [18, 31]. We inquired the risk perception of participants about the three components of Tdap vaccine and two further immunizations of occupational interest among HCWs, i.e. Hepatitis B Virus (HBV) and influenza. OPh were asked about: the probability of natural infection (I^{INF}) in HCW, the frequency of vaccine-related adverse effects (I^{VAC}), and whether they perceived the severity of the natural infections (C^{INF}) and vaccine-related adverse effects (C^{VAC}). In order to summarize the results, we used a fully labeled 1 to 10 scale. A Risk Perception Score (RPS) was eventually calculated for all diseases as a cumulative score as follows:

$$\text{Risk perception} = I^{INF} * C^{INF} - I^{VAC} * C^{VAC}$$

4. **Attitudes**. Participants were asked to rate 1 (totally disagree) to 5 (totally agree) the perceived usefulness pertussis vaccination in (a) avoiding natural infection in HCWs; (b) avoiding diffusion to other adults; (c) avoiding diffusion to children/newborns. Attitudes were eventually dichotomized in somehow agree (i.e. totally agree, agree) *vs* somehow disagree (totally disagree, disagree, neuter/no opinion).
5. **Practices.** Participants were initially asked whether they usually recall immunization status towards pertussis of HCWs, recommending/performing Tdap when requested. Again, as tetanus vaccine is compulsory for certain professionals, being OPh very familiar with this specific vaccination, and pertussis

immunization is commercially available only associated with tetanus vaccine, participants recalled their preferred formulation for tetanus vaccine, i.e. monovalent (T/t), divalent (Td), or Tdap.

Ethical considerations. Before giving their consent to the survey, participants were briefed that all information would be gathered anonymously and handled confidentially. Participation was voluntary, and the questionnaire was collected only from subjects who had expressed consent for study participation. As individual participants cannot be identified based on the presented material, this study caused no plausible harm or stigma to participating individuals. As the study neither included clinical data about patients nor configured itself as a clinical trial, while its anonymous designs assured an adequate protection of study participants, a preliminary evaluation by the Ethical Committee of the competent Provincial Agency for Health Services (in Italian: Azienda Provinciale per i Servizi Sanitari, APSS) was statutorily not required.

Data analysis. The described indices for general knowledge (GKS) and risk perception (RPS) were calculated as previously described, and then presented as percent values in order to be more easily comparable. All synthetic indices were eventually dichotomized by median value as > median *vs* ≤median. Continuous variables were tested for normal distribution (D'Agostino & Pearson omnibus normality test): where the corresponding p value was < 0.10, normality distribution was assumed as rejected and variables were compared through Mann-Whitney or Kruskal-Wallis test for multiple independent samples. On the other hand, variables passing the normality check (D'Agostino & Pearson p value ≥ 0.10) were compared using the Student's t test or ANOVA, where appropriate. In multiple comparisons, Pertussis Vaccine was assumed as the referent category. Categorical variables were reported as per cent values, and their distribution in respect of the outcome variable of proactive status for pertussis vaccination in HCWs was initially analyzed through chi-squared test. In comparisons, age (≤ 40 years *vs* > 40 years), seniority (< 10 years *vs* ≥ 10 years), medical specialization (occupational medicine *vs* all others) were dichotomized. All categorical variables that at univariate analysis were significantly associated with a positive attitude towards Pertussis Vaccine (i.e. $p < 0.05$) were included in a stepwise binary logistic regression analysis model in order to calculate multivariate odds ratios (OR) and their respective 95% confidence intervals (95%CI). Regression analysis was also controlled for age and sex of participants. All statistical analyses were performed by means of IBM SPSS Statistics 24.0 for Macintosh (IBM Corp. Armonk, NY).

Results

Descriptive analysis. As shown in Table I, a total of 148 OPh (14.3% of the eligible population) participated to the inquiry. Respondents had a mean age of 40.3 ± 13.2 years, and a seniority of 12.9 ± 13.8 years; 45.9% were males, and 54.1% females, while 45.9% reported that their household included at least a child aged < 14 years. The majority of respondents referred practicing as specialist in occupational medicine (45.9%), followed by specialists in Hygiene and Public Health (32.4%), legal medicine (11.5%). Overall, 40.5% had previous interactions with at least one patient affected by pertussis.

Assessment of vaccine knowledge (Tab. II). After normalization, the mean GKS was 72.3% ± 20.9 (actual range 33.3-100; median 75.0%), and internal consistency coefficient amounted to Cronbach's alpha = 0.718. Focusing on most frequently reported misbeliefs, even though 70.3% of participants had knowledge that adults should receive at least a Tdap dose at periodic immunizations, only 45.9% of participants followed official PNPV recommendation towards preferential use of combined formulations (Td/Tdap) for adult immunizations, with an even lower share of respondents preferentially using Tdap formulation (16.2%). Moreover, only 47.2% correctly recalled that receiving a new dose of tetanus vaccine or Td less than 2 years after a dose of Tdap does not increase the risk for side effects. Overall, a significant share of respondents exhibited some uncertainties about pertussis in older age groups, as 40.5% of them were unaware that a previously vaccinated adult may contract pertussis even after natural infection or a previous vaccination in pediatric age, and then diffuse pertussis in susceptible subjects (i.e. 35.1%).

Assessment of attitudes. As shown in Figure 1, 75% of identified HCWs pertussis vaccination as useful in order to avoid workers' infection, and diffusion to other adults, while 97.3% acknowledged the usefulness of HCWs immunization for preventing infection of children and newborns.

Assessment of the risk perception. As shown in Tab. III, participants acknowledged pertussis natural infection as significantly less severe (C^{INF} = 72.1% ± 20.2 *vs* 94.6% ± 11.9 and 88.6% ± 11.3 for tetanus and diphtheria, respectively), but also more probable in HCWs (I^{INF} = 36.8% ± 20.7 *vs* 30.3% ± 17.6 and 23.2% ± 13.3) than other components of Tdap vaccine. On the contrary, pertussis natural infection was identified as both less probable and severe than seasonal influenza (C^{INF} = 66.5% ± 21.9; I^{INF} = 80.5% ± 15.3; p = 0.018 and < 0.001, respectively), while HBV infection was reported as not significantly more severe (C^{INF} = 74.1% ± 19.4, p = 0.752) but significantly more probable (I^{INF} = 53.0% ± 19.6, p < 0.001). Focusing on frequency and severity of vaccine-related adverse effects for the presented immunizations, no significant differences were reported regarding the assessed C^{VAC}, while participants reported a perceived increased risk for side effects associated with seasonal influenza vaccine (I^{VAC} = 23.0% ± 14.7 *vs* 18.9% ± 11.3 for pertussis, p = 0.012).

As a consequence (Figure 2), OPh scored the highest cumulative RPS for seasonal influenza (73.9% ± 10.9), followed by HBV (68.1% ± 10.1), tetanus (62.1% ± 8.1), pertussis (60.8% ± 9.5), while the lower score was re-

Tab. I. Demographics of Attitudes of 148 Italian Occupational Physicians participating to an internet survey on knowledge, attitudes, practices about pertussis vaccination in healthcare workers from pediatric settings (HCWs) (2017). Note: S.D. = standard deviation; T/t = tetanus toxoid vaccine, monovalent; Td = combined tetanus/diphtheria vaccine, divalent; Tdap = combined tetanus/diphtheria/pertussis acellular vaccine, trivalent.

Variables	
Gender (No., %)	
Male	68, 45.9%
Female	80, 54.1%
Age (years, mean ± S.D.)	40.3 ± 13.2
Seniority (years, mean ± S.D.)	12.9 ± 13.8
Children in the household (any; No., %)	68, 45.9%
Medical specialization (No., %)	
Occupational medicine	68, 45.9%
Hygiene and Public Health	48, 32.4%
Legal medicine	17, 11.5%
Other	15, 10.1%
Previous interaction with patient(s) with pertussis (No., %)	60, 40.5%
Knowledge Score	
mean ± S.D.	72.4% ± 14.9
> median (75.0%)	68, 45.9%
Risk Perception Score	
mean ± S.D.	60.8% ± 9.5
> median (59.6%)	76, 51.4%
Acknowledging pertussis vaccination as useful for ... (No., %)	
... avoiding infection in HCW	111, 75.0%
... avoiding diffusion to other adults	111, 75.0%
... avoiding diffusion to children/newborns	131, 88.5%
Preferred formulation for tetanus vaccination (No., %)	
monovalent formulations (T/t)	96, 64.9%
combined formulations, Td	12, 8.1%
combined formulations, Tdap	24, 16.2%
none	16, 10.8%
Proactive status towards Tdap in HCW (No., %)	78, 52.7%

Tab. II. General Knowledge Test on Tdap vaccine of 148 Italian Occupational Physicians participating to an internet survey on knowledge, attitudes, practices about pertussis vaccination in healthcare workers from pediatric settings (HCW) (2017).

Statement	Correct answer	No., %
01. Adult tetanus vaccination should be preferentially performed with combined formulations (Td, Tdap)	True	68, 45.9%
02. Adults should receive at least a Tdap dose at periodic immunizations	True	104, 70.3%
03. Vaccinating an adult against pertussis is useless	False	116, 78.4%
04. Formulations containing pertussis antigens should be used only in subjects living with subjects < 14 year-old	False	112, 75.7%
05. Pertussis is a diseases of children and young adults (< 20 year-old)	False	120, 81.1%
06. Pertussis is scarcely contagious	False	132, 89.2%
07. In a previously vaccinated adult, pertussis may exhibit unusual, incomplete clinical patterns	True	120, 81.1%
08. A previously vaccinated adult may develop pertussis being unable to diffuse it	False	96, 64.9%
09. Children < 1 year-old are naturally protected against pertussis infection	False	132, 89.2%
10. Adult may contract pertussis even after natural infection or a previous vaccination in pediatric age (< 14 year-old)	True	88, 59.5%
11. Vaccination with Tdap may be performed alongside other formulations	True	132, 89.2%
12. Receiving a dose of tetanus vaccine or combined diphtheria-tetanus vaccine less than 2 years after a dose of Tdap increases the risk for side effects	False	68, 47.2%

ported for diphtheria (57.4% ± 5.9). In multiple comparisons, risk perception for pertussis was significantly higher than that reported for diphtheria ($p < 0.01$), while being significantly lower than that for seasonal flu ($p < 0.001$), and HBV ($p < 0.001$).

Univariate analysis. As shown in Tab. IV, distribution of a proactive status for pertussis vaccination among participating OPh had no significant differences based on demographics. On the contrary, a proactive Tdap status was positively associated with GKS ($p = 0.048$),

Fig. 1. Attitudes of 148 Italian Occupational Physicians participating to an internet survey on knowledge, attitudes, practices about pertussis vaccination in Healthcare Workers (HCWs). Participants were asked to rate 1 (totally disagree) to 5 (totally agree) the perceived usefulness pertussis vaccination in (a) avoiding natural infection in HCWs; (b) avoiding diffusion to other adults; (c) avoiding diffusion to children/ newborns.

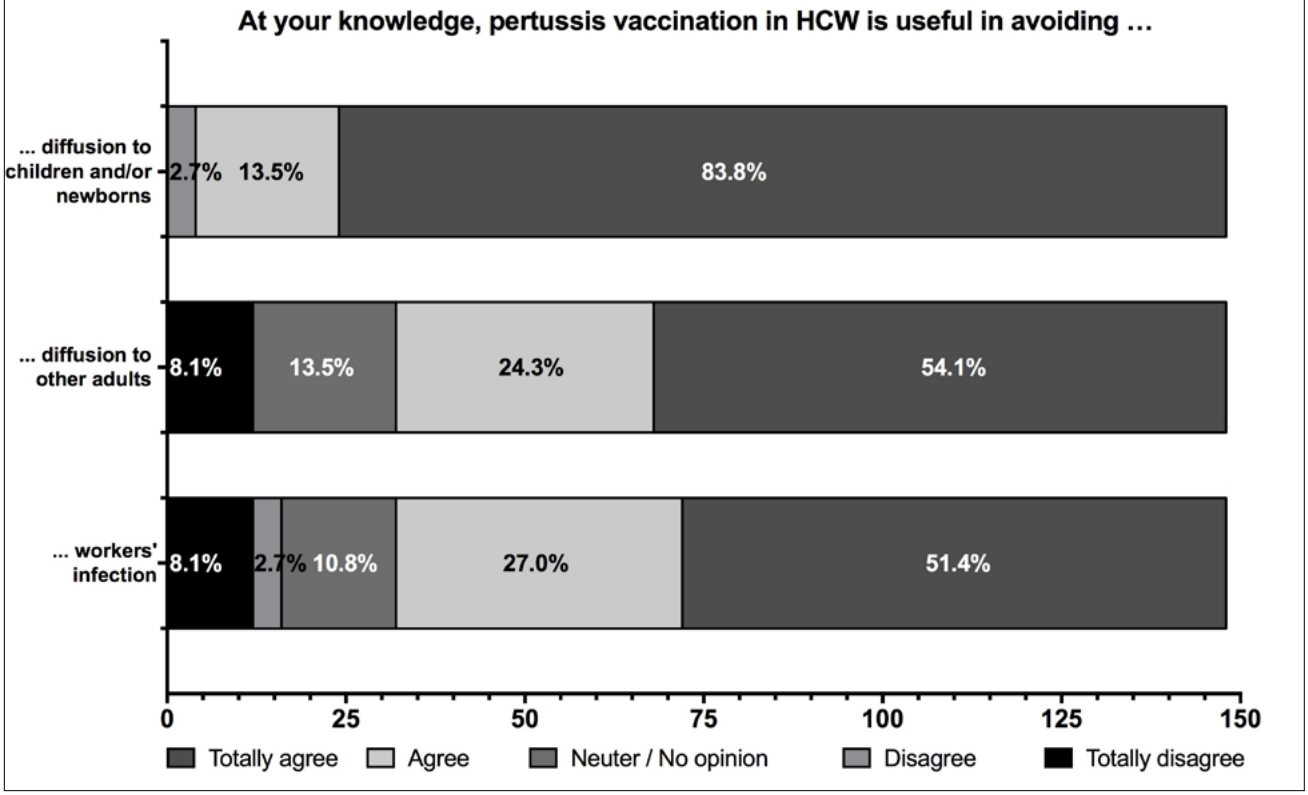
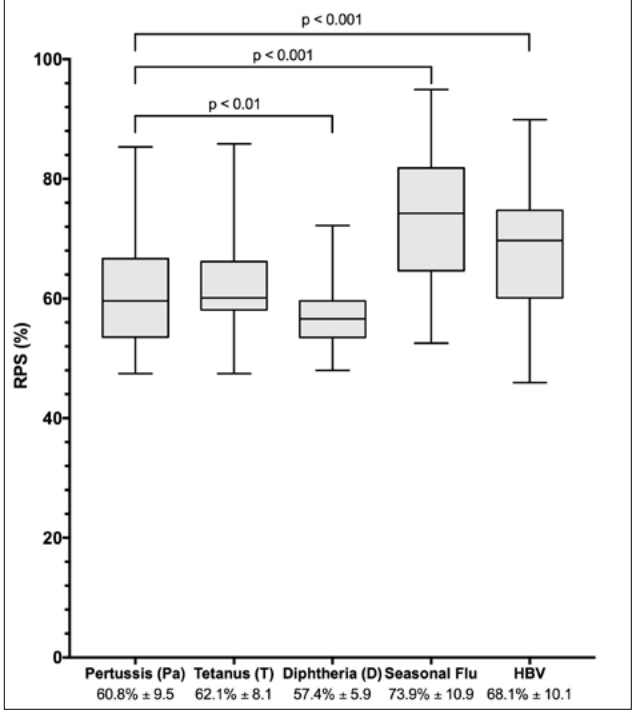


Fig. 2. Risk Perception Score (RPS) towards pertussis (Pa), Tetanus (T), Diphtheria (D), Seasonal Flu, Hepatitis B Virus (HBV) infection in 148 Italian Occupational Physicians participating to an internet survey on knowledge, attitudes, practices about pertussis vaccination in Healthcare Workers (HCWs). Multiple comparisons were performed through ANOVA, with Dunnet post-hoc test assuming RPS for pertussis as the referent one.



and acknowledging pertussis vaccination as useful for avoiding infection in HCWs ($p < 0.001$) and diffusion to other adults ($p < 0.001$). Consistently, RPS for Tdap was significantly associated with GKS ($r = 0.244$, $p = 0.003$). In other words, a better knowledge status (i.e., less misconceptions and/or less personal attitudes guiding the vaccine decisions) was associated with a greater risk perception for pertussis infection.

Regression analysis. Regression analysis model for Tdap included GKS > median, and acknowledging pertussis vaccination as useful for avoiding infection in HCWs and diffusion to other adults. Also in regression analysis, GKS was a significant predictor for a proactive attitude towards pertussis vaccination (OR 4.186; 95% CI 1.809-9.685), and similarly acknowledging pertussis vaccine as useful in avoiding infection in HCWs (OR 11.459; 95% CI 3.312-39.651). On the contrary, acknowledging pertussis vaccine as useful in order to avoid pathogen diffusion to other adult was not (OR 1.503; 95% CI 0.514-4.397).

Discussion

HCWs are at increased risk of pertussis infection compared to the general population, and their preventive immunization represents an evidence based approach to prevent pertussis spread among institutions, eventually reducing pathogen transmission to the patients,

Tab. III. Risk perception of pertussis, diphtheria, tetanus, seasonal influenza and HBV infections in 148 Italian OPh participating to the present study. Participants were asked to rate 1 (minimum) to 10 (maximum) the probability that HCWs get natural infection (I^{INF}), the frequency of vaccine-related adverse effects (I^{VAC}), and whether they perceived the severity of the natural infections (C^{INF}) and vaccine-related adverse effects (C^{VAC}). Results are presented in per cent values.

	Natural infection				Side effects of vaccination			
	C^{INF}	P value	I^{INF}	P value	C^{VAC}	P value	I^{VAC}	P value
Pertussis	72.1% ± 20.2	Ref	36.8% ± 20.7	Ref	29.5% ± 25.8	Ref	18.9% ± 11.3	Ref
Tetanus	94.6% ± 11.9	< 0.001	30.3% ± 17.6	0.005	27.0% ± 26.1	0.817	17.8% ± 10.8	0.770
Diphtheria	88.6% ± 11.3	< 0.001	23.2% ± 13.3	< 0.001	28.9% ± 26.0	0.999	18.3% ± 11.3	0.870
Influenza	66.5% ± 21.9	0.018	80.5% ± 15.3	< 0.001	28.9% ± 22.9	0.999	23.0% ± 14.7	0.012
HBV	74.1% ± 19.4	0.752	53.0% ± 19.6	< 0.001	26.8% ± 25.0	0.757	17.6% ± 9.5	0.665

Tab. IV. Factors associated with proactive status towards pertussis vaccine (Tdap pos.; i.e. assessing pertussis immunization status, and/or performing Tdap vaccine) for healthcare workers in 148 occupational physicians participating to the survey. Multivariate odds ratio (OR) with respective 95% Confidence Intervals (95%CI) were calculated through a regression analysis model including all factors associated with Tdap in univariate analysis ($p < 0.05$), and controlled for age and sex. Note: GKS = general knowledge score; RPS = risk perception score; HCW = healthcare workers; Tdap = tetanus-diphtheria-acellular pertussis formulate).

	Tdap pos. (No./78, %)	Tdap neg. (No./70, %)	P value	OR (95%CI)
Age > 40 years (No., %)	27, 34.6%	25, 35.7%	1.000	
Seniority > 10 years (No., %)	31, 39.7%	21, 30.0%	0.286	
Male sex	35, 44.9%	33, 47.1%	0.911	
Children in the household (No., %)	40 (52.6%)	40 (55.6%)	0.848	
GKS > median	42, 53.8%	26, 37.1%	0.048	4.186 (1.809; 9.685)
RPS > median	35, 44.9%	41, 58.6%	0.134	
Previous interaction with pertussis cases (No., %)	36 (46.2%)	24 (34.3%)	0.193	
Acknowledging pertussis vaccination as useful for ...				
... avoiding infection in HCW	72, 92.3%	39, 55.7%	< 0.001	11.459 (3.312; 39.651)
... avoiding diffusion to other adults	69, 88.5%	42, 60.0%	< 0.001	1.503 (0.514; 4.397)
... avoiding diffusion to children/newborns	70, 89.7%	61, 87.1%	0.812	
Specialization in Occupational Medicine	31, 39.7%	37, 52.9%	0.152	

particularly on pediatric and gynecology/obstetric wards [32-34]. Pregnant women and infants under 6 months are at serious risk of morbidity, mortality and adverse pregnancy outcomes from pertussis [35-37], but maximal protection against the pathogen is attained only after the third dose of the vaccine, usually performed at 6 months of age in North America, and 11 months in Italy [38, 39]. Nevertheless, available reports suggest increasing difficulties in promoting adherence of HCWs to evidence-based immunization recommendations, including pertussis [32-34, 40-46].

Numerous studies have assessed why HCWs do not receive the recommended vaccinations, being knowledge gaps and lack of confidence in vaccinations the main determinants of such behaviours [19, 22, 47-49]. On the contrary, KAP of OPh have been scarcely investigated [16-18]. This is a critical issue, as OPh are not only HCWs themselves (potentially contributing to the pathogen transmission), but they also perform and promote vaccinations, and may implement acceptance and knowledge among other HCWs [18]. Appropriate interventions on OPh could then maximize the consent for vaccination programs, contributing to overcome the mutual misunderstanding between public health professionals and vaccine hesitant individuals or even vaccine objectors [16-18].

Unfortunately, evidence suggests that even OPh may be significantly affected by false beliefs and misconceptions on vaccines and vaccination policies, that ultimately hinder their contribute to vaccination programs [18]. Also in our study, only half of participants actively assessed and promoted vaccination against pertussis in their clinical practice, and knowledge status was identified among the main determinants of a proactive attitude. These results were not unexpected, being substantially in line with previous reports and with the base assumption of KAP studies, i.e. higher the understanding, better the practices [18, 50-54]. However, even though GKS and RPS were well correlated, the latter was relatively low, and not significantly associated with a proactive status. Actually, the understanding of actual risks associated with pertussis infection was substantially inappropriate. More specifically, OPh apparently underestimated both the severity and potential communicability of pertussis, both in comparison with other components of Tdap vaccine, and with HBV and even seasonal influenza. In particular, we should stress that the positive attitude towards Tdap was associated with the aims of avoiding HCWs infection, whereas prevention of pertussis infection in other adults and children/newborns was apparently unrelated. In other words, OPh were apparently focused on the workers they directly assist, not under-

standing the risk that HCWs may eventually transmit the illness to other subjects, and particularly high risk groups [19, 21 32]. Not coincidentally, around 40% of respondents was apparently unaware that adults may contract and spread pertussis, even if previously vaccinated, and identified in T/t monovalent formulation the preferred one for tetanus vaccination, implicitly losing the opportunity to improve vaccination rates against pertussis, as otherwise recommended by PNPV [55]. Again, such results are consistent with previous reports on HCWs, and more specifically on OPh [16, 18], and collectively suggest that factors involved in the promotion of HCWs vaccinations are very complex, not residing only in knowledge and rational understanding of pathogen associated risks, being also characterized by a complicated interplay of individual (e.g. previous experiences, confidence in the vaccine, etc.) and organizational factors (e.g. availability of vaccines, content of medical protocols, etc.) [21 22, 32 33, 40, 49].

However, our study is affected by several limitations. First and foremost, it shares the implicit limits of Internet-based surveys [56, 57]. Web surveys have been shown as reliable and cost-effective as they usually require fewer resources, being also much faster than a paper-based survey. However, participants are somehow "self-selected", and the final sample may potentially over-represent some sub-groups of the original population, i.e. subjects from younger age groups, with a greater literacy, and more accustomed to the internet access. Therefore, it is not possible to rule out the existence of a significant selection bias. Participating voluntarily could be due to a proactive attitude or greater knowledge about vaccination. In the same way, the fact of not participating could be understood as a negative attitude or a lack of knowledge about vaccinations.

Again, we cannot rule out that results of knowledge score may have been affected by a significant social desirability bias, with participants reporting the "*socially appropriated*" rather than their authentic behaviors, so that our result could have ultimately overstated the share of OPh having an effective understanding of Tdap associated issues [16, 17, 32, 32, 34, 58].

Moreover, our sample was of limited size, including only 148 out of 7166 OPh from the national list of OPh [59], and their geographic origin was deliberately not assessed in order to improve the protection of study participants. As Italy has been repetitively acknowledged for very heterogeneous vaccination rates, our results should be cautiously interpreted as representative of the National level [60-62]. On the other hand, while a certain selection is usually performed by social media managers of specific discussion groups (e.g. by registering only subjects who receive a specific invitation by the manager; answering to specific "selection" questions; etc), often requesting to certificate their professional activity, we cannot rule out that some of the study participants were not actively working as OPh, limitedly or even not fulfilling our initial selection criteria.

Finally, data we collected were not externally validated, lacking an estimate of HCWs followed by sampled OPh. More specifically, we are unable to ascertain how often sampled professionals interact with HCWs from pediatric settings, and which share of their practice they actually represent. In fact, it should be stressed that even in the specific field of pediatric cares, the spreading of pertussis infection among HCWs may be severely influenced by the setting in which the interaction between spreaders and potential recipients actually occurs (i.e. nurseries, acute hospitals, ambulatory care, etc.), with a subsequently heterogeneous attention level in both OPh and HCWs they care [63, 64]. Similarly, we are unable to assess how reliable are the practices reported by respondents, that which share of HCWs followed by participants actually receive vaccines and/or specific recommendations [16-18, 62]. As a consequence, we were unable to estimate the effective extent of the social desirability bias, being the actual vaccination rates for Tdap potentially even lower than those self-reported by study participants.

Conclusions

In conclusion, our results are consistent with previous reports on HCWs, and with the limited evidence on OPh. More specifically, participants significantly underestimated the risks associated with pertussis infection, not only in the high-risk group of HCWs operating in pediatric settings, but more broadly in the general population interacting with HCWs. Moreover, our results suggest that a significant share of OPh actually ignores or only partially applies official recommendations on vaccine formulations to be used in clinical practice. As knowledge status was identified as the main predictor of a proactive attitude towards Tdap in HCWs, it is reasonable that filling information gaps may improve vaccine propensity of OPh, and possibly increase vaccine acceptance in HCWs. As the only way to counter pertussis infection is achieving and maintaining over time high vaccination rates, at least in high risk groups, a better interaction of OPh with HCWs, particularly in pediatric settings, would be therefore instrumental in increasing reducing the potential spreading of such infectious disease, not only in the occupational settings, HCWs, but also in general population.

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Conflict of interest statement

The authors declare no conflict of interest.

Authors' contributions

MR, GG, LV and FB equally contributed to the design and implementation of the research, to the analysis of the results and to the writing of the manuscript. NLB contributed by editing the final text of the paper, performing the amendments and contributing to the revision of the discussion and conclusion section. However, as primary investigator, MR was asked to assess unclear responses of the questionnaires to determine the correct answers, whereas GG and LV performed the majority of preliminary data analysis.

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ORIGINAL ARTICLE

The influence of socio-environmental determinants on hypertension. A spatial analysis in Athens metropolitan area, Greece

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Keywords

Hypertension • Socio-environmental factors • Geographic information systems

Summary

Introduction. While epidemiological and pathophysiological aspects of hypertension are still being investigated, there is an increased global interest between hypertension and social health determinants and environmental factors that this study aims to examine.

Methods. The sample size used in this work included 2,445 individuals, from Athens metropolitan area, who were randomly enrolled in ATTICA study, during 2001 to 2002. Principal component analysis (PCA), Poisson regression modeling and geographical analysis, based on Geographic Information Systems (GIS) technology, were applied.

Results. Geographical analysis and thematic mapping revealed that the West municipalities of Athens had the lowest socio-environmental status. Three components were derived from PCA: high, low and mixed socio-environmental status. Poisson regression analysis showed that high socio-environmental status, educational and economic level were negatively correlated with hypertension in some sectors of Athens ($p < 0.05$, for all).

Conclusions. Through the use of geospatial surveillance the underlying epidemiology of hypertension, and those at greater risk, can be more precisely determined. This study underlines the need to account for environmental factors when developing public health policies and programs for effective hypertension prevention or reduction.

Introduction

Hypertension is a major global health challenge and is one of the principal risk factors for cardiovascular disease [1, 2]. Approximately 40% of adults over 25 years are diagnosed hypertensive, and at least 45% and 51% of deaths from heart disease and stroke, respectively, are associated with hypertensive status [3].

Although epidemiological and pathophysiological risk factors of hypertension are still being investigated [4], there is an increased global interest in social-health determinants that increase the prevalence of various diseases possibly via behavioral modification [5, 6]. Hypertension is one such disease, associated with highly modifiable behavioral risk factors (diet, excessive alcohol, tobacco use, and inactivity) influenced mainly by income, type of employment, education and housing conditions [1, 6-8]. The impact, however, of socioeconomic status (SES) on hypertension has been reported in several epidemiological studies with conflicting results [9-13], potentially due to spatial inequalities and differential socio-environmental characteristics among study areas. For instance, Sabri et al. [13] found that hypertension tended to be more prevalent in lower income population in United Arab Emirates. In contrast, a study carried out in Lebanon found that hypertension was significantly associated with higher income levels [12]. On the other hand, Howitt et al. [10] did not observe variation in hypertension prevalence by socioeconomic position in Barbados, supporting this finding in the disparities of the social distribution of hypertension in the Caribbean [14, 15]. However, although it has been argued that residential socio-environmental status is associated with a variety of health outcomes, including cardiovascular diseases [16], research on environmental factors in association to blood pressure is limited [17].

The use of Geographic Information Systems (GIS), a geospatial technology with significant role in health research and spatial epidemiology [18-21], can help objectively identify health indicators, including socio-environmental conditions, social integration, physical aspects of places, and resources [22]. In addition, mapping socio-environmental factors and epidemiological data allows the recognition of spatial patterns [23] and the interpretation of statistical analysis results.

Therefore, the aim of the study was to examine the influence of socio-environmental conditions on hypertension prevalence, in the area of Athens, Greece by mapping spatial variation of hypertension among geographical and social heterogeneous areas, using GIS. To date, and to our knowledge, no such geospatial studies have been performed in Greece.

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Methods

Sample

The ATTICA study is a population-based health and nutrition survey [24], that was carried out in Athens metropolitan area (including 78% urban and 22% rural regions) during 2001-2002; the 10-year follow-up completed in 2012 [25], and it was held by the First Cardiology Clinic of Athens University Medical School and the Department of Nutrition and Dietetics of Harokopio University. In total 3,042 individuals voluntarily participated in the study; 1,514 men (18-87 y) and 1,528 women (18-89 y). The sampling was random and stratified by age, sex, distribution of the area municipalities, according to the latest census (2001). Individual information was interview based (at home or workplaces) by trained personnel (cardiologists, general practitioners, dieticians and nurses) upon signing an informed consent form. The ATTICA study was approved by the Hippokration Hospital Scientific Committee (protocol reference number: 0017/2002). Written informed consent was obtained from all the study subjects.

During the survey, various sociodemographic, clinical and lifestyle characteristics of the participants were recorded, including educational status (years of school attended) and residential address (suburb). Arterial blood pressure was measured, according to the latest American Heart Association (AHA) recommendations [26]. In summary, individuals were measured using a calibrated sphygmomanometer (ELKA aneroid manometric sphygmometer, Von Schlieben Co, West Germany) at the end of the physical examination. Subjects were relaxed, in a comfortable sitting position, back and arm supported, with an angle of 45^{o} from the trunk, and all clothing removed from the area of the upper right arm (where the cuff would be placed). The presence of hypertension was based on an average of three consecutive measurements (measured by a physician or nurse) of systolic blood pressure ≥ 140 mm Hg and/or diastolic blood pressure 90 ≥ mm Hg and/or use of special medication. Level of systolic and diastolic blood pressure were determined by the first perception of sound (tapping quality), and by phase V when the repetitive sounds become fully muffed (disappear), respectively. Changes in loudness were not considered.

Socio-environmental data

Environmental and socioeconomic parameters were used to outline the status of Athens' area sectors. Socioeconomic status was classified using the following proxy variables: (i) educational level, (ii) percentage of immigrants to the total population and population density (residents per km^2) based on 2011 census' data of the Statistical Authority of Greece, (iii) average annual income and average real estate prices (year 2009) that were obtained from General Secretariat for Information Systems (GSIS) of the Greek Ministry of Economy and Finance, and (iv) average years of education (year 2001-2) from ATTICA study. The population was categorized with higher education if they had completed upper secondary education and population with degree from university or technical institute - ISCED* level 3, 4, 5 and 6, and illiterate if the population had not completed primary school (ISCED level 0). The environmental variable used was the percentage of green urban areas to the total area of each municipality, based on land-use data for the reference year 2006, from Urban Atlas of European Environment Agency (EEA).

Spatial data

Athens is characterized by social segregation [28, 29] and geographical disparities in population composition and natural and built environment. In order to assess spatial distribution of hypertensive population in Athens, the parameter of spatial heterogeneity was accounted for and sectors were defined with social cohesion and common environmental characteristics, to avoid a potential effect of these inequalities on results obtained.

Athens metropolitan area was, therefore, divided into five main sectors as recommended [29, 30], consisted of municipalities with common socioeconomic characteristics. Geographical and statistical analyses were applied to the same sectors: East sector (Es) (7 units - 374,816 population, 391 sample size), South sector (Ss) (7 units - 437,171 population, 288 sample size), West sector (Ws) (11 units - 775,014 population, 548 sample size), North sector (Ns) (10 units - 496,025 population, 326 sample size) and Central sector (Cs) (5 units - 1,055,101 population, 892 sample size) (Fig. 1).

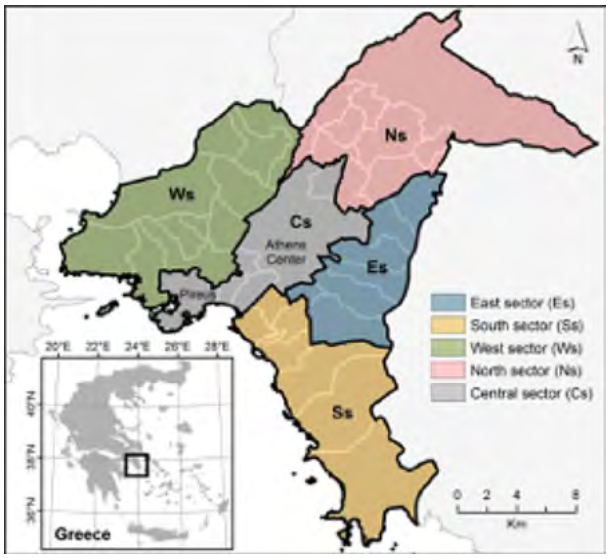
Geographical analysis

GIS technology was used to manage geographic data. A spatial database was created, with GIS layers of administrative units (municipalities), socioeconomic and environmental data, and the ATTICA study observations. A series of GIS-supported procedures were implemented to geocode and aggregate all data in the corresponding municipalities. Geocoding of hypertension data was based on the address factor and the allocation of each observation was implemented. Aggregation was related to the summation of the observations (used to calculate total number of cases in each spatial unit). Hypertension prevalence was estimated by counts of hypertensive population, expressed as proportion to incidences per 1,000 observations, a typical action for spatial epidemiological analysis [31].

Furthermore, every socio-environmental variable was calculated for each administrative unit, enabling the production of a series of *choropleth* (thematic) maps that show spatial variation of socio-environmental variables and hypertension rate across the five sectors of Athens. Geodatabase, spatial analyses and mapping were performed using the ArcGIS version 10.4 (ESRI Inc., Redlands, California, USA).

* ISCED (International Standard Classification of Education) is UNESCO's classification standard for education level [27].

Fig. 1. Athens metropolitan area, sectors and municipalities (2015).



Statistical analysis

Generalized linear models were used to investigate the relationship between hypertension prevalence and socio-environmental variables. To eliminate collinearity problems, three models with different socio-environmental variables were applied. Model 1 included immigrants and average years of education, Model 2 included population with higher education, average real estate prices and population density, and the last three variables of illiterate population, average annual income and green urban areas were inserted in Model 3. The three models were used for the whole study area and for each sector separately. Models were fitted using Poisson regression analysis to assess the association of hypertensive population per 1,000 observations (depended variable) and socio-environmental variables (independent), and with patterns of socio-environmental status. To obtain socio-environmental status patterns, PCA was used. The data sets of the socio-environmental variables were subjected to multivariate data analysis using PCA in order to diminish the dimensionality of the initial information by reducing the number of variables to several groups of individuals (components) [32]. To decide the number of components to retain from the PCA, the eigenvalues that derived from the correlation matrix of the variables were examined and Kaiser criterion (eigenvalues > 1.0) was used. Socio-environmental patterns were defined in relation to the individual variable scores that correlated most with the factor. Scores ≥0.4 were used, since higher absolute values indicate variables contributing most to the formulation of a component. The results from the regression models are presented as b-coefficients and its standard errors. Normality was assessed using the Kolmogorov-Smirnov test. Statistical analysis were based on 5% significance level using SPSS version 23.0 (Armonk, NY: IBM Corp) software.

Results

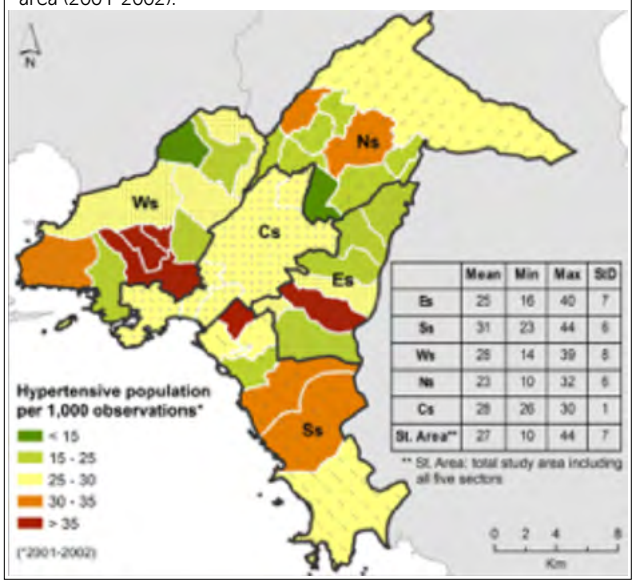
Figure 2 indicates that hypertension proportion varied among the municipalities, and within their sectors, except in Cs where uniform proportions were identified throughout the sector. The lowest proportions were found only in small municipalities, one in Ws and one in Ns, whereas the highest proportions were seen mostly in Ws, one in the Es, and a small proportion in Ss.

Figure 3 shows mean, minimum (Min), maximum (Max) and standard deviation (StD) values of the socio-environmental variables, both for the whole study area (St. Area) and for the five sectors separately, according to the values of the municipalities of each sector. Moreover, thematic maps indicated the spatial distribution of the variables' mean values, demonstrating the spatial and socioeconomic inequalities across the sectors.

Regarding the results of the socio-environmental variables mapping, Es had the lowest illiterate rate (Fig. 3b) and population density (Fig. 3g), and had high rate of higher educated population (Fig. 3c) and more years of education attendance than the mean value of the study area (Fig. 3a). The population of this sector had also high incomes (Fig. 3d), while real estate prices, as well as the immigrant rate, were almost on the same level as the mean value of the study area (Fig. 3e and 3f), whereas the % of green urban areas was lower than the study area's mean (Fig. 3h).

Ns was identified as sector with high socio-environmental status with the highest concentrations of higher-income population and real estate prices (Fig. 3d and 3e). Regarding the educational level, Ns' residents attended more years of education than the population of the rest sectors (Fig. 3a), however, a high rate of illiterate population (Fig. 3b) was also found along with an average rate of higher educated population (Fig. 3c) compared with the study area. Ns had the lowest mean immigrant

Fig. 2. Map of hypertension prevalence in Athens metropolitan area (2001-2002).

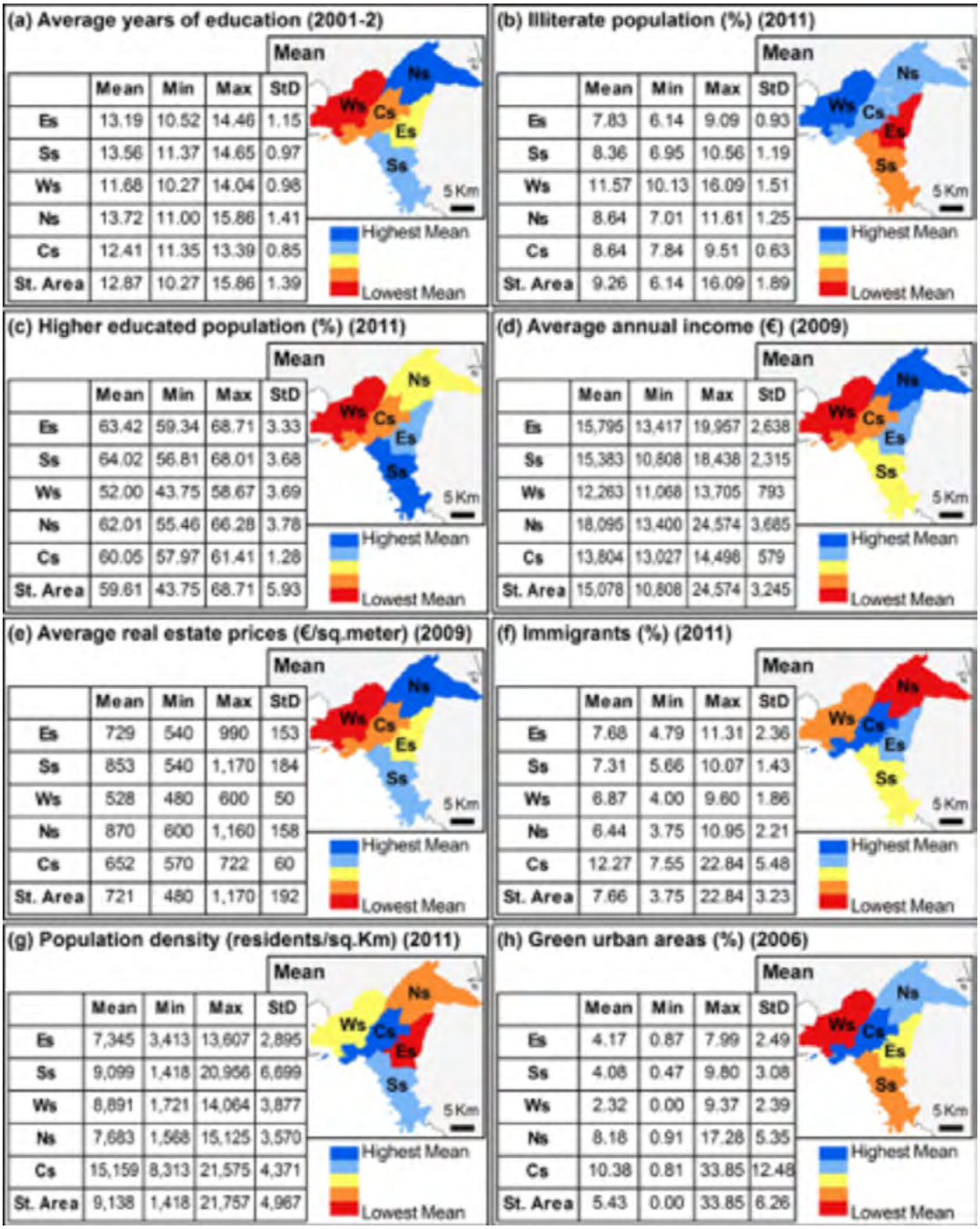


rates compared to the other sectors (Fig. 3f), it was not densely populated and was concentrated in green urban areas (Fig. 3g and 3h).

South sector (Ss) scored high rates in all variables related to educational level (Fig. 3a and 3c) with low rates of illiterate population (Fig. 3b). It had the second highest average real estate prices (Fig. 3e), whereas the annual income was slightly higher than the study area's mean value (Fig. 3d). However, Ss was the second most densely populated sector (Fig. 3g) with very low rate of green urban areas (Fig. 3h), and with medium rates of immigrants (Fig. 3f).

Ws was identified as sector with very low socio-environmental status, as most mean values examined were much lower than the study area's mean values, especially regarding economy and education. Particularly, Ws population had (i) the lowest average years of education compared to residents of other sectors (Fig. 3a),

Fig. 3. Spatial distribution of socio-environmental factors in Athens metropolitan area.



(a)	Mean	Min	Max	StD
Es	13.19	10.52	14.46	1.15
Ss	13.56	11.37	14.65	0.97
Ws	11.68	10.27	14.04	0.98
Ns	13.72	11.00	15.86	1.41
Cs	12.41	11.35	13.39	0.85
St. Area	12.87	10.27	15.86	1.39

(b)	Mean	Min	Max	StD
Es	7.83	6.14	9.09	0.93
Ss	8.36	6.95	10.56	1.19
Ws	11.57	10.13	16.09	1.51
Ns	8.64	7.01	11.61	1.25
Cs	8.64	7.84	9.51	0.63
St. Area	9.26	6.14	16.09	1.89

(c)	Mean	Min	Max	StD
Es	63.42	59.34	68.71	3.33
Ss	64.02	56.81	68.01	3.68
Ws	52.00	43.75	58.67	3.69
Ns	62.01	55.46	66.28	3.78
Cs	60.05	57.97	61.41	1.28
St. Area	59.61	43.75	68.71	5.93

(d)	Mean	Min	Max	StD
Es	15,795	13,417	19,957	2,638
Ss	15,383	10,808	18,438	2,315
Ws	12,263	11,068	13,705	793
Ns	18,095	13,400	24,574	3,685
Cs	13,804	13,027	14,498	579
St. Area	15,078	10,808	24,574	3,245

(e)	Mean	Min	Max	StD
Es	729	540	990	153
Ss	853	540	1,170	184
Ws	528	480	600	50
Ns	870	600	1,160	158
Cs	652	570	722	60
St. Area	721	480	1,170	192

(f)	Mean	Min	Max	StD
Es	7.68	4.79	11.31	2.36
Ss	7.31	5.66	10.07	1.43
Ws	6.87	4.00	9.60	1.86
Ns	6.44	3.75	10.95	2.21
Cs	12.27	7.55	22.84	5.48
St. Area	7.66	3.75	22.84	3.23

(g)	Mean	Min	Max	StD
Es	7,345	3,413	13,607	2,895
Ss	9,099	1,418	20,956	6,699
Ws	8,891	1,721	14,064	3,877
Ns	7,683	1,568	15,125	3,570
Cs	15,159	8,313	21,575	4,371
St. Area	9,138	1,418	21,757	4,967

(h)	Mean	Min	Max	StD
Es	4.17	0.87	7.99	2.49
Ss	4.08	0.47	9.80	3.08
Ws	2.32	0.00	9.37	2.39
Ns	8.18	0.91	17.28	5.35
Cs	10.38	0.81	33.85	12.48
St. Area	5.43	0.00	33.85	6.26

(ii) the highest rate of illiterate population and, (iii) the lowest rate of higher educated population (Fig. 3b and 3c). Moreover, Ws had also the lowest average annual income and real estate prices (Fig. 3d and 3e). Green urban areas were also the least concentrated in this sector (Fig. 3h), although it was moderately densely populated (Fig. 3g). On the other hand, mean value of immigrants in Ws was the second lowest (after Ns) and below the mean of the study area's (Fig. 3f).

The last sector (Cs - sector 5) could be characterized as a low socio-environmental status sector, although it had slightly better rates than Ws in the educational and economic level (Fig. 3a to 3e). Furthermore, this sector was highly densely populated (Fig. 3g) with very high rate of immigrants (Fig. 3f). Concerning the physical environment, Cs had more green urban areas than all the other sectors, with mean value 10.38%, which was approximately twice the mean value of the whole study area's municipalities (Fig. 3h).

The Kolmogorov-Smirnov test for normality for average years of education, average annual income and average real estate prices reported $p = 0.038$, $p = 0.003$ and $p = 0.002$ respectively, revealing that the variables were not normally distributed. Table I shows the results of Poisson regression analysis that was performed between hypertension and the socio-environmental variables examined, in all municipalities. Results revealed that economic level variables related (income and real estate prices) and average years of education, were negatively associated with the prevalence of hypertension ($p = 0.004$, $p = 0.049$ and $p < 0.001$ respectively). The same associations were confirmed in Es ($p = 0.017$, $p = 0.005$ and $p = 0.006$ respectively). Average years of education and real estate prices were also inversely correlated with hypertension in Ns ($p = 0.004$ and $p = 0.013$). Negative relationship with green urban areas was observed in Es ($p = 0.046$) and with population density in Ns ($p = 0.008$). In Ws, hypertension was inversely correlated with higher educated population ($p = 0.003$), while in two other sectors, Ss and Cs, no relationship between hypertension and any of the socio-environmental variables was found.

PCA extracted three components for Es, Ss and Cs, while two components were extracted for all municipalities' analysis, Ws and Ns. The loadings for the socio-environmental status components (patterns), which represent the correlation of each socio-environmental variable with the corresponding component, are presented in Table II (bold font indicates the coefficients with absolute loadings > 0.4). The first two extracted components are common for all sectors and they are characterized as high socio-environmental status (component 1) and low socio-environmental sta-

Tab. I. Results from Poisson regression analysis that evaluated the association of socio-environmental variables (independent) on hypertension (dependent).

	All municipalities		East sector		South sector	
Model 1	**b ± SE**	**p value***	**b ± SE**	**p value**	**b ± SE**	**p value**
Immigrants, %	0.004 ± 0.0097	0.690	0.032 ± 0.0355	0.375	0.029 ± 0.0685	0.669
Average years of education	-0.082 ± 0.0226	< 0.001	-0.166 ± 0.0606	0.006	0.080 ± 0.1015	0.428
Model 2						
Population with higher education, %	0.002 ± 0.0085	0.771	0.053 ± 0.0426	0.217	0.044 ± 0.0467	0.349
Average real estate prices, €/m2	-0.001 ± 0.0003	0.049	-0.003 ± 0.0009	0.005	-0.001 ± 0.0012	0.489
Population density, residents/km2	2.64x10-6 ± 6.76x10-6	0.697	-1.98x10-5 ± 2.58x10-5	0.441	-2.78x10-6 ± 2.73x10-5	0.919
Model 3						
Illiterate population, %	-0.005 ± 0.0209	0.827	-0.171 ± 0.1613	0.290	-0.076 ± 0.0621	0.219
Average annual income, €	-3.74x10-5 ± 1.31x10-5	0.004	-1.16x10-4 ± 4.89x10-5	0.017	-1.05x10-6 ± 3.41x10-5	0.975
Green urban areas, %	-0.006 ± 0.0055	0.264	-0.087 ± 0.0436	0.046	-0.021 ± 0.0258	0.410
	West sector		**North sector**		**Central sector**	
Model 1	**b ± SE**	**p value**	**b ± SE**	**p value**	**b ± SE**	**p value**
Immigrants, %	0.015 ± 0.0434	0.725	-0.032 ± 0.0333	0.340	-0.004 ± 0.0171	0.814
Average years of education	-0.084 ± 0.0853	0.326	-0.146 ± 0.0512	0.004	-0.027 ± 0.1081	0.800
Model 2						
Population with higher education, %	-0.042 ± 0.0193	0.032	0.016 ± 0.0257	0.527	-0.066 ± 0.1678	0.693
Average real estate prices, €/m2	9.84x10-5 ± 0.0014	0.945	-0.002 ± 0.0008	0.013	-3.69x10-4 ± 0.0018	0.836
Population density, residents/km2	-3.02x10-6 ± 1.56x10-5	0.847	-6.63x10-5 ± 2.50x10-5	0.008	1.46x10-5 ± 0.0001	0.774
Model 3						
Illiterate population, %	0.017 ± 0.0452	0.714	0.031 ± 0.1140	0.784	0.052 ± 0.1455	0.723
Average annual income, €	-1.54x10-4 ± 0.0001	0.111	-2.53x10-5 ± 3.45x10-5	0.463	-7.63x10-5 ± 0.0002	0.757
Green urban areas, %	-0.028 ± 0.0263	0.283	-0.005 ± 0.179	0.765	0.002 ± 0.0120	0.894

*level of significance a = 0.05

Tab. II. Score coefficients derived from principal components analysis regarding socio-environmental variables.

	All municipalities		East sector			South sector			West sector		North sector		Central sector		
	Component		Component			Component			Component		Component		Component		
	1	2	1	2	3	1	2	3	1	2	1	2	1	2	3
Average years of education	**0.806**	-0.027	**0.568**	0.228	0.059	**-0.748**	**0.524**	0.011	**0.730**	**-0.580**	**0.910**	0.151	**0.920**	0.197	-0.303
Population with higher education, %	**0.917**	0.162	**0.894**	0.157	0.172	**0.773**	**0.528**	-0.121	**0.955**	0.225	**0.896**	-0.039	**0.995**	-0.011	-0.086
Illiterate population, %	**-0.866**	-0.329	**-0.774**	**-0.502**	0.047	**-0.666**	**-0.642**	0.222	**-0.751**	**-0.440**	**-0.873**	**-0.428**	**-0.949**	-0.078	0.292
Average annual income, €	**0.886**	-0.130	**0.925**	-0.198	0.265	**0.565**	0.368	0.299	**0.873**	0.268	**0.948**	-0.053	0.260	**0.782**	**0.565**
Average real estate prices, €/m2	**0.887**	-0.132	**0.964**	-0.036	0.023	**0.891**	-0.234	0.273	**0.648**	0.334	**0.935**	-0.107	**0.576**	**-0.487**	**0.554**
Immigrants, %	-0.173	**0.812**	**-0.684**	**0.701**	0.100	**0.802**	-0.290	-0.354	-0.390	**0.752**	**-0.619**	**0.534**	**0.624**	-0.184	**0.675**
Population density, residents/km2	-0.253	**0.763**	-0.247	**0.538**	**0.791**	-0.272	**0.642**	**-0.636**	**-0.540**	**0.424**	**-0.557**	0.381	**0.888**	-0.351	-0.258
Green urban areas, %	0.347	**0.445**	0.239	**0.713**	**-0.645**	-0.064	**0.570**	**0.808**	-0.069	**0.710**	0.247	**0.884**	0.275	**0.943**	-0.060

* Score coefficients are similar to the correlation coefficients. Higher absolute values indicate that the body composition variable is correlated with the respective component. Numbers in bold indicate loadings greater than 0.4. ** Component 1: High socio-environmental status, Component 2: Low socio-environmental status, Component 3: Mixed socio-environmental status

tus (component 2), while the third component, extracted only for Es, Ss and Cs, is characterized as mixed socio-environmental status (component 3). Regression analysis that was performed between hypertension and the 3-PCA patterns, revealed that high socio-environmental status was negatively associated with hypertension in Es and Ws, as well as in all municipalities analysis (Tab. III). In contrast, component 2 and component 3 were related with hypertension neither to all municipalities nor to sectors.

Tab. III. Results from Poisson regression analysis that evaluated the association of PCA component socio-environmental status (independent) on hypertension (dependent).

	All municipalities		East sector		South sector	
	b ± SE	p value	b ± SE	p value	b ± SE	p value
High socio-environmental status	-0.113 ± 0.0311	< 0.001	-0.245 ± 0.882	0.005	0.070 ± 0.0724	0.337
Low socio-environmental status	0.037 ± 0.0306	0.222	0.037 ± 0.0772	0.633	-0.109 ± 0.0746	0.145
Mixed socio-environmental status			-0.072 ± 0.0830	0.383	-0.057 ± 0.0774	0.461
	West sector		North sector		Central sector	
	b ± SE	p value	b ± SE	p value	b ± SE	p value
High socio-environmental status	-0.156 ± 0.0581	0.007	-0.078 ± 0.0700	0.267	-0.029 ± 0.0936	0.758
Low socio-environmental status	0.050 ± 0.0623	0.421	-0.124 ± 0.0667	0.062	-0.031 ± 0.0967	0.752
Mixed socio-environmental status					-0.031 ± 0.0955	0.749

* Component 1: High socio-environmental status, Component 2: Low socio-environmental status, Component 3: Mixed socio-environmental status

Discussion

In summary this study showed hypertension prevalence varies with social segregation and geographical inequalities in Athens, in particular with differing socio-environmental factors. Although it is well accepted that hypertension is a global health challenge, the present study is novel in using geographic approaches, to analyze spatial distribution of hypertension in adults and its relationship with socio-environmental status, in an urban characterized of geographical inequalities [29, 30]. This is critical to environmental public health surveillance, and formulating evidence based program development.

Strong negative associations with hypertension were found in sectors of higher educational and financial level (Ns and Es) in Athens, metropolitan area, in agreement with other studies, which have concluded that low socioeconomic status, and especially low educational level is related with high blood pressure [7, 33-35]. However, a negative association was also found in sectors with low-educated and low-income population (Ws), underlying the evidence that multi-components need to be addressed.

Higher income and real estate prices were negatively associated to hypertension in accordance to study showing adverse influence of low economic status on hypertension [36]. In sectors, however, where higher economic status was concentrated (Ns and Es), prevalence of hypertension was high in some municipalities, in agreement with studies showing that hypertension is more prevalent among higher SES populations [19]. This may be due to the limited green urban space (Es) as per results from some studies, showing a negative association between higher-scoring green/recreational and prevalence of hypertension [37, 38]. The Ns, on the other hand, have a substantial amount of illiterate population. It seems, therefore that various socio-environmental factors may interact and need to be more thoroughly studied.

Low population density was also negatively correlated with hypertension (Ns). In agreement to studies suggesting that population density, as a result of urban growth, may generate numerous stressors [39] on blood pressure. On the other hand, in the most densely populated sector with the highest rate of green urban areas as well (Cs), these associations were not confirmed, suggesting an important effect of green space on hypertension prevalence, despite other risk factors present.

Pattern analysis used, to examine the association of socioeconomic and environmental characteristics on hypertension showed that high socio-environmental status, explained mostly by factors related to education and financial status (component 1), was negatively associated with hypertension in all municipalities, as well as in Es and Ws, although the latter had a large population of low SES. The latter further suggesting that area-environment-education and social state intertwine on their final effect on hypertension.

Many studies have already examined the influence of socioeconomic status on hypertension at individual level, though, to the best of our knowledge, this is one of the first studies to document the relationship between hypertension and an area's socio-environmental conditions. Adding geographical dimension to consider spatial risk factor heterogeneity on hypertension prevalence is the main strength of this study, since, GIS-based analysis gives spatial epidemiology a big advantage over other methods, as it improves the understanding and prediction of health risk factors in a spatial context [40-42]. Moreover, reducing Athens metropolitan area into five sectors contributed to minimizing spatial inequality bias and using *choropleth* maps, increased visual understanding of results. However, this study has limitations with one related to potential socio-environmental remnant disparities within the limits of the municipalities. Another limitation is the time-difference among the variables (blood pressure data from 2001-2, annual income and real estate prices from 2009, and 2011 census data). Nevertheless, there were no significant proportionate socio-environmental differences among the municipalities, between 2001-2011, making socio-environmental variables from 2009 and 2011 reliable estimators, in time alignment with the epidemiological data. Finally, this study took place in an urban region and, therefore, results cannot be generalized to rural regions.

Conclusions

In conclusion, the present study revealed that as the socio-environmental status of a residential area increases, the hypertension rates decreases. Particularly, educational and economic level, as well as the amenities that are provided by non-densely populated areas with higher rates of green public spaces, are the main socio-environmental factors that should be given attention against hypertension. This can lead to more effective public health policies and intervention programs that target the reduction of hypertension prevalence.

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Conflict of interest statement

The authors declare no conflict of interest.

Authors' contributions

CC, AT and DBP conceived and designed the research. AF, CC, AT, CP and DBP contributed to acquisition of data. AF performed the spatial and statistical analysis. AF, CC, EM and ENG contributed to data interpretation. AF and EM participated in writing the manuscript. AF, CC, EM and DBP participated in the literature search.

All authors critically read and revised the manuscript and approved the final version.

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ORIGINAL ARTICLE

Knowledge, attitudes, and practices regarding diabetic retinopathy among primary health care physicians in Al-Hasa, Saudi Arabia

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Keywords

Diabetic retinopathy • Screening • Primary health care

Summary

Background. *Diabetic retinopathy (DR) has been shown to be the third most observed cause of visual loss in Saudi Arabia. In the Al-Hasa region in particular, the prevalence of DR has been shown to be 30%. Primary health centre (PHC) physicians play a central role in the early detection and prevention of DR. The aim of this study was to evaluate the knowledge, attitudes, and practices regarding DR of PHC physicians in Al-Hasa, Saudi Arabia.*
Methods. *A cross-sectional descriptive study was conducted at PHCs in Al-Hasa, Saudi Arabia. A self-administered questionnaire was provided to every participant along with a consent form. Out of 71 centres in the region, 63 were included in this study. The questionnaire consisted of three sections and a total of 18 questions. Statistical analysis was carried out using the Statistical Package for the Social Sciences version 21 software program (IBM Corp., Armonk, NY, USA).*
Results. *One hundred forty-one of 209 physicians completed the questionnaire for a response rate of 67%. The mean of overall knowledge score for all participants was 2.6 ± 1.16 points out of four points. Only 34 (24.1%) of the participants correctly referred their diabetic patients according to the guidelines of the American Academy of Ophthalmology. Additionally, only 52 (36.9%) physicians educated their patients regarding the early detection of diabetic complications.*
Conclusion. *The present study concluded that there exist gaps in applying the correct guidelines. Physicians' attitudes toward patient education were overall satisfactory. Further medical symposiums and workshops are warranted to teach physicians about diabetic complications and screening schedules, including DR.*

Introduction

Diabetes is the most common chronic disease related to metabolic and endocrine impairment [1, 2]. About 382 million people are affected by diabetes and, every minute, about 10 people die from its complications [2]. Long-term duration of diabetes, poor control of blood glucose, and genetic basis are possible risk factors for the development of microvascular complications of diabetes, including diabetic retinopathy (DR) [3, 4]. DR is one of the most common complications of diabetes and the leading cause of blindness in the productive age range [5]. Seventy-eight percent to 97% of type 1 diabetes patients and 60% to 80% of type 2 diabetes patients will develop some degree of DR after more than 15 years with the disease [6]. In Saudi Arabia, it has been shown that DR is the third most observed cause of visual loss [7]. DR affects 31.3% of diabetic patients in Saudi Arabia [7, 8]. In the Al-Hasa region, the prevalence of DR has shown to be 30% [5, 9].
Although the rate of blindness due to DR is high, early detection, the application of effective screening programs, and efforts to control the risk factors for DR are crucial to delay the onset and slow the progression of the condition [3, 9]. According to the American Academy of Ophthalmology guidelines, immediate evaluation of DR in type 2 diabetes patients at the time of diagnosis and annually thereafter should occur [10]. On the other hand, in type 1 patients, ophthalmoscopy screening is initiated beginning at five years after diagnosis and annually from then [6, 10]. A study performed in Riyadh found that 71% of physicians referred type 2 diabetes patients to an ophthalmologist correctly, while only 24% of physicians did a correct referral for type 1 diabetes patients [11]. Another study conducted in Tabuk City suggested that only 27.6% of general practitioners (GPs) follow the guidelines correctly regarding referring type 1 diabetic patients [12]. On the other hand, a study in Taif City revealed that the majority of GPs have good knowledge and attitudes toward DR screening in general [13].
Physicians who work in primary health centres (PHCs) have a central role in the early detection and prevention of DR [9]. They represent the first line of management of diabetes and referrals if complications take place [14]. The aim of this study was therefore to evaluate the knowledge, attitudes, and practices regarding DR among PHC physicians in Al-Hasa, Saudi Arabia.

Methods

A cross-sectional descriptive study was conducted at PHC centres in Al-Hasa, Saudi Arabia between October

2017 and February 2018. The study population consisted of all physicians working in PHC centres in this region during this time period. According to the 2016 version of the statistical yearbook of the Saudi Ministry of Health, there are 453 physicians distributed among 71 PHC centres in Al-Hasa and the affiliated villages [17]. With a precision of 5% at a 95% confidence level, the calculated sample size was 209 physicians. The participants of the study were randomly selected according to lists provided from the health sectors. All physicians of PHC centres in Al-Hasa who were involved in diabetic patients' care were eligible for inclusion in this study, while other health care providers and physicians who work at hospitals and secondary health care centres as well as those not involved in the care of diabetic patients were excluded. Ethical approval was given by the research committee of the College of Medicine, King Faisal University and the institutional review board committee of King Fahad Hospital in Hofuf. The questionnaire used herein was taken from a previous study and modified [11]. A pilot survey was conducted for the investigation and validation of the questionnaire, in which 10 questionnaires were distributed in four different PHCs. The outcome of this pilot study was that the questionnaire was clear and valid. The pilot survey participants were subsequently excluded from the main study population.

A self-administered questionnaire in the English language was given to every participant along with a consent form declaring that the collected data would be confidential and used only for research purposes. The questionnaire consisted of three sections and a total of 18 questions, with seven questions being about demographic and professional data, four questions being about knowledge regarding DR, and seven questions being about attitudes and practices toward DR screening, respectively. In the knowledge section, a score of one point was given for each correct answer, while zero points were awarded for wrong answers (total is four points). The study participants were instructed to answer all questions without referring to any textbook or colleagues.

Statistical analysis was carried out by using the Statistical Package for the Social Sciences version 21 software program (IBM Corp., Armonk, NY, USA). Descriptive statistics for all variables were performed, including means, medians, interquartile ranges, and standard deviations (SDs). An inferential analysis was conducted to detect the association among different study variables. Analysis of variance (t-test) was used to detect the differences in mean score between different subgroups stratified according to gender, age, medical specialty, and primary health sector. A p-value of less than 0.05 was set as a statistically significant result.

Results

A total of 141 physicians completed the questionnaire for a response rate of 67%. Eighty-seven (61.7%) of these were male, while 54 (38.3%) were female. Mean age was 33.0142 years (SD: 6.8889 years, range: 25-58 years). Years of medical practice ranged from less than one year to 25 years, with a mean of 5.5674 years (SD: 5.39120 years) (Tab. I).

Tab. I. Demographic data of PHC physicians.

Variable	Category	N	%
Gender	Male	87	61.7
	Female	54	38.3
Health sector	Omran	41	29.1
	Hofuf	51	36.2
	Mubaraz	49	34.8
Nationality	Saudi	107	75.9
	Non-Saudi	34	24.11
Medical specialty	Family medicine	56	39.7
	Internal medicine	10	7.1
	GP	75	53.2

The mean score of knowledge was 2.560 ± 1.161 points out of four points. Eight participants (6.4%) scored zero points, while 16 (11.3%) scored one point, 37 (26.2%) scored two points, 45 scored three points (31.9%), and 34 (24.1%) scored four points. The mean score was between 2.367 and 2.753 (CI = 95%). With a cut-off of 50% of the ideal score, 56% had good knowledge and 44% had poor knowledge. Only 58 (41.1%) participants followed the correct protocol in referring newly diagnosed type 1 diabetic patients for fundoscopy. More than half of the participants (57.4%) knew the correct interval of follow-up for type 1 diabetic patients according to recent guidelines for DR screening. The majority of the subjects (83.7%) followed the recent guidelines for the newly diagnosed type 2 diabetic patients. About three-quarters of the participants (73.8%) were aware of DR screening intervals for type 2 diabetic patients (Tab. II).

The time physicians usually spent explaining the management of diabetes to their patients varied among the study subjects, with 13.5% taking less than 15 minutes, 31.2% taking 15 to 30 minutes, and 6.4% taking more than 30 minutes, respectively, while the rest (48.9%) answered that it depends upon the patient. Most physicians (89.4%) reported instructing their diabetic patients to apply lifestyle modifications (e.g., diet and exercise), 63.8% taught them about the disease itself, and 63.1% educated their patients on the importance and necessity of adhering to the treatment plan and follow-up visits. Nevertheless, only 36.9% taught their patients about how to detect complications early.

Considering the number of patients seen by PHC physicians per week, 79.4% of them reported that they saw 10 or less type 1 diabetic patients, 14.9% saw between 11 and 20 patients, 3.5% saw between 21 and 30 patients, and 2.1% reported consulting more than 30 type 1 diabetic patients. Separately, 41.1% of the physicians responded that, weekly, they saw 25 or less type 2 diabetic patients, 31.9% reported that they saw between 26 and 50 patients, and 9.2% of the participants mentioned a range of 51 to 75 patients. Only 13.5% of all participants reported consulting 76 to 100 type 2 diabetic patients on a weekly basis, while the rest (4.3%) of the participants reported having more than 100 type 2 diabetic patients. Concerning patients' compliance with undergoing regu-

Tab. II. Knowledge and scoring regarding DR.

Variable	Category	N	%
When do you request initial fundoscopy for a newly diagnosed T1 DM patient?	At diagnosis	56	39.7
	After 1 year	20	14.2
	After 3 years	7	5
	After 5 years	58	41.1
How regularly should a type 1 diabetic patient visit an ophthalmologist?	Every 5 years	14	9.9
	Every 2 years	11	7.8
	Every year	81	57.4
	Based on ophthalmologist screening assessment	31	22
	I don't know	4	2.8
When do you request initial fundoscopy for a newly diagnosed T2 DM patient?	At diagnosis	118	83.7
	After 1 year	20	14.2
	After 3 years	2	1.4
	After 5 years	1	0.7
How regularly should a type 2 diabetic patient visit an ophthalmologist?	Every 5 years	10	7.1
	Every 2 years	10	7.1
	Every year	104	73.8
	Based on ophthalmologist screening assessment	16	11.3
	I don't know	1	0.7
Total score (Mean score = 2.560 ± 1.161 points)	0 points	8	6.4
	1 point	16	11.3
	2 points	37	26.2
	3 points	45	31.9
	4 points	34	24.1

lar fundoscopy, 25 (17.7%) of the participants reported that less than 25% of their patients underwent routine fundoscopy, while 56 (39.7%) reported 25% to 50% of their referred patients underwent the procedure. Thirty-six (25.5%) reported that 50% to 75% of their referred patients underwent fundoscopy, and 24 (17%) reported that more than 75% of their patients followed their regular referral requests to undergo fundoscopy.

According to the physicians' experiences, the barriers that prevented their diabetic patients from undergoing fundoscopy when requested included a lack of rapid appointment (44%), financial reasons (12.1%), lack of compliance (56%), no available ophthalmologist (17%) and other (6.4%). Twenty-five (17.7%) of the participants always receive a report of their referred patients regarding DR screening, 47 (33.3%) of them usually receive a report, 35 (24.8%) sometimes receive a report, and 24 (17%) rarely receive a report. Ten (7.1%) participants reported having never received a report on their patients regarding DR screening.

A comparison of the mean scores of knowledge regarding diabetes type 1 and diabetes type 2 separately concluded that there is a significant difference between the mean knowledge scores of type 1 and type 2 in favour of type 2. However, the comparison of knowledge scores between genders revealed that there is no significant difference between males and females regarding the overall score (Tab. III). There is also no significant difference in the mean knowledge scores among physicians working in different sectors, different nationalities, and medical specialities, with p-values of 0.162, 0.099, 0.159, and 0.056, respectively. Furthermore, this study, using Pearson correlation, revealed that there was no significant relationship between knowledge score and both age of the physicians and their years of practice (Tab. IV).

Discussion

This study reported that, among all participants, there was a significant difference between the mean knowledge scores of type 1 and type 2 diabetes, in favour of type 2. About half of the participants correctly referred their patients with type 1 diabetes versus 80.1% who correctly referred type 2 diabetic patients. This difference can be attributed to the fact that PHC physicians encounter more patients with type 2 than type 1 diabetes on a daily basis, as type 1 diabetics are usually followed by endocrinologists. Our results are similar to the findings of Preti et al., [15] who reported correct referral

Tab. III. Knowledge scores for physicians by gender and type of diabetes.

	Gender	N	Mean	Std. deviation	T	p-value
Scores	Male	87	2.4828	1.14995	-1.476	0.142
	Female	54	2.7778	1.16013		
	Type 1	141	0.9858	0.74628	7.387	0.0001
	Type 2	141	1.6028	0.65334		

Tab. IV. Knowledge scores for physicians by age and years of medical practice.

	Age	Years of practice	Score	
Age	Pearson correlation	1	0.869	-0.033
	Sig. (two-tailed)		0	0.695
	N	141	141	141
Years of practice	Pearson correlation	0.869	1	-0.013
	Sig. (two-tailed)	0		0.877
	N	141	141	141
Score	Pearson correlation	–0.033	–0.013	1
	Sig. (two-tailed)	0.695	0.877	
	N	141	141	141

rates of 36.9% and 86.9% for type 1 and type 2 diabetes, respectively. Similarly, Al-Rasheed et al. [11] reported a correct referral rate of 24% for type 1 diabetics versus one of 71% for type 2 diabetics.

The present study showed no significant difference between males and females in the mean scores of knowledge. Similar findings were reported by Al-Rasheed et al. [11]. Furthermore, it also found no significant difference in the mean knowledge score upon comparing it among physicians of different age groups and years of medical practice since graduation. These results are similar to the findings of Al-Ghamdi et al. [13], who reported no significant difference in the mean knowledge score between physicians with less than five years and five to 10 years of practice. This is contrary, however, to the findings of Preti et al. [15], who reported a correct referral rate of 54.8% for GPs who had graduated five years ago versus that of 22.1% for GPs who had 20 years or more of experience since their graduation. Al-Rasheed et al. [11] separately reported higher knowledge scores in physicians with more than 15 years of practice as compared with physicians with less than five years of practice.

This study found that the majority of the participants reported that a high percentage of their patients didn't undergo fundoscopy if requested; however, the percentage of compliance is anticipated to decrease further over the passage of time as the Alfadda and Abdulrahman study in Saudi Arabia showed [16]. According to the participants' experiences, the most influential barrier was the lack of patient compliance followed by the lack of rapid appointment. The lack of rapid appointment can be attributed to the fact that there exists a limited number of ophthalmologists [17] in conjunction with a high and still-increasing number of DR cases in the Al-Hasa area [9]. Therefore, it's convenient to suggest that physicians in the PHCs should be the ones who perform routine fundus examinations for DR screening, as they are qualified to screen for DR and perform fundoscopy, as it was proven by Verma et al. [18] and Askew et al. [19] that GPs are able to detect DR changes nearly as accurately as ophthalmologists. However, in the study conducted by Al-Ghamdi et al. in Taif, Saudi Arabia, only one-third of the included 180 GPs felt confident in performing fundoscopy [13]. Thus, this study suggests that PHC physicians must be trained and provided with proper equipment to be able to perform fundoscopy to screen for DR in PHCs without referring diabetic patients to an ophthalmologist.

Only a small percentage of physicians responded that they invested less than 15 minutes in teaching their patients about diabetes. The majority of physicians educate the patients about the disease itself, the appropriate lifestyle modifications, and the importance of adhering to treatment and regular follow-up visits. However, about two-thirds didn't educate their patients about the early detection of diabetic complications, including DR screening. Not having an adequate perception of the complications of diabetes was found to be the most common cause of the lack of compliance with undergoing regular fundoscopy examinations in previous studies conducted in Saudi Arabia, India, Malaysia, and Ireland [20-24]. Therefore, PHC physicians should be advised to place more emphasis on teaching their diabetic patients about both the potential complications and the importance of undergoing regular screening.

Limitations

There are a few limitations of this study. First, the response rate of this study was 67%. The study also didn't cover all PHC centres in Al-Hasa and the affiliated villages; therefore, the study results shouldn't be generalized to all PHC physicians across the region, country, or other parts of the globe.

Conclusion

PHC physicians have a crucial role in the early detection and prevention of DR. Regarding these physicians' knowledge, the present study concluded that there are gaps in applying the correct guidelines. The physicians' attitudes toward patient education were overall satisfactory. Most of the physicians dedicated enough time to their patient management efforts. Medical symposiums and workshops are warranted to teach PHC physicians about the seriousness of diabetic complications and the appropriate screening schedules. Moreover, training programs must be organized for PHC physicians to master fundoscopy so as to perform it at PHCs without referral to an ophthalmologist, since the most reported barrier to screening nonadherence was the lack of rapid appointment.

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Conflict of interest statement

The authors declare no conflict of interest.

Authors' contributions

AEA conceived and designed the research project, collected and analysed the data, contributed to the writing of the manuscript, critically revised the manuscript, and approved the final manuscript. MA Alsultan, MA AlShareet, FAA, MAA, and AIA collected and analysed the data, contributed to the writing of the manuscript, critically revised the manuscript, and approved the final manuscript. MRN contributed to the writing of the manuscript, critically revised the manuscript and approved the final manuscript, and supervised and coordinated the research implementation. SIA analysed the data, critically revised the manuscript, and approved the final manuscript.

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Appendix 1

Knowledge and awareness regarding diabetic retinopathy among general practitioners in Al-Ahsa, Saudi Arabia

We would highly appreciate your assistance with this research, which is being conducted to observe the practice of general practitioners towards diabetic retinopathy. This research was designed in order to give us a clear view of how diabetic retinopathy is screened in Al-Ahsa region and whether or not there are any obstacles that prevent the general practitioners from screening. If you want to participate in this research, please complete the consent form below.
I hereby give voluntary permission to be a part of the study conducted by the student's scholars of College of Medicine, King Faisal University, Al-Ahsa.
I know I do not have control or access to the final results of the research. However, I can access my personal data if available.
I have informed that my identity will be kept confidential by the Students scholar/Researchers.

Participant's signature: ……..Date/Time/Place: ……

Demographic data:

1. **Gender:**
   Male ☐ Female ☐
2. **Age:** …….
3. **Years of service as a GP:** …
4. **Place of graduation:** ……
5. **Health sector:**
   Omran ☐ Hofuf ☐ Mubarraz ☐ Other: …
6. **Nationality:**
   Saudi ☐ Egyptian ☐ Sudanese ☐ Syrian ☐ Jordanian ☐
   Indian ☐ Pakistani ☐
   Other nationality, specify_____
7. **Medical specialty:**
   Family medicine ☐ Pediatrics ☐
   Internal medicine ☐ General Practitioner ☐
   Endocrinology ☐

Knowledge and awareness

1. **In your daily practice, when do you request fundoscopy to a newly diagnosed T1 DM patient for the first time?**
   At diagnosis ☐
   After 1 year ☐
   After 3 years ☐
   After 5 years ☐
2. **How regular should a type 1 diabetic patient visit an ophthalmologist?**
   Every 5 years ☐
   Every 2 years ☐
   Every year ☐
   Based on ophthalmologist screening assessment ☐
   I don't know ☐
3. **In your daily practice, when do you request fundoscopy to a newly diagnosed T2**
   DM patient for the first time?
   At diagnosis ☐
   After 1 year ☐
   After 3 years ☐
   After 5 years ☐

4. **How regular should a type 2 diabetic patient visit an ophthalmologist?**
   Every 5 years ☐
   Every 2 years ☐
   Every year ☐
   Based on ophthalmologist screening assessment ☐
   I don't know ☐

Attitudes and practices

1. **How much time does it take for you to explain how to manage diabetes?**
   < 15 minutes ☐
   15 to 30 minutes ☐
   > 30 minutes ☐
   Depends upon the patient ☐
2. **Which aspects you usually educate your diabetic patients about? (Check what apply)**
   The disease: What is diabetes, symptoms and possible complications ☐
   Lifestyle suggestions to control the disease: Diet, exercise and weight loss ☐
   The necessity of sticking to the treatment plan and follow-up visits ☐
   How to detect some complications early ☐
3. **The number of DM Type 1 patients who visit your clinic weekly (on average):**
   [… …]
4. **The number of DM Type 2 patients who visit your clinic weekly (on average):**
   [… …]
5. **Do most diabetic patients undergo fundoscopy when requested?**
   Less than 25% ☐
   25-50% ☐
   50-75% ☐
   More than 75% ☐
6. **If a requested fundoscopy is not done, what is the reason?**
   Lack of rapid appointment ☐ Financial reasons ☐
   Lack of compliance ☐ No available ophthalmologist ☐
   Others: …..
7. **How often do you receive a report regarding the patient situation from the ophthalmologist?**
   Always ☐
   Usually ☐
   Sometimes ☐
   Rarely ☐
   Never ☐

ORIGINAL ARTICLE

Prevalence of catastrophic health expenditure and its associated factors, due to out-of-pocket health care expenses among households with and without chronic illness in Bangalore, India: a longitudinal study

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Keywords

Government health care • Financial burden • Direct costs

Summary

Background. *India, one of the economic powerhouses of the world, is lacking in health development.Moreover, it is facing 'Triple burden of disease'. Indians have one of highest proportion of out-of-pocket (OOP) health expenses. Salient reasons are poor quality public health care, costly private care and lack of health insurance. This has led to catastrophic health expenditure (CHE). Another contributor to this CHE is the chronic illness, which require long-term follow-up. It is estimated that catastrophic health expenditure impoverishes 3.3% of Indians every year. This study was undertaken with an aim to estimate the prevalence of catastrophic health expenditure and its associated factors.*

Methods. *A longitudinal study with one-year follow-up period was conducted among 350 households of an urban area in Bangalore city. Simple random sampling method was used to select the study sample. Data collection done using pre-tested, semi-structured questionnaire by interview method.*

Results. *Chronic illness mean health expenditure was 1155.67 INR (56.09% of the direct cost was spent on drugs). In acute illness, mean health expenditure was 567.45 INR (59.54% of the direct cost was spent on drugs). Fourty eight (14.86%) of the households experienced CHE in the one year. Statistically significant association was found between socio-economic status and catastrophic health expenditure. Eighty-five 42% of the households who experienced CHE had a member with chronic illness in it.*

Conclusion. *Reducing the financial burden of high health care expenses is possible by improving the government health care system, free quality regular supply of medications to chronic disease patients and to improve the beneficiaries under insurance schemes.*

Introduction

India, a country with impressive economic development, has failed to show similar results in field of health. Our country now suffers with 'Triple burden of disease'. With growing communicable diseases, along with nutrition related health problems and rampantly increasing non-communicable diseases has added to the triple burden. In such a situation, equity in health-care distribution; a longstanding principle to serve all the under-privileged members of the society becomes important [1]. This is possible only with adequate public health expenditure. In developed countries, government health spending accounts to around 5 per cent of GDP or more. Even in Asian developing countries other than India, the average is around 3 per cent of GDP. But India, an economic powerhouse has government health expenditure amounting to less than 1 per cent of GDP [2]. Due to inadequate public spending for health development and also the high health care costs in private sector, the economic burden of health spending entirely lies on private spending which in India is majorly by out-of pocket expenses [3]. India has one of the highest proportions of household out-of-pocket health expenditures in the world, estimated at 71.1% in 2008-09 [1]. Household's share in health spending is almost more than two-thirds in India which is around three times the amount of all government expenditure [4].

India has an estimation of more than 290 million people living below the poverty line [5]. Diseases can still further deteriorate an individual condition by affecting the quality of life, loss of savings and assets, indebtedness and an inability to cope with future illness [6]. Such a financial burden can be blamed on low-funded and low-quality health care of public health system which forces consumers to seek care from expensive private sector. Another contributor which causes the financial burden is the lack of protective mechanisms like health insurance [7]. Less than 10% of India's population is covered by the protective mechanisms against health care expenses.1 The unpredictable character of illness requiring huge amounts of money are impoverishing an estimated 3.3% of India's population every year [8].

World Health Organization proposes that health expenditure should be called catastrophic whenever it is greater than or equal to 40% of the capacity to pay [9]. Some

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studies, have defined Catastrophic Health Expenditure if the total health expenditure is more than 10% of annual income [10]. The precursors for catastrophic payments are the availability of expensive health services, low capability to pay, and the lack of health insurance [7]. Another contributor to catastrophic payments is Chronic diseases. It is a known fact that catastrophic payments are more in chronic illness. As people with chronic diseases require long-term follow-up, long-lasting medications and also have an increased risk of in-patient or Intensive care unit admissions, thus leading to more health expenses [11]. As there are fewer studies about catastrophic payments at household level, this study was conducted with an objective to assess the out-of pocket health expenses among the households, prevalence of CHE among the households and to determine the associated factors of CHE.

Materials and methods

Study design, area and study population

This was a longitudinal study with one-year follow-up conducted among the households of an urban area in Bangalore, Karnataka. The study was conducted from January 2016 to April 2017.

Study sample size

Based on a previous study by Mani et al. [8], the preference of the households for health care at a government facility was found to be 65% and at 5% significance, sample size was calculated to be 350 households.

Household selection method

There are 3 sectors in the urban field practice area with total 6237 households (1684 + 2182 + 2371). Sample size was achieved ensuring equal representation to all sectors in study area by Probability Proportional to Size sampling. Sample size 350 was proportionately divided obtaining 95,122 and 133 households in each sector. By simple random technique, households were chosen in each sector from the survey list available in the health center, irrespective of family composition and by using lottery method.

Inclusion criteria

1. Those who are the permanent residents in the area since 3 years.
2. Households who gave consent for a follow-up study.

Exclusion criteria

Guests contributing to health expenditure at the time of study.

Ethical consideration, study tool and data collection method

Data collection was started after obtaining ethical clearance from the Institutional Ethical committee. A written informed consent was obtained from the households for study. Data was collected using a pre-tested and semi-structured questionnaire by interview method. Study tool was standardized by a Pilot study and those households who participated in pilot study were not included for analysis. The households who satisfied the eligibility criteria were recruited for the study. Data regarding socio-demographic profile, chronic illness in the family, health expenses incurred preferred health care system were obtained during recruitment of households into the study. Among the recruited households, the ones with chronic illness patients were noted down. Then those subjects and other households were followed up for a period of one year to assess the annual health expenditure and catastrophic health expenditure.

Follow-up data collection method

A well informed contact person was identified in each household for follow-up. A log book was distributed to them which contained the components of health expenditure like type of visit to health center, illness, health center visited (private/ government), total health expenditure and also the split expenditure of direct and indirect cost. Direct cost contains consultation fees, drug expenses and investigation expenses. Whereas indirect costs contain transport expenses, food expenses and consecutive income loss. Each month the households were contacted and the data from the log book were retrieved.

Statistical analysis

Data was entered in Microsoft Excel sheet and analyzed using SPSS software version 22. Descriptive statistics, Chi-Square test and logistic regression were used for analysis and results were presented in the form of tables and figures. The model for logistic regression used for this study was $\frac{1}{1+e^{-(\beta°+\beta 1x1+\beta 2x2+\cdots\ldots\ldots\beta nxn)}}$.

The total health expenditure is divided into direct and indirect cost. Direct cost contains consultation fees, drug expenses and investigation expenses. Whereas indirect costs contain transport expenses, food expenses and consecutive income loss. Catastrophic health expenditure was calculated by considering total health expenditure spent by households annually for all type of services (curative, preventive, chronic illness) and the annual income of the household. The health expenditure was said to be catastrophic when the total health expenditure is more than 10% of the annual income [10].

Results

Socio-demographic profile of the population

Study was conducted among 350 households of an urban area which included 1581 individuals. 991 (62.68%) adults, 162 (10.25%) under-5 children and 66 (4.17%) elderly population. It was seen that female population was slightly higher in our study (811, 51.3%) than the

males (770, 48.7%). Most of the households belonged to upper lower class (54.29%) followed by lower middle (35.71%) class according to Modified Kuppuswamy scale 2016. Majority of households i.e. 263 (75.10%) were below poverty line.

Socio-demographic profile of subjects with chronic illness

Among the 350 households the total number of individuals with chronic illness was 109 (6.90%): 72 (66.05%) were in the age-group of 30-60 years, and 37 (34%) above 60 years. Among them 64 (59%) were females. 84 (77.06%) were literates with majority of them completed primary education. Table I shows the various types of chronic illness among the households.

Health care sector preference in individuals with and without chronic illness

Table II depicts that the individuals with chronic illness prefer private clinics (68, 62.39%) over Government sector (30, 27.52%). Even in individuals with acute illness episodes (1204 episodes) majority of them were found to prefer private clinics over government sector (988, 82.06%). Over the counter medication history was higher among individuals with acute illness (86, 7.14%) compared to (3, 2.75%) those with chronic illness (109).

Out-of-pocket health expenditure among the households with and without chronic illness in family

In chronic illness mean health expenditure was 1155.67 INR. 56.09% of the direct cost was found to be spent on drugs and 26.16 % on investigations. Whereas lower proportion was for consultation fees. When interviewed about the health expenses spent for out-patient visits for acute illness, it was found that mean Total Health Expenditure was 567.45 INR during each visit. 59.54% of the direct cost was found to be spent on drugs and 23.70% on consultation fees. Whereas lower proportion was for investigation (16.69%).In indirect expenses major contributor was food expenses and income loss.

Tab. I. Types of Chronic illness among individuals (n = 109).

Chronic illness	Frequency	Percentage
Diabetes Mellitus	32	29.36%
Hypertension	25	22.94%
DM+HTN	21	19.27%
Hypothyroidism	7	6.42%
Respiratory illness	7	6.42%
Cardiovascular diseases	8	7.33%
Kidney disorder	3	2.75%
Epilepsy	2	1.83%
Others (mental disorders, bone disorders)	4	3.66%

Catastrophic Health Expenditure (CHE) among households

In our study 48 (14.86%) of the households experienced CHE in the one year. (Fig. 1) A large portion of health expenses was found to be out of pocket expenses i.e out of earning and savings. To cope up with the high health care expenses ten households were in debt.

Table III shows the association between various parameters of the households and catastrophic health expenditure. The association was found to be statistically significant (Chi-square value = 9.06 and $P < 0.05$) with socio-economic status. It depicts that as the socio-economic status lowers there is increase in Catastrophic Health Expenditure among the households. It emphasizes that the Lower middle and upper lower household population suffer CHE and are pushed more below poverty.

The total number of households with one or the other member having chronic illness was 99. Table III shows that the association between households with chronic illness and CHE was statistically significant ($X^2 = 79.55$, p value = < 0.001). It was seen that 41 out of 99 households with chronic illness experienced CHE (41.41%).

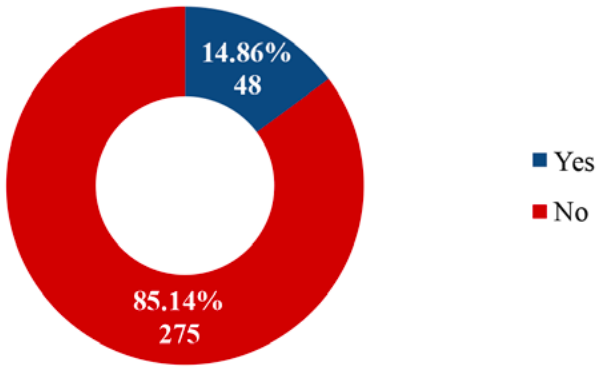
But we already have seen that total number of households who experienced CHE overall were only 48. Out of which 41 households have one or more member with chronic illness in it; i.e 85.42% of the households who experienced CHE had a member with chronic illness (Fig. 2). It was seen that the most common chronic illness among the households experiencing CHE was Diabetes Mellitus and Hypertension (70%).

Table IV depicts that the odds of CHE among joint family was 2.695 times more when compared to three-generation family (constant). Similarly, the odds of CHE was 1.29 times more among nuclear family compared to the odds among three-generation family. The odds of CHE was 1.5 times more among the households with chronic illness compared to the ones without chronic illness. Total number of family members and also socio-

Tab. II. Type of health sector visited for illness (both acute and chronic).

Health sector	Acute illness (n = 1204) Frequency (%)	Chronic illness (n = 109) Frequency (%)
Private clinic	988 (82.06%)	68 (62.39%)
Government	98 (8.14%)	30 (27.52%)
Nursing home	30 (2.49%)	5 (4.59%)
Over the counter medicine	86 (7.14%)	3 (2.75%)
Alternative system	2 (0.10%)	3 (2.75%)

Fig. 1. Proportion of households experienced CHE during follow-up of 1 year (n = 323)*.



* Loss to follow-up.

economic status of the household had odds ratio of 0.99 (approximately 1)

Discussion

Among the 350 households the total number of individuals with chronic illness was 109 (6.90%).

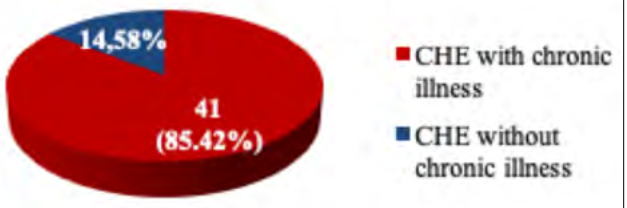
In a study by Bhojani et al. the prevalence of self-reported chronic conditions was 8.6% in the general population and 13.8% among adults (age ≥ 20 years). In this study majority of the visits were to private clinics, which is similar to a study conducted by Bhojani et al. where it found that overall, 80.6% of people with chronic conditions sought care from private healthcare providers, while 19.4% sought care from government health services [11]. But findings are in contradiction with another study by Kanungo et al. where 53.16% episodes were treated by non-qualified practitioners, 34.02% by qualified practitioner from private sector and only 12.82% by qualified practitioner from Government sector [12].

Diabetes Mellitus and hypertension were the most commonly reported conditions similar to study by Bhojani et al. where hypertension and diabetes had a self-reported prevalence of 10.0% and 6.4%, respectively [11].

When we look into the health expenses, similar results were also found by Bhojani e al. They found similar OOP payments for chronic illness treatment [11]. Another study which shows similar results is a study by Quintussi et al. where it was seen that the households' average monthly costs related to non-communicable diseases (1573 INR) and bulk of expenditures on care for chronic diseases (74%) were related to additional medical services, mostly drugs [13].

In our study, the prevalence of catastrophic health expenditure was 14.86% (48 households) and major source of health expenses was from earnings and sav-

Fig. 2. Comparison of CHE among households with and without chronic illness (n = 48).



Tab. III. Associated factors with catastrophic health expenditure (n = 323).

Factors	CHE Yes	CHE No	Chi-square value	P value
	Frequency	Frequency		
Religion				
Hindu	40	233	0.06	0.8
Muslim	8	42		
Type of family				
Nuclear	34	193	1.232	0.54
Joint	5	18		
3-generation	9	64		
Socio-economic status				
Upper middle	5	28		
Lower middle	8	106		
Upper lower	35	141	9.06	**< 0.05**
Chronic illness				
Yes	41	58	79.55	**< 0.001**
No	7	217		
***BPL card holders**				
Yes	38	205	0.468	0.494
No	10	70		

* below poverty line

Tab. IV. Logistic regression model for risk factors of catastrophic health expenditure

SL No	Risk factors	Odds ratio	95% CI for Odds ratio	
			Lower	Upper
1	**Religion**			
	Hindu	0.046	0.008	0.269
	Muslim	0.052	0.008	0.354
2	**Type of family**			
	Nuclear	**1.293**	0.498	3.358
	Joint	**2.695**	0.686	10.582
3	Total family members	**0.996**	0.682	1.179
4	**Socio-economic status**			
	Lower middle	0.46	0.085.	2.49
	Upper lower	**0.904**	0.396	2.063
5	Chronic illness	**1.505**	**1.016**	**3.163**

ings. Similarly, a study by Rehman et al. showed that a large majority (86%) of the study participants had to bear the expense out of pocket, either by borrowing money (42%); or by selling their household belongings (23%) [14]. Study by Balasubramanian et al. showed that the prevalence of catastrophic expenditure was 5.6% and almost 59% of the patients paid for the healthcare from their income or savings [15].

A statistically significant association was found between socio-economic status and catastrophic health expenditure in our study. Similar to the study by Bhojani et al. where the median share of household income spent on OOP payments was significantly higher among the lowest income quintile compared with the highest income quintile [11]. Our study also found that out of 48 households who experienced catastrophic health expenditure during one year, 41 (85.42%) were households with one or the other chronic illness.

Limitations of the study

Catastrophic health expenditure can be better calculated by considering household's capacity to pay and proportion of health expenditure out of total expenditure which could not be computed in this study. Moreover, an element of recall bias could not be eliminated since it is a follow-up study.

Conclusions

We had conducted this study with an objective to study the health expenditure incurred by the households and to estimate the prevalence of catastrophic health expenditure. Nearly 7% of the population had chronic illness. Direct cost was more for the treatment of chronic illness when compared to acute illness episodes and majority of those expenses was for medications and investigations. Catastrophic health expenditure prevalence was found to be 14.85% which was significantly associated with lower socio-economic status and chronic illness. Only ways to reduce the financial burden of high health care expenses is to improve the government health care system by providing quality health care services, free quality regular supply of medications to chronic disease patients and also to improve the beneficiaries under insurance schemes.

Ethical approval

The study was approved by the Institutional Ethics Committee, Bangalore Medical College & Research Institute.

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Conflict of interest statement

The authors declare no conflict of interest.

Authors' contributions

NBS and SS planned, designed and conducted the study. NBS and SS did the data entry and analysis along with review of literature which was guided by SS.

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Review

Strategies for elimination of rubella in pregnancy and of congenital rubella syndrome in high and upper-middle income countries

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Keywords

Rubella • Vaccination • Congenital rubella syndrome • Surveillance • Coverage

Summary

Rubella infection generally leads to mild symptoms; otherwise, in pregnant women it can cause severe damages. The only way to prevent rubella is vaccine. Before the introduction of the vaccine, up to 4 babies in 1000 live births were born with CRS.
This work aims to review the most important strategies for the elimination of CRS in upper and high-income countries.
Papers were selected through a PubMed search up to January 2019, using keywords rubella, congenital rubella syndrome and epidemiology. Articles published in the last 12 years and referred to upper income and high-income countries in title or abstract were included.
Sixty-five papers were selected dealing with one or more of the following strategies: increasing of rubella vaccination coverage in childbearing age women, males, immigrants; exploitation of all appropriate occasions; improving of rubella surveillance.
Despite numerous suggestions and indications for valid strategies to eliminate rubella in pregnancy and congenital rubella syndrome, a practical application is often missing.

Introduction

Rubella is an acute viral infection that generally leads to mild symptoms, such as fever and rash in children and adults. It spreads by contact with infected nasal or throat secretions or by breathing droplets sprayed into the air when an infected person sneezes, coughs or talks. In pregnant women, however, rubella infection can cause severe damages. During the first trimester, it can result in miscarriage, fetal death, stillbirth, or infants with congenital malformations, known as congenital rubella syndrome (CRS). These children can present eye and heart defects, hearing impairments and other lifelong disabilities as diabetes and thyroid dysfunctions. All these are serious clinical conditions, with high costs in terms of therapy, care and disabilities [1].
The only way to prevent rubella is vaccination; before the introduction of the vaccine, up to 4 babies in 1000 live births were born with CRS [2]. The widely used rubella-containing vaccine (RCV) is safe and effective and one dose is about 97% effective in preventing rubella [1].
Since the 1980s, WHO recommended national use of routine childhood rubella vaccination. Three World Health Organization (WHO) Regions (American, European and Western Pacific Region) have rubella and CRS elimination goals [3]. WHO, summarizing global progress toward rubella and CRS control and elimination, reports that as of December 2016, 152 of 194 countries had introduced RCV into their national immunization schedule. In the WHO European Region 95% of 53 Member countries incorporated a RCV by 2009 into their routine childhood immunization programs, and, in 2010, 67% of the WHO Member States included rubella in association with measles vaccines in their national immunization programs [4-6].
Furthermore, according to WHO's guidelines, a key strategy for achieving rubella elimination is the implementation of a high-quality Surveillance System. Today we can find Surveillance System for rubella, rubella in pregnancy and congenital rubella syndrome in most of the American, European and Western Pacific Region's countries [2].
Unfortunately, despite the existence of well-established immunization programs and the presence of Surveillance Systems, in high and upper-middle income countries epidemiological data show that rubella, rubella in pregnancy and CRS still represent an important Public Health issue.
In this scenery, a review of the existing literature was performed:

- to identify the most important strategies for the elimination of rubella in pregnancy and CRS in high and upper-middle income countries;
- to highlight aspects that can lead to an improvement in the fight against CRS.

Materials and methods

Papers were selected through a PubMed search up to January 2019, using the following keywords: rubella and congenital rubella syndrome and epidemiology.

https://doi.org/10.15167/2421-4248/jpmh2020.61.1.1310

Inclusion criteria were (Fig. 1):
- papers published from 2007 to 2018;
- papers referred to high and upper-middle income countries [according to the New country classifications by income level: 2017-2018 by the World Bank (69)] in title or abstract;
- papers with abstract;
- papers in English and other languages of the European Community.

Full text of selected articles was evaluated and papers were excluded if they did not present data about national surveillance systems and strategies to improve vaccination coverage.

The analysis was performed in 65 articles considering three topics:
- strategies to increase coverage in risk groups: women in childbearing age, males not included in universal rubella vaccination programs and immigrants;
- strategies to use every opportunity to offer immunization, like different places or situations;
- strategies to implement surveillance system considering solution for correcting underestimation, collaboration with laboratories and integrating measles and rubella surveillance.

Results

The selected papers addressed at least one of the following strategies for the prevention of rubella in pregnancy and CRS: rubella vaccination coverage in childbearing age women, males and migrants; different opportunities to offer vaccine; problems related to rubella surveillance [1, 4, 6-68].

Coverage

Rubella vaccination coverage was considered in fifty-one (78%) articles (Tab. I).

Rubella vaccination coverage in childbearing age women

Among the twenty-two selected articles that considered this point, many underlined that comprehensive strategies are needed to prevent CRS [8, 9, 25, 31, 51, 55, 66]. High levels of immunity (≥ 95%) in the general population and immunization of susceptible subjects are the cornerstones to prevent CRS [50].

Seroprevalence studies are useful to identify susceptible groups that may require additional prevention strategies and should be carried out periodically [25, 41]. A great number of childbearing age women are still unprotected from rubella [6, 10, 44, 54]. Three studies in women of reproductive age showed that between 14 and 17% were susceptible to rubella [8, 29, 66]. In Greece [8] vaccination coverage was 18.5% while in China [66] generally lower vaccination coverage was indicated. Countries should make efforts to reach women of childbearing age either through routine services or mass campaigns [1, 38]. The priority is to reach a high coverage in susceptible women, offering vaccination in every occasion, in particular to immigrant women [35].

Supplemental immunization activities are required also for countries, that revised their immunization strategies. In fact, when rubella vaccination was offered to all children at 12 months instead of immunizing only girls at 11-13 years of age, for some time the amount of susceptible people increased in general population, and among them we can find women in childbearing age [25].

Catch-up programs are necessary to reach susceptible individuals missed in routine immunization even if vaccine coverage is as high as 97-99% [26] and they have been implemented in many countries [25].

Immunization strategies should be integrated with preconception care [19, 41]. When this is not possible, susceptible women should be vaccinated during the postpartum period [10]. Females of childbearing age and pregnant women must be aware of mother-to-child transmission to reduce the incidence of CRS [14, 46] and a study demonstrated that a high proportion (36%) of the pregnant women of the study group was unaware of the risk posed by rubella infection contracted during pregnancy [29].

Rubella vaccination coverage in males

For many years the prevalent vaccination strategy for rubella has focused on women coverage [32]. In this way the male population has become a major reservoir of susceptible subjects in many cases [42, 58]. Therefore, to interrupt endemic rubella transmission, supplementary immunization activity should be focused on male adults [43, 62]. For example, three countries (Chile, Brazil and Argentina) focused campaign between 1999 and 2006 on women and transmission and outbreaks of rubella mainly occurred among adolescent and adult males [12]. Therefore, the immunization strategy was focused on males starting in 2007. In Brazil it was shown that the greater incidence in men lead to new outbreaks of CRS [39]. In Mexico and Costa Rica no cases of CRS have been recorded since 2008, thanks to a universal vaccination strategy [6, 39].

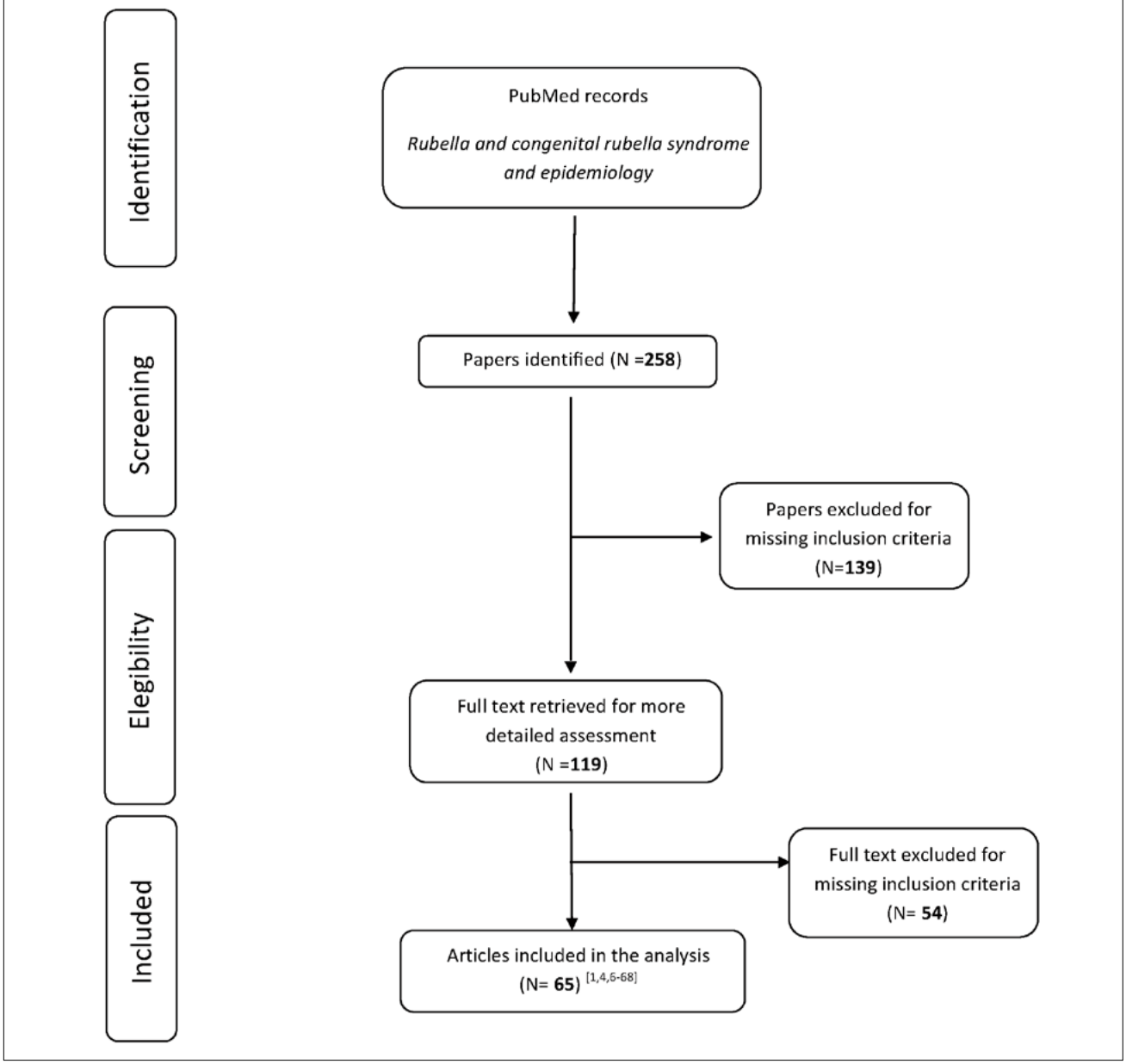
In the American Region, in countries that had vaccinated only women during mass campaigns, outbreaks of rubella occurred in 2007 despite a reduction of 97.8% of confirmed cases [13].

In Europe, many countries introduced rubella vaccine in females earlier than in males. In Catalonia, it was shown that infected males had contact with potentially pregnant females of the same age and therefore males became the target of specific vaccination campaigns [34].

Poland and Romania, as a result of a strategy that initially focused on females, experienced rubella outbreaks that predominantly affected males in 2012 [1]. In Poland, the selective vaccination of adolescent girls since 1989 explains the 81% of cases among 15-29 year-old males during the outbreak in 2013 [41].

In Japan, there has been a large outbreak of rubella in 2012-2013 and most cases were reported in males (aged 20-49 years). The following year Tokyo Metropolitan Government began offering free (or reduced cost) vacci-

Fig. 1. Flow chart for articles selection.



nations to females of childbearing age and their partners as a response to the outbreak [56].

Rubella vaccination coverage in immigrants

Vaccination policies are not common to all countries. In particular, rubella is not a priority for many of the migrants' countries of origin [33] and generally the percentage of seronegativity is higher in foreign born women, especially those from Asia [23]. In a large study performed in Ireland rubella susceptibility was 6% in European mothers and 11.4% in women born outside the European Union [40].

Immigrant women, who presently represent the population with higher fertility [28] and that are one of the most vulnerable and frequently neglected groups, represent a priority for rubella vaccination [7, 10, 32].

Rubella elimination in Europe, may be obtained also through the control of transmission form countries with high incidence [25].

In UK most of the recent cases of CRS have been observed in infants of foreign born mothers because of the lack of vaccination programs or sub-optimal coverage in their countries of origin [59]. Further attention is needed to respect the catch-up program after entering the UK [9]. Other important occasions of transmission can be the visit of relatives and friends from endemic countries [64].

Pregnant women who return to their countries of origin with endemic virus circulation may be on danger (i.e. Nigeria) [63].

Women from countries that do not have specific immunization programs for rubella may give birth to an infant with CRS [19, 68]. For preventing CRS in immigrants,

Tab. I. Strategies for preventing rubella and CRS – Coverage.

References	Authors / Strategies	Coverage		
		Childbearing age women	Males	Immigrant
7	Bonanni 2007			x
8	Giuola 2007	x		
9	Jin 2007	x		x
10	Rota 2007	x		x
12	CDC 2008		x	
13	Weekly epidemiological record 2008		x	
14	Canepa 2009	x		
18	McElroy 2009			x
19	Pandolfi 2009	x		x
23	Hernandez Diaz 2011			x
25	Usonis 2011	x		x
28	Bechini 2012			x
29	Calimeri 2012	x		
31	Metcalf 2012	x		
32	Song 2012		x	x
33	Tkadlecova 2012			x
34	Barrabeig 2013		x	
35	Bechini 2013	x		x
38	Cutts 2013	x		
39	Mongua Rodriguez 2013		x	
40	O'Dwyer 2013			x
41	Paradowska-Stankievicz 2013	x	x	
6	Bouthry 2014	x	x	
42	Grangeot-Keros 2014		x	
43	Yamada 2014	x	x	
44	Khandaker 2014	x		x
45	Lo Giudice 2014			x
46	Morioka 2014	x		
48	Cozza 2015	x		
50	Giambi Filia 2015	x		
51	Jyoti 2015	x		
1	Lambert 2015	x	x	
54	Neu 2015	x		
55	Plans 2015	x		
56	Sugishita 2015		x	
58	Kinoshita 2016		x	
59	Ogundele 2016			x
62	Mori 2017		x	
63	Baltimore 2018	x		x
64	Bukasa 2018			x
66	Meng 2018	x		
68	Seppälä 2018			x

a Canadian study proposes the possibility to offer vaccination to women of childbearing age after investigating their immune status or immediately without serological control [18].

Similarly, an Italian study proposes vaccination of foreign-born women at their first encounter with the healthcare system [35] especially considering that in recent years in Italy there has been an increased number of immigrant women (to joint family members) and also a large number of women employed as care providers or domestic workers [45].

Appropriate occasions

Eighteen of the selected articles (28%) consider this point (Tab. II).

It is important to take advantage of every opportunity of encounter with the health system to inform about risks of CRS and provide an active vaccination offer to susceptible women in childbearing age in different locations and situations [14, 29, 48]. Several strategies have been suggested to increase the achievement of vaccine offer in susceptible:

Tab. II. Strategies for preventing rubella and CRS – Opportunities.

References	Authors / Strategies	Opportunities					
		School and work place	Travel medicine	Post partum post abortion	Vaccination session	First PAP test	Education of clinicians
10	Rota 2007			x			
14	Canepa 2009						x
16	Lugner 2009			x			
22	Gross-Galiano 2011						x
23	Hernandez Diaz 2011			x			
25	Usonis 2011		x				
28	Bechini 2012				x	x	
29	Calimeri 2012			x		x	x
35	Bechini 2013	x		x			
43	Yamada 2014			x			
44	Khandaker 2014	x	x				
48	Cozza 2015		x		x	x	x
50	Giambi Filia 2015			x			
54	Neu 2015			x			
56	Sugishita 2015	x					
57	Vilajeliu 2015			x			
67	Pettinicchio 2018			x			
68	Seppälä 2018			x			x

School and work place

Considering the most appropriate age for vaccination (target age group 10-14), the school may be a privileged place for the promotion [44]. Vaccination of school personnel could also be an opportunity to explore [35]. Mass vaccination is essential to eliminate rubella transmission at workplaces. In a rubella epidemic in March 2013 in Tokyo, the workplace was the most frequent location of transmission, among adults. The Tokyo Metropolitan Government provided financial support for adult MR vaccination to local administrations for 1 year [56].

Visit at the travel medicine service

Vaccination of susceptible people visiting foreign countries could be an opportunity [25, 48]. Susceptible pregnant women should evaluate the danger of travelling to countries where rubella is endemic [44].

Post-partum [10, 16, 23, 54, 68] and post abortion vaccination of susceptible women [29, 35, 67]

It is an opportunity to increase vaccination coverage against rubella and other vaccine-preventable diseases and strategy to protect women and consequently prevent CRS [57].

An Italian research showed 16% of susceptibility to rubella in a two-year period (2014-15) among women accessing voluntary termination of pregnancy in Rome. Among them, only 15% accepted the vaccine [67].

In the Italian national elimination plan, several strategies have been proposed for post-partum vaccination. Vaccination of the susceptible women could be performed before discharge from the ward [29, 50]; or the public vaccination service could take care of the active call and immunization; or the first access of the newborn to the vaccination service could be exploited to vaccinate also the susceptible mother [50].

Many hospitals offer rubella immunization to women not immune for rubella and this strategy was generally shown to be effective. However, a poor adherence to the second dose has been reported [35, 50, 57].

A Japanese study has shown that despite knowledge of the risk of contracting rubella in pregnancy, women do not get vaccinated. Japanese guidelines recommended to investigate the immune status of women during pregnancy and to vaccinate those with low titer in postpartum [43].

Other occasions

It is important however to be able to exploit any access to the vaccination services. In Italy, for example, some studies propose to exploit the opportunity of HPV immunization session or the routine anti-tetanus–diphtheria–pertussis booster dose [28, 48].

In addition, the occasion of the screening tests can be exploited like the first pap-test screening visit at 25 years [28, 29, 48].

In addition is always crucial to improve awareness of clinicians and of healthcare workers because of the role played by general practitioners, health personnel and specialists involved in women's health [14, 22, 29, 68].

Surveillance

Fifty-three of the selected articles (81%) consider this point (Tab. III).

The problem of underestimation

Despite the awareness about the importance of notification in a high-quality Surveillance System, there is a

Tab. III. Strategies for preventing rubella and CRS – Surveillance.

References	Authors / Strategies	Surveillance		
		Underestimation of R and CRS	Laboratories' role	Integrating MR
9	Jin 2007		x	
11	Carnicer-Pont 2008	x		
12	CDC 2008	x		x
13	Weekly epidemiological record 2008		x	x
14	Canepa 2009		x	
15	Forsey 2009	x		
17	Martin 2009			x
19	Pandolfi 2009	x		
20	Bisbo de Filippis 2011		x	x
21	Castillo-Solorzano 2011		x	x
24	Rota 2011		x	
25	Usonis 2011	x	x	
26	Zimmerman 2011	x	x	x
27	Zimmerman Muscat 2011	x	x	x
28	Bechini 2012			x
30	Goodson 2012		x	
34	Barrabeig 2013	x	x	
35	Bechini 2013	x	x	
36	Buffolano 2013	x		
37	CDC 2013	x		x
41	Paradowska-Stankievicz 2013		x	
6	Bouthry 2014		x	x
44	Khandaker 2014			x
47	Chan 2015		x	
49	Giambi 2015	x	x	
50	Giambi Filia 2015	x	x	
52	Martinez-Quintana 2015	x	x	
53	Masa Calles 2015	x	x	
54	Neu 2015			x
55	Plans 2015			x
56	Sugishita 2015	x	x	
60	Paradowska-Stankievicz 2016		x	
61	Vynnycky 2016	x		
4	Grant 2017		x	
65	Edirisuriya 2018		x	
68	Seppälä 2018	x	x	

problem of rubella underestimation due to the variable clinical pattern and to an incomplete reporting, especially in the private sector [11]. Some documents deal especially with the fundamental importance of harmonizing the notification by using standard documents for reporting, introducing the zero-reporting and guaranteeing the notification from regional to central level [49, 50, 53, 56].

CRS is typically underestimated [61], not only because of the lack of notifications. In fact, cases of CRS may go under-recognized due to the asymptomatic nature of rubella infection in mothers and a late onset of CRS symptoms in infants and children [25].

Even if CRS is often a severe disease with specific symptoms (Gregg's triad) [15], it may present with other manifestations like thrombocytopenic purpura, encephalitis [56]. Rubella infection during pregnancy may be asymptomatic or can cause abortion [19].

WHO proposes retrospective search into hospital records as a complementary approach to the surveillance of congenital rubella. However, in most countries only the codes referring to the most severe types of congenital rubella syndrome are considered (deafness, cataracts, heart defects) while the milder, asymptomatic and late-onset cases go unnoticed [11]. In many cases even abortions, stillbirths and fetal deaths are neglected [49, 50].

For this reason, it is mandatory to involve pediatricians, obstetricians, cardiologists, ophthalmologists and otolaryngologists in the surveillance [36], with the recommendation to investigate all pregnant women with fever and rash [37], to follow and record the pregnancy outcomes [52] and to report all the suspected cases of CRS [53]. It is also important the retrospec-

tive search into hospital records, using a wide range of codes [34, 35, 68], so that even the most atypical cases of CRS can be recognized [26, 27].

Strengthening laboratories' capacity

In a high-quality Surveillance System, laboratory role is fundamental, not only for the diagnosis and for the confirmation of the etiology [41, 52]. In fact, laboratory investigations can give information about: susceptibility in pregnant women [26] or women in childbearing age [49]; seroprevalence in the population and in risk groups [50]; success or failure of vaccine [34]; origin of infection through virus genotyping [6, 20, 21, 27].
Worldwide, thanks to molecular biology, surveillance has improved, and the number of rubella virus genotype sequences increased in the last fifteen years [4].
Despite the WHO recommendations and the existence of national reference laboratories, genotyping of the virus is still underused and needs to be increased in most of the member countries [24]. For strengthening CRS surveillance systems it is very important to improve the laboratory confirmation [9, 13, 14, 30, 35, 41, 47, 53, 68], that is often not adequate [25, 60]. Even in Japan where there is a good Surveillance System, not all rubella cases are laboratory confirmed [56].
Investigation concerning levels of rubella specific IgG seropositivity can provide evidence of increase or decrease over the years, giving an idea of how the country proceeds towards elimination [65].

Integrating measles and rubella surveillance

According to different authors [6, 12, 13, 17, 21, 28, 44, 54, 55] and CDC (Centers for Disease Control and Prevention), surveillance for rubella infection benefits from integration with measles surveillance system [37]. In fact, the two diseases may be similar from a clinical point of view, and since the diagnosis is made by using the same laboratory testing methodology, and the vaccination is made by combined vaccines, WHO strongly recommended the integration of measles and rubella surveillance [26, 27].
Measles and rubella integrated surveillance system started in 1999 and took origin from the surveillance system developed for measles. Patients suspected of having measles or rubella infection were searched at the same time for both measles and rubella IgM. PAHO (Pan American Health Organization) has recommended since 1996, that all suspected IgM negative measles cases should be tested for rubella IgM [20].

Discussion

High vaccination coverage and Surveillance Systems are the cornerstones for eliminating rubella and congenital rubella syndrome (CRS).
The increase of rubella vaccination coverage is the target of many published studies. However, in the literature few practical experiences are described and few results of their implementation are presented. The few available experimental studies show that women of childbearing age present obstacles in accepting vaccinations even if they are the most important target [70]. Furthermore, seroepidemiological studies and Surveillance Systems' data from high and upper-middle income countries suggest that many women do not know their immune status regarding rubella [14, 29, 43, 44, 48, 50, 56, 67, 71].
In most situations, a combined rubella and measles vaccine (at least) is currently being used. This is at the same time an advantage because it takes the appropriate opportunities for both vaccines but a disadvantage for rubella that ends up bringing all the fears evoked by anti-measles vaccination.
There are other aspects to be considered, like the problem of the second dose. However, this second dose does not seem to be essential for the prevention of rubella.
It has been shown by mathematical models that a coverage of about 80% is enough to obtain the elimination of rubella. A proportion of 80% is needed in all target groups and there is still a part of the population that is not immunized even in countries with high coverage. At present susceptible groups include women of childbearing age, males not included in universal rubella vaccination programs and immigrants.
In the main risk group of women of childbearing age, we found out two main problems: susceptibility and a low level of awareness. We could face them with adequate health promotion campaigns. Furthermore, it is extremely important to use all the possible occasions to inform about the risk of contracting rubella during pregnancy, to investigate immune status and to actively offer vaccination against rubella. These occasions could be: preconception care, post-partum or post-abortion period, children's routine immunization sessions, adolescent HPV immunization session, the first pap-test screening visit and the routine anti tetanus-diphtheria-pertussis booster dose.
For many years, the prevalent vaccination strategies for rubella have focused only on women coverage, turning men into a reservoir of susceptible subjects and, then, hindering elimination of rubella. For this reason, it is crucial to reach these susceptible males with a supplementary immunization campaign focused on male adults.
Though a recent study estimates that approximately 131,000 CRS deaths in low-income countries may be prevented by increasing vaccination coverage [72], not all countries in the World have vaccination policies and unfortunately, even if they have them, rubella is not considered a priority. Consequently, immigrants and particularly immigrant women represent an important vulnerable group, which increase the risk of transmission of rubella even in those countries that achieved the elimination goal. It is essential to increase coverage among immigrants, through focused vaccination campaigns and by taking advantage of the first encounter with the healthcare system to verify the immune status and to offer vaccination to those who are susceptible [73].
Some more results were obtained on Surveillance Systems. During 2000-2016, there has been an increase of

more than 40% in countries reporting rubella and CRS cases worldwide. Furthermore, in the Region of the Americas and in 33 of 53 countries of the European Region, the elimination of rubella has been reached since 2015 and 2016, respectively [4].

Though these data show a decrease in the number of cases, the limits highlighted in Surveillance Systems are several. To achieve the goal of rubella and congenital rubella syndrome elimination, the existence of an effective and high-quality Surveillance System is crucial [7, 14, 25, 57, 71, 74]. A Surveillance System is currently active in most of the countries in the World and, particularly, in the European Region [50, 53, 75]. But, according to data from CDC, WHO and different authors [27, 48], many of these Surveillance Systems *"do not meet the standard surveillance performance indicators recommended for monitoring progress towards and verification of [...] rubella elimination"* [76], leading to a serious problem of underreporting and, consequently, underestimation [77].

The underestimation of rubella, rubella in pregnancy and particularly of CRS is not only due to the lack of notifications. In fact, cases may go under-recognized because of the wide range of clinical manifestations of CRS and the asymptomatic nature of rubella infection in adults. The solution for this problem could be the education of all healthcare workers, in order to investigate all pregnant women with fever and rash, following and recording the pregnancy outcomes [14, 22, 29, 48]. Moreover, it could be helpful a retrospective search into hospital records using a wide range of codes, so that even the most atypical cases of CRS could be recognized. Furthermore, from a clinical point of view, rubella can be confused with measles. For this reason, WHO recommends the integration of measles and rubella surveillance.

Obviously, it is desirable to overcome the differences among the Surveillance Systems. Although they have been shaped on identical guidelines, the countries' Surveillance Systems are different in some aspects [28]. First of all, "*rubella surveillance across Europe is complicated by the different methods used to collect data in each country [...]*" [25]. The most important difference concerns the case definition of congenital rubella: only in some countries the asymptomatic congenital infection fits in the definition of congenital rubella and, therefore, is reported [11]. Furthermore, not all countries collect information about the origin (autochthonous or imported) of the cases [49]. These differences create difficulties in comparing the situation among countries, and therefore in interpreting the progress in the elimination process.

Possible solutions to all these problems are the standardization of Surveillance Systems, following WHO guidelines. Is mandatory to strength laboratories' capacity, to create a Surveillance System in those countries which still do not have it [27, 78] and to improve the existing ones in all countries across Europe and the World [30, 39, 49].

In conclusion, in addition to the possible strategies (routine childhood vaccination programs, mass rubella immunization campaigns, surveillance of childbearing age susceptible women, surveillance of imported cases, rapid response to outbreaks [38], strengthening of CRS surveillance [17, 19], improvement of laboratory test results) other measures could improve the results and might help elimination efforts. For example: simplified handling and simplified storage of the vaccine may help in specific contexts [30]. Another focal point to reach elimination is to adapt public health strategies to local culture and customs [22] and building public confidence and demand for vaccination [38]. Awareness about the risk of rubella in pregnancy is crucial among women in childbearing age and among health care workers that must be ready to stimulate patient attention on subject. This could also help to reduce costs associated with prenatal care [14, 22, 29, 48, 71, 79]. It seems also important to establish clear serological screening guidelines including health care workers and students in training [79, 80].

Conclusions

The risk of contracting rubella in pregnancy is known, even a famous writer exploits it as a motive for a murder in her book (The Mirror Crack'd from Side to Side by Agatha Christie) [81]. However, despite the widespread awareness of its danger, there continue to be women who underestimate the risk and health care workers who do not give adequate attention to this problematic. Tools to solve this problem exist, however it is a common problem not to be able to solve it. Concrete interventions often focus on response to epidemics and are mostly short-term programs [56].

It emerges from this study that the applicable strategies are mostly known and there is an awareness of their potential functioning, however much work remains to be done to reach the goal of elimination.

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Authors' contributions

EF conceived the idea of the study and supervised the working group. ET, FA, VP, LZ contributed to the literature search and the writing of the manuscript. All the

authors critically revised the manuscript and approved the final version.

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Review

The hepatitis C virus in Iran: health policy, historical, ethical issues and future challenges

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Keywords

Hepatitis C virus • Policy analysis • Ethical features • Stigma • Policy triangle framework

Summary

Background. *Hepatitis C infection (HCV) can have a harmful effect on the health of people and can impose relevant healthcare costs. The World Health Organization has identified the elimination of Hepatitis C by 2030 as an important goal for all countries. This study aimed to identify the HCV-related policies in Iran.*
Methods. *A qualitative approach was used for this study. Data was collected through a comprehensive search of documents and interviews with different stakeholders related to the HCV program. Data was analyzed and validated using content analysis based on the policy triangle framework.*
Results. *Our findings highlighted that certain social and cultural issues related to stigma can impact on awareness-raising processes. It is also necessary to consider HCV directly in the context of government policies. All relevant stakeholders should be included. Continued talks and interactions need to be made between them for the active participation of all actors.*
Conclusion. *The findings of this study can provide useful information for improving, supporting and developing policy processes. Healthcare providers should address all aspects of the disease by 2030 in order to achieve the goal of HCV elimination. Evidence-based planning, support for up-to-date policies and resource mobilization are needed to achieve this ambitious goal.*

Introduction

Viral hepatitis is a major public health challenge worldwide [1]. Hepatitis C infection (HCV), a blood-borne viral hepatitis, can have a harmful effect on the health of people and can impose relevant healthcare costs [2, 3]. In 2017, the World Health Organization (WHO) has estimated that, globally, around 71 million people have been infected with chronic HCV infection [4] and about 399,000 people have developed liver cirrhosis and hepatocellular carcinoma [4].
The WHO has identified the elimination of this infection by 2030 as a major and important objective. As such, all countries are required to reduce new infections by 90% and related deaths by 60% within 2030 [5]. To achieve such an ambitious goal, effective policies should be used to prevent and treat HCV [6]. In recent years, valuable advances have been made regarding epidemiological evidence, diagnosis and treatment of HCV by using direct antiviral agents (DAAs). The use of antiviral drugs has, indeed, increased the rate of recovery in patients by up to 90% [7, 8]. This has changed management perspectives: many countries have put HCV infection as a health priority [9-11].
Health policy-making is a complex process that examines the different dimensions of decisions, plans, role of various stakeholders and actions needed to be taken in order to achieve a health-care goal [12]. Policy analysis as a practice in the health sector is increasing in low- and middle-income countries. Paying attention to the nature of policies, how they are created, implemented, and affect health, and how agenda setting is developed is of crucial importance [13]. A better understanding of processes underlying healthcare and the acknowledgement of their impact on health issues can lead to an effective design and policy-making [14].
Due to the specific nature of the health sector, policy analysis requires more attention and sensitivity because it has a direct impact on the health of the community [13]. In Iran, the prevalence of HCV infection is relatively low according to epidemiological studies [15], especially when compared to settings such as the Middle East and North Arica (MENA) countries, like Pakistan and Egypt, even though in the last years the scenario is changing. According to a recent meta-analysis, the prevalence of HCV in the general population is estimated to be 0.6% [16]. In a further meta-analysis conducted in blood donors in 2013, HCV prevalence is estimated to be 0.5% [17]. In high-risk groups, the estimated prevalence of HCV is 32.3% and can increase up to 43.1% among injection drug users (IDUs) [18]. In meta-analyses in prisoners, street children and thalassemia patients, the prevalence of HCV has been found to be, respectively, 28%, 2.4% and 19% [19-21]. In Iran, the number

of injecting drug users is increasing and this is reflected by the parallel increase in HCV infection rate: this is considerably changing the HCV epidemiology in the country [15].

Health systems around the world have implemented various strategies and programs for preventing, screening and treating HCV and achieving the WHO goal [22]. Understanding these policies is important in any country or community, and healthcare policy-makers can make better decisions about implementing HCV elimination programs by knowing more about the factors involved in the transmission and spread of the infection [23]. Many people believe that due to the seriousness of HCV for public health, prevention and control plans by the government, organizations and stakeholders at the highest levels should be considered.

In Iran, the Ministry of Health and Medical Education (MoHME) has launched various programs – the last in 2017 – in order to eliminate new cases of infection in three major areas: prevention, screening and treatment [24]. The educational programs are aimed at raising public awareness by providing appropriate information related to HCV prevention [25]. Currently HCV screening is carried out passively in Iran. Across the country, good laboratories and facilities work to diagnose the disease [26]. In 2014, it has been estimated that there are about 18,6500 HCV patients in Iran [27]. By providing DAAs to infected patients, the National Health System aims to reach Sustainable Development Goals (SDGs) goals, and to eliminate the disease by 2030 [27].

The MoHME, in line with the upfront documentation of long-term national development and the fulfilment of the country's international obligations, understands the necessity and importance to prevent and control the disease. The MoHME has, therefore, planned to adopt a comprehensive and systematic approach as well as to implement effective strategies to eliminate the disease together with the establishment of a national hepatitis committee.

This study aimed to examine the HCV-related processes, programs, strategies, and documents in Iran, with the aim that identifying these policies can improve the existing gaps between the present and the desired situation.

Methods

Ethical approval and consent to participate

This study received ethical approval from the School of Health Management, Iran University of Medical Sciences (IR.SUMS.REC.1396.9423557001).

Research team and reflexivity

Two authors (MB and HAG) conducted the first (documents collection and review) and second (interviews) steps of the present investigation. The research team involved has experience in conducting qualitative studies. For a better coordination, before the study was completed, a meeting was held and the research methodology process was discussed. Training events were also organized in order to better get in touch with the participants. Prior to conducting interviews, questions were sent to five experts on HCV for the pilot, and their comments and feedbacks were used to modify the questionnaire, if deemed necessary.

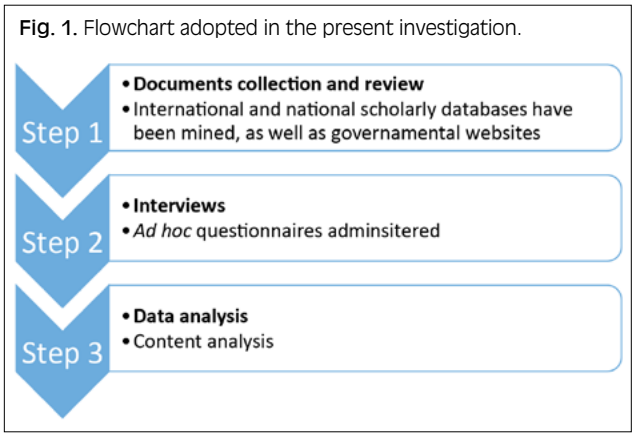

Fig. 1. Flowchart adopted in the present investigation.

Study design

A qualitative policy analysis approach was used for this study. Data were collected through a broad and comprehensive search of documents and interviews with different stakeholders related to the HCV program (Figure 1).

Documents collection and review

The first step was to review policy documents related to HCV. To find documents, first the MoHME website was searched. After finding documents in the MoHME website, a list of relevant stakeholders including ministries, national and international organizations, companies and non-governmental organizations (NGOs) was prepared. The websites of the Parliament (*Majlis*) and the Expediency Discernment Council (EDC) were also searched. In Iran, for macro policies, the leader has a very important role in determining policies, and, as such, the documents communicated by him were also examined. The WHO website containing reports, policies and programs was also mined. In addition, international scholarly databases such as PubMed/MEDLINE, Scopus, ISI/Web of Science (WoS) and Embase, and the national databases including MagIran and SID were extensively searched for finding relevant policies-related documents.

Interviews

This step was based on the "Consolidated criteria for reporting qualitative research" (COREQ) checklist[28], a 32-item checklist for properly conducting qualitative research interviews and focus groups. These items regard three major domains; namely (i) research team and reflexivity, (ii) study design and (iii) data analysis and reporting.

The number of people contacted for the interviews was 26, of which 21 answered. They were contacted by telephone and email before the interview, and they were given a description of the goals and reasons for doing the

study. For optimal use of interview time, the questionnaire was sent to them prior to the interview.
The second step comprised of interviews with diverse groups of respondents (n = 21), including policy-makers, academics involved in health policy, hepatitis specialists, senior researchers, senior clinicians, representatives of pharmaceutical companies, health directors working in the field of primary health care (PHC), NGOs, blood bank managers, nurses, laboratory managers and journalists. The key informants were identified with assistance from documents collection and review and the research unit at the MoHME. During the interview, snowballing sampling was used: the interviewees were asked to introduce other people who had experience or vision in HCV to participate in the study. Face-to-face interviews were conducted at workplace, clinics, or where the participants felt comfortable. To create a friendly and confident relationship – during the interview – only the participants and researchers were present. All the interviews were conducted following the proper methodology: no interview needed to be repeated. Researchers recorded and took written notes of each interview.

Data collection

This study was conducted between September 2017 and July 2018. After the search and collection of relevant documents, a form was prepared and the title, content and year of publication of HCV-related policies and documents were extracted. Semi-structured, face-to-face interviews with participants of length varying between 45 and 60 minutes were performed and were digitally recorded with their permission. Open-ended questions were used. Interviews continued until data saturation was reached. After sixteen interviews no new data emerged and therefore the material was considered saturated.

Analytical framework

The policy triangle framework is a useful model for analyzing topics in the health sector. This model includes four components related to policy issues, such as context, content, actors and process. This model can provide a very important framework for understanding health sector-related issues for policy- and decision-makers. This model can be used retrospectively or prospectively [29].
Questions related to prevention, screening and treatment were asked. More in detail, the questions were the following:

1. Please describe the social, cultural, political, international and economic dimensions of HCV disease in Iran.
2. What is the structure of HCV-related policy in Iran since its inception concerning the prevention, screening and treatment? Which goals are being pursued in the country regarding the control and management of hepatitis C?
3. How do you see the policy process in the country? How are policies being developed, implemented and evaluated?
4. How and why are these policies taken into account? Why are these policies considered as one of the main priorities for health policy in the country?
5. Which organizations, institutions or individuals have a great impact on the hepatitis C policy process in Iran?
6. Are there other points of view regarding the state of policies and plans for hepatitis C in the country?

Data analysis

The policy triangle model was used as a framework for extraction and analysis of identified policy documents [29]. After the recorded interviews, two authors transcribed them *verbatim*.
Data related to each phase of the HCV disease – including: prevention, screening and treatment – and the four components (context, content, actors and process) of the study framework were extracted from the interviews. Any disagreements between authors were resolved by discussion [30]. Data were analyzed and validated using content analysis. To validate the data, prolonged engagement and proper interaction with participants, and careful data revision helped to increase the credibility of the data. Also, methodological triangulation and diversity of sampling increased the credibility of the data and led to confirmability. Concerning verifiability, this was guaranteed by two academic members, with assistance of the researchers, by thorough and careful review of the text of the interviews, the codes, and the themes of the framework until agreement was reached. The transcription of interviews, the use of external checks and re-reading of all data ensured the overall reliability of the process. After being provided with the codes, a number of participants gave confirmation feedbacks.

Results

Overall, 21 different experts in the field and stakeholders related to the HCV program in Iran were interviewed. The mean age of participants was 39 ± 11.3 years. Among them, 17 were male and 4 females.

Context

In Iran, the general public has a negative attitude towards HCV. They think the disease is fatal and affects people who do not observe ethical issues. People believe that patients should be quarantined to prevent the transmission and spread of disease. Many people do not know enough about the ways and strategies to prevent it, and they consider it a terrible disease, like HIV.
"When colleagues or people understand that I suffer from HCV, their behaviours change. They think that I have committed an immoral act and stay away from me. People do not feel good about me and they are not even willing to interact with me".
To increase awareness among people, educational activities are carried out at various levels of the health sector. Most of these activities take place especially in PHC, informing and raising awareness about HCV, but are

generally poor and badly organized. Most HCV research activities have also been carried out by research centres of the Ministry of Health whereas less attention has been paid to socio-cultural and economic dimensions.

"Perhaps due to cultural problems associated with attitudes towards HCV in the Iranian society, schools, universities, and centres that do not have the task of informing about various health-related issues important for the community are less likely to inform about the disease".

Most health services in Iran are based on a public sector model. PHC is completely free, and in addition to state-sponsored subsidies, health insurance also covers a portion of the health-care generated costs. Medical universities affiliated with the Ministry of Health and Social welfare hospitals provide healthcare related to HCV patients. All PHC activities are provided in the public sector. Many of these hospitals have good laboratories to detect HCV.

"Diagnostic capacities in Iran have grown dramatically in recent years, and therefore there is no problem in diagnosing HCV patients. On the one hand, the government should have a lot of financial support for managing these patients. On the other hand, in my opinion, if all the costs of these patients would be free, patients would be more interested in the treatment and this could prevent further outbreaks of the disease".

Screening and active case finding play an important role in preventing the transmission of disease. The introduction of the family physician in some villages in Iran in 1997, the community-based training, the referral of suspect case, the early detection and treatment demonstrated to be effective strategies to prevent and control HCV. However, these strategies have not been implemented all over the country and therefore their advantages are not nationwide.

"*One of the benefits of a family doctor is the timely screening of people suspected of HCV. If the family doctor in Iran was fully implemented, this could prevent and screen many illness cases in Iran*".

Diagnosis and treatment of HCV patients are important, especially if defined and provided through a multi-professional evaluation. Hepatitis network – that includes gastroenterologists, specialists in infectious disease and general practitioners – implemented locally, in order to avoid patient transfer to the capital which implies paying for travel and accommodation, should be considered. Despite this, some service providers are not willing to cooperate in treating HCV patients for various reasons.

"Unfortunately, some doctors in Iran do not believe that HCV patients can be treated and, therefore, are unwilling to collaborate in providing services".

Pharmaceutical companies have recently begun to produce HCV drugs and insurers have sponsored domestic medications and put them on the list of medications they support. Of course, in some cases, people who tend to use foreign drugs should pay some of the cost of the treatment. The main concern is about people who do not have insurance coverage and must have out-of-pocket payments.

"In all countries, drug companies are providing medicines and meeting with the needs of patients. In recent years, some companies have imported drugs due to lack of manufacturing technology. This has caused problems for patients, and insurers did not have the desire to support and cover for the cost of these drugs, but with the pursuit of authorities in Iran, some companies have begun to produce drugs locally, which significantly reduced costs".

Neighbourhood with Pakistan or other countries with high HCV rates and Afghanistan as the largest drug producer in the world have led to the highest transit of narcotics from Iran. This has resulted into an increase in the number of injecting drug users in recent years. Cupping and tattooing are also rising as factors contributing to the spread of HCV infection.

"HCV disease, like many diseases, depends on several national and international variables. The prevalence of HCV in neighbouring countries is a dangerous alarm for the Iranian health sector. The high security level in Iran has caused many immigrants to decide to live in this country, and so we have to think in terms of various communicable diseases, including HCV, for properly screening them".

One of the weaknesses in the health sector in Iran is the lack of a framework to prioritize the main problems in this area. It seems that if Iranian had a proper information system, it could have a better prioritization of illnesses and this would help administrators in planning. Local and regional data on HCV, especially in high-risk groups, are not available in many Iranian provinces. Hence, planning for these groups is difficult without proper evidence.

"Despite the many problems that HCV can have for any country, Iran has still major weaknesses in the information gathering system for these patients. Researcher, in view of the role of information in planning for disease control, should conduct research in the general population and at-risk groups in different provinces".

Like many countries that have committed to the SDGs to eliminate HCV by 2030, health policy- and decision-makers are aware both of the importance and of the problems that this disease can cause to Iran, and therefore they are trying to implement effective policies to achieve this international goal.

"Iran has been struggling to achieve international goals in recent years. In terms of the Millennium Development Goals (MDGs), Iran has been able to improve its health indicators and achieve its goals. So, policy- and decision-makers are trying to reach the goals of the SDGs, which makes it possible to eliminate HCV".

There are limited financial resources in the health sector in all countries. In Iran, in recent years, there has been limited funding available for educational programs, activities and treatment for HCV patients, but, after the implementation of the Health Development Plan, funds were provided by the Ministry of Health. The plan made the processes associated with these patients more prominent and the government paid a large part of the cost of treatment.

"Many health ministry staff members say that for health-related problems, more spending and new financial resources are needed. In the last decades, health has been considered as a very important priority. We should take this opportunity and use the new financial resources for health challenges like HCV".

The health sector, however, faces a shortage of human resources. There are shortages of nurses in many hospitals. In some provinces there is a shortage of specialized physicians. Given the attitudes of some providers about infectious diseases and the hardships they should undergo during HCV treatment processes; they expect to receive better payments. Low salaries for nurses, failure to enforce tariffs for services for them, low tariffs for internal and external medical practitioners, delay in reimbursement by insurers are some of the problems that healthcare providers have to face.

"Iran's health system faces a serious shortage of human resources concerning all professional groups (from general practitioners to specialists and nurses and other allied health workers). The high volume of work for many employees has made them tired. This shortage reduces the quality of services provided and is also a threat to HCV. If we pay more for HCV service providers, we can improve the quality of services to patients".

The private sector has currently no role to play in the provision of healthcare to these patients, but in the future it could participate together with the government in providing management and treatment options to HCV patients.

"To reduce the volume of work in the public sector, some services can be provided by the private sector. Of course, in order to reduce costs for patients, the government has a lot to do for HCV together with the private sector".

Content

A national survey would be required to determine the current state of HCV in Iran at the country level. This type of study can be of great help to policy- and decision-makers.

"There is no information on HCV based on a large study. If we can do this with the help of researchers, we can have a better and more realistic plan".

In many years, governments have mandated many organizations to work on prevention, diagnosis and treatment for all people in the community, and they have accepted such responsibility.

"In recent years, health policy- and decision-makers have been working to make HCV a top priority. The efforts that have been made to diagnose, treat and educate have somewhat contributed to counteract and mitigate the burden of disease. However, for instance, the higher risk of HCV in co-infected people, such as those with HIV, has not yet been mentioned directly in important national documents. Once explicitly mentioned, more funds may be available to control the spread of infections".

"*One of the strengths associated with HCV is the existence of national and international collaborations for Iran. There is a good relationship between Iranian and international researchers. Iranian physicians are well-known for their studies on HCV*".

Studies show that the content of the laws and the plans developed by policy- and decision-makers in Iran increases the access to healthcare for patients. HCV screening and treatment is also a favourite target of policy-makers. They are trying to approve upstream legislation to support these patients.

Documents and policies indicate that Iran's health sector is seeking to fulfil its international obligations. In particular, Iran is trying to achieve the 2030 target. The Health Ministry has been working to achieve this goal, in accordance with the WHO framework, in its four areas.

The Iranian Blood Transfusion Organization has been asked to screen all donated blood for HCV. This has provided access to healthy blood products.

Considering that the number of HCV patients in Iran is increasing, screening for at-risk groups should be considered as an optimal strategy, including for example, HCV test before imprisonment, but this has not been yet fully implemented.

"Many people need blood to continue living. It is very good that today there is no problem in getting healthy blood. It costs a lot, but people are no longer concerned".

The health sector plans to reduce HCV-related deaths by 65% and to curb new HCV cases by 90% by 2030.

"*In the action plan, the main goal of the health sector in relation to HCV is to achieve the goals of the SDGs and, in accordance with the WHO guidelines, it aims to be consistent with global goals and targets*".

For a better treatment and management of HCV patients, the health department has provided physicians with advice on delivering optimal services and improving patient recovery, as well as with national and international guidelines. Of course, valid and up-to-date global references can also be used.

Actors

The most important actor who has the greatest impact on HCV policies in Iran is the MoHME. The ministry carries out extensive activities to support policies aimed at controlling the disease, including planning, funding, medical, educational and screening activities.

Several organizations in Iran have the responsibility to focus on activities such as screening, providing social, cultural, and financial support for patients and people at risk. However, there seems to be a kind of lack of effective collaboration between them. Moreover, some organizations are responsible for social protection of addicts, but little is done for a variety of reasons, such as lack of financial resources. In the meantime, screening in prisons has still to be fully implemented.

"It is not good that the entire workload related to HCV is up to the Ministry of Health. If at least some funding was provided by a number of organizations, this would help the Ministry of Health focus on patient care. If the dialogue between the Ministry of Health and other organizations is combined with practical action, we could see more success in reaching the SDGs".

NGOs and media associations do not currently play a major role in raising awareness about HCV society whereas members of the religious section in Iran have a good place among people, but it seems that there is no good cooperation between policy- and decision-makers and religious people due to the negative attitudes towards HCV in society and the lack of proper use of emerging information and communication technologies (ICTs).

"Many people use the information services of NGOs in Iran. In addition, with the recent development of virtual networks and ICTs, these important facilities and infrastructures seem to have an enormous potential for education, which is still underused. These groups and networks can be used to change the attitudes of people towards the disease".

The role of international organizations in coping with financial issues related to HCV in Iran is currently minor, even though this is changing in the last years. For instance, the WHO has been able to influence health policies by providing its own reports on HCV. Accordingly, the Iranian Ministry of Health has developed its plans and programs for the disease control and management in accordance with the framework of the WHO and other relevant international organizations.

One of the important actors in blood screening and blood supply for those in need is the Iran Blood Transfusion Organization. After 76 years, the organization has been required to screen all donated blood. Therefore, Iran has currently no problem in providing healthy blood.

"Undoubtedly, the policy of healthy blood in Iran has been very successful. Thanks to the efforts of the blood transfusion organization, in addition to screening services, provision of healthy blood for the needs of at-risk groups is very desirable. Perhaps the free provision of these services has led many people to use them with great satisfaction".

Pharmaceutical companies have been able to play an important role in the treatment process and in reducing the costs by producing locally HCV drugs. This has resulted in a decrease in the economic-financial burden that the Ministry of Health had previously to cope with. The private sector has currently little to do with investing in the drug sector and providing diagnostic services, even if in the future there is room for its engagement and involvement.

Finally, the Iran's Hepatitis Network has a huge impact on the implementation of the program as a government group (identifying, recording patients' information, and treating them).

"The Iran's Hepatitis Network has done a very good job in the process of controlling and managing HCV. If not, most of the patients would be unaware of their status. They do a lot of educational and therapeutic activities".

Process

A key step in the HCV policy-making process in Iran has been the formation of a national hepatitis committee, in which key people were researchers, health policy- and decision-makers. The main tasks of the committee are policy-making and planning, management, monitoring and evaluation, training and guidance of activities related to HCV control programs. The committee has been created by the Ministry of Health. At the same time, various meetings with other organizations related to HCV programs have taken place and almost good decisions have been made to counteract the spread of HCV. In order to attract the cooperation and participation of all ministries, organizations and stakeholders in maintaining and promoting the health of Iranian communities, the Council has helped create more cohesive programs through the formation of networks and the presence of many important members actively involved and engaged in HCV programs.

"The Hepatitis Country Committee in Iran has played a very important role in controlling hepatitis. People who are present in this committee have a high, reputed scientific and political status. The presence of these people is a great opportunity to implement large-scale programs to eliminate or at least control HCV".

The most important source of funding for health sector programs in Iran is provided by the Parliament based on a proposal from the government. Like many countries, many lobbyists are trying to use funds in other sectors, but the most important point is that most members of Parliament (MPs) are paying particular, increasing attention to health and related programs. The Ministry of Health is in charge of meeting with the needs of the health sector and interacts with the government and parliament.

"*In recent years, the Ministry of Health has implemented several good plans and Iranian policy- and decision-makers have opened new perspectives by providing better services and addressing community health problems. Effective conversations and interactions between the Ministry of Health and policy- and decision-makers have been conducted to get their comments and feedbacks on how to effectively run the programs*".

Most HCV-related policies are top-down. There is a great deal of work and activities to carry out related to healthcare in the health sector, and as a result of the problems with the treatment of HCV patients, there are some processes that are prolonged. Some organizations do not fulfil their duties and all the expectations from the Ministry of Health are confronting this important challenge. All relevant stakeholders should be more actively engaged in HCV-related policies and plans.

"One of the main challenges in Iran's health system is its doctor-centeredness. Many physicians manage many departments. The treatment perspective is dominant. If some members of the staff who perform executive activities are used in the training, some policies and programs would be more realistic to run. Many services offered should be presented as long-term processes and objectives".

With the arrival of the President Rouhani, the establishment of his government and the launch of a broad health promotion plan, the availability of new financial resources, the need of controlling the increase in injectable drug users and the obligations of SDGs for Iran have

been considered as a good opportunity for HCV-related policies to be put into action and to be implemented.

"The Health Transformation Plan has many good strengths. With regard to new activities that can be used to provide services to marginalized settings and those who do not have a proper financial situation, prevention and control programs can be further implemented".

The role of service providers in PHC and nurses in the provision of services should be given more attention.

Moreover, the lack of proper implementation of the referral system is one of the weaknesses of the health sector. Unfortunately, despite the role of PHC, patients are only aware of their illnesses in hospitals and do not use PHC services to monitor the treatment. If PHC collaborated more extensively, it would be easier for patients to have more adequate time and space.

"The potential of the PHC network for HCV is not fully exploited. A large number of Iranian communities, especially those living in villages, would be interested in using these services. There must be a simple and up-to-date program for them".

Finally, there is no specific mechanism for evaluating HCV policies in the country. The evaluations are mostly individual, personal, cross-sectional rather than longitudinal, limited, with short-term organizational goals, and there is no specific structure and system for it. The related organizations have carried out independent monitoring activities, which are largely interrupted, inadequate and non-conclusive.

"*In recent years, evaluation has not been carried out on programs for the training, screening and treatment of HCV. The weaknesses and strengths of these programs are not clear. The Ministry of Health must have an appropriate evaluation system in cooperation with other independent organizations*".

Discussion

The present study comprehensively addressed HCV-related policies and programs in Iran. The findings of this study emphasized the impact and complexity of various factors for policy making. Policy analysis has shown that for the development and implementation of a health program, some barriers that prevent it from being properly implemented should be identified and properly removed. Therefore, in order to investigate the health sector's challenges, we must correctly identify the problems and consider the various options for solving them and consider the different issues at the implementation stage [31].

Using a policy model, this study examined the various dimensions of HCV in Iran. More in detail, in the context of HCV, one of the major barriers that policy- and decision-makers in Iran have been unable to properly defeat is illness-related stigma. This has caused many people not to be educated enough concerning HCV and be afraid of individuals infected [32]. The lack of trust in information and the lack of mass media use has led to a lack of public awareness in Iran [33]. Policy- and decision-makers have had a lot of problems in raising social awareness of diseases such as HCV and HIV [34]. One of the major challenges associated with HCV control is the lack of awareness among the general population and health workers. Supporting educational programs by government and relevant organizations is of paramount importance [35]. The Ministry of Health can exploit national TV to raise awareness about HCV. In recent years, people have become more aware of HIV through the use of television, radio, social media, and people who have a great impact on the general public's perception of HIV (the so-called advocacy). Policy- and decision-makers can make use of the experience gained in this area to change people's awareness and attitudes towards HCV in Iran.

HCV can have devastating effects on the economies of the countries, and therefore adequate funds for controlling this disease, in addition to those for preventing the transmission of the disease, would counteract the loss of funds imposed by the disease [36]. In recent years, funding for treating patients has been a major concern for the Ministry of Health, who has been working to provide good support for people who are not able to pay for the treatment.

Regarding the content of existing HCV-related policies in Iran, there is no specific reference to HCV in macro policies. There are many programs and activities in the form of guidelines issued by the Ministry of Health, although organizations and health departments are not directly instructed. In this regard, the National Committee on Hepatitis in Iran has been working to guide physicians, staff and other organizations.

Considering that Afghanistan as the neighbouring country of Iran is the largest producer of narcotics and given the high volume of immigration, Afghanistan's health policy- and decision-makers need to be involved in controlling HCV refugees. Unfortunately, despite the fact that many people from Afghanistan migrate to Iran annually, international organizations do not actually donate funds to Iran to improve their health [37]. Therefore, the Ministry of Health needs international financial resources for the screening and treatment of Afghan refugee patients [38].

The findings of this study showed that the major problems with the HCV programs is how policies have been designed (most of them are top-down) and the lack of use of comments and feedbacks from relevant stakeholders. When decision- and policy-makers do not use the views of individuals who run the executive process of a policy, it seems to be difficult to achieve the desired goals [39]. Furthermore, existing evidence suggests that physicians and other relevant stakeholders should be involved in the HCV policy-making processes.

In addition to specialized hospitals and clinics, the PHC health services network plays an important role in providing educational, health and therapeutic services. The potential of this network has not been fully exploited for the purpose of patients, so doctors working in this network have still much to offer to patients with HCV [40].

Other points to be noted are that the policies that have been taken to control HCV are at a national level and have not or little responded to local priorities, especially in areas with high-risk factors for transmitting and spreading the disease [41].
Because of the high level of healthcare bureaucracy, policies aimed at controlling HCV should be quickly implemented. In some cases, such as insurance services and subsidies for patients, the government must notify the organizations to enforce them, but, in other cases, it seems that the length of approval and implementation is too long, and hence the effectiveness of these policies is less than that expected [42].
Despite the existence of national data on vulnerable groups, there are still not many local data. In addition, many policies that are introduced on the basis of these data encounter many problems and issues during the implementation phase. In order to properly implement policies, they should be presented clearly and without any ambiguity. One of the important reasons for this lack of proper implementation is the weakness during the step of knowledge translation and the lack of effective communication between policy-, decision-makers and researchers [43].
Many stakeholders are involved in the process of controlling HCV in Iran. One of the challenges is the lack of appropriate interactions between the actors and the various organizations. Due to the fact that the national documents do not refer directly to HCV, the tasks of the organizations are not exactly defined. Of course, there are activities for each of them, but many organizations consider the Ministry of Health as the main actor and responsible for the plans; practically, activities that are relevant to the cultural, social and economic structures of society and patients are not properly implemented. For example, many injecting drug users are faced with plenty of economic problems that should be addressed. On the other hand, many stakeholders only consider the treatment of patients and have forgotten other issues such as education, culture, and protection of high-risk groups.
There is no doubt that the most important and powerful actor in charge of the HCV control program in Iran is the Ministry of Health, but the Ministry alone cannot do all the activities. Other organizations must fulfil their obligations. This commitment is in the fields of education, screening and treatment [44]. Health policy- and decision-makers need broad support to implement their HCV control policies [45].
As in many countries in the world, people using injecting drugs are the most important sources of HCV transmission in Iran [46], as well as prisoners [19]. Evidence suggests that screening and treatment activities among these people should be seriously addressed by policy- and decision-makers to prevent HCV [47], implementing strategies such as needle and syringe programs (NSPs) and opioid substitution therapy (OST) [48, 49]. In recent years, the Ministry of Health has set up centres to provide services to reduce harm and prevent the transmission of communicable diseases such as HIV and HCV [50].
These policies can be effective in reducing HCV transmission in Iran, but despite the positive attitude of prison staff towards implementing these policies, some officials and managers have little commitment and motivation [51] and many people who inject drugs (PWID) do not use the services of the centres.
Moreover, the evaluation of services provided in the HCV program has not yet been taken seriously by policy- and decision-makers [52]. The Ministry of Health and other organizations should implement the evaluation of HCV-related programs.
Our study has some strengths: it is one of the first studies, if not the first, focusing on HCV-related policies in the WHO Eastern Mediterranean Regional Office (EMRO) region, which is a geographical area with a high HCV incidence. Regarding the triangle policy framework, various aspects of HCV were studied. To increase the credibility and reliability of the data, after evaluating the results, a group of experts was involved and consulted in the various steps of the research.
On the other hand, our study has some limitations. Some people were not willing to be interviewed. As such, the sample recruited may be not representative of all the stakeholders involved in HCV-related policies.

Conclusions

The findings of this study, based on the policy triangle framework as a model of policy analysis, showed that various factors can affect HCV policy in Iran. Certain cultural problems caused by stigma can impact on awareness-raising processes. It is also necessary to consider HCV directly in the context of governmental policies. All relevant stakeholders, including the private sector, should be involved. The findings of this study can provide good information for improving, supporting and developing policy processes in Iran. Evidence-based planning, epidemiological surveys conducted in Iranian provinces characterized by HCV prevalence rates, support for up-to-date policies and resource mobilization are needed to achieve the ambitious goal of HCV elimination by 2030.

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Conflict of interest statement

The authors declare no conflict of interest.

Authors' contributions

MB and NLB conceived the study, MB, NLB and MM drafted the manuscript, SA, HAG and MM revised the manuscript. MB, SA, MM and NLB performed a search

of the literature. All authors critically revised the manuscript. All authors have read and approved the latest version of the manuscript.

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Review

The barriers to the full implementation of strategic purchasing and the role of health policy and decision-makers: past, current status, ethical aspects and future challenges

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Keywords

Healthcare systems and organizations • Contracting and strategic purchasing • Healthcare services and provisions • Scientific evidence • Cost-effectiveness

Summary

Healthcare systems are complex, multi-level, highly integrated organizations, comprising of different professional figures, institutions, and resources. Such breadth and complexity reflect the multi-dimensionality of the concept of health, which implies the adoption of a holistic approach. Health, rather than merely being the absence of disorders or infirmity, is a highly dynamic state, which represents the abilities of an individual to cope with adverse social, physical and emotional/psychological events and conditions, continuously adapting to them. Ensuring an adequate health state is one of the most important concerns, and the healthcare systems are called to renew themselves in order to meet with the new challenges and health needs. Throughout the last decades, due to demographic shifts and transitions, epidemiological and societal changes, technological achievements and scientific advancements, healthcare systems have undergone an extensive series of reform plans. Therefore, health policy- and decision-makers have made efforts to develop and implement initiatives for preserving the quality of the healthcare provisions. Strategic purchasing is an approach of purchasing that takes into account several health-related issues such as a proper, comprehensive planning of service delivery, the design and selection of the best packages of services and provisions, the appropriate selection of providers and the allocation of economical and financial incentives to provide better services and to motivate managers to adopt appropriate policies to implement strategic purchasing. Here, we intend to consider the various dimensions and aspects that can be effective in strategic purchasing, as well as the main barriers and obstacles that hinder its full implementation.

No healthcare system is an island: complexity of the health organizations

Healthcare systems are complex, multi-level, highly integrated and coordinated organizations, comprising of different professional figures, institutions, settings and resources [1]. As such, they represent the key determinants of well-being in the modern-day society, being a valuable asset that deliver high-quality health provisions, trying to address the health needs of the target population and to ensure optimal quality of life, functioning, productivity and prosperity [2]. Healthcare systems are an array of cultural and organizational competencies and skills, staff and workforce, economic and financial resources, infrastructures, information technologies, sophisticated equipment and facilities [3]. Such breadth and complexity reflect the multi-dimensionality of the concept of health, which implies the adoption of a holistic approach [4].

Health, rather than merely being the absence of disorders or infirmity, is a highly dynamic state, which represents the abilities of an individual to cope with adverse social, physical and emotional/psychological events and conditions, and to overcome them, continuously adapting to them [5]. Ensuring an adequate health state is one of the most important concerns as of today, and the healthcare systems are called to renew themselves in order to meet with the new challenges and health needs, reflecting the persistent importance and growing role of policy- and decision-making, state governance and inter-departmental leadership, aiming at maintaining and improving people's health in its various dimensions [6].

Healthcare systems are not islands, that is to say isolated organisms, but interact with a variety of bodies, including other health – and more specifically, public health – agencies, regulators, purchasers and clients at an inter-sectoral level [7].

Throughout the last decades, due to unprecedented demographic shifts and transitions, epidemiological and societal changes, including aging population, increased life expectancy, long-term decline in birth rate and the shift from acute communicable disorders to chronic-de-

generative non-communicable diseases, as well as due to technological achievements and scientific advancements, healthcare systems have undergone an extensive series of reform plans [8, 9].
These aspects are, undoubtedly, among the most important factors directly affecting the delivery of healthcare services and, as such, impacting on the well-being of the society. Therefore, health policy- and decision-makers have made efforts to develop and implement initiatives for preserving the quality of the healthcare provisions [10]. These reforms have aimed at increasing the sustainability of the health organizations, managing the rising costs of development and service delivery, probing and ensuring the tenability of health systems in a globalizing world and promoting the increasing importance of health problems related to lifestyle, environmental and living conditions [11, 12].
Yet, despite such impressive efforts, these reforms and initiatives have failed to provide a true solution to the growing economical, financial and organizational/logistical problems that nowadays healthcare systems have to face [13].
In the next paragraph, we will briefly overview the meaning and the role of strategic purchasing in healthcare organizations. For the present article, we have conducted a literature review using "strategic purchasing" as major key-word and mining the entire content of the PubMed/MEDLINE scholarly database, since its inception, with no time or language filters. Furthermore, we have relied on the expertise of our group, which has already published on this topic.

The role of strategic purchasing

The rising costs of services provided in the health sector represent a significant challenge. Problems such as resources waste, leakages and low efficiency [14], lack of social justice and fairness in access to healthcare services and inappropriate use of financial resources are the main weaknesses that plague the traditional way of purchasing health services and provisions [15].
Strategic purchasing is a concept initially introduced by the Thatcher's government (Tab. I), implying an active role of purchasers in contracting and buying, in which aspects like population needs and health, quality, scientific evidence, efficiency and effectiveness, and equity and fairness are incorporated [16]. As such, strategic purchasing is a highly participatory and shared series of processes, in which a variety of stakeholders (from citizens and patients to purchasers, providers, regulators, and governments) [15] are actively involved. This calls up for a shift from passive to active purchasing [17].
In 2000, the World Health Organization (WHO), in its report, recommended the adoption of strategic purchasing as a valuable tool for improving the healthcare system's performance and the quality of service delivery, increasing responsiveness, ensuring fairness in funding allocation and a wider access to healthcare services [18].
Strategic purchasing as a dynamic and non-traditional process of contracting and purchasing has led to the following questions: namely, i) which healthcare services we should buy, ii) from whom we should buy healthcare services, iii) how healthcare services should be bought, and iv) how much money we should pay for buying healthcare services [18, 19].
Strategic purchasing as an important strategy requires attention to several health-related issues such as a proper and comprehensive planning of service delivery in the different health sectors, the design and selection of the best packages of services and provisions, the appropriate selection of providers and the allocation of economical and financial incentives to provide better services and to motivate managers to adopt appropriate policies to implement strategic purchasing [4, 20].
Indeed, the different aspects and dimensions of strategic purchasing should be taken into account when implementing a policy [16]. Undoubtedly, if policy- and decision-makers in the world are trying to achieve the ambitious goal of the universal healthcare or Universal Health Coverage (UHC) [21], they should pay particular attention to strategic purchasing and they should identify and address the opportunities as well as the challenges they are facing. UHC requires the development of new financing schemes and, as such, strategic purchasing can be a very valuable tool to reach that goal [20]. Health policy- and decision-makers should consider the four dimensions of strategic purchasing, in terms of the abovementioned questions, in order to develop an appropriate strategy (Fig. 1).
In the current paper, we intend to consider the various dimensions and aspects that can be effective to ensure strategic purchasing, as well as the main barriers and obstacles that hinder its full implementation.

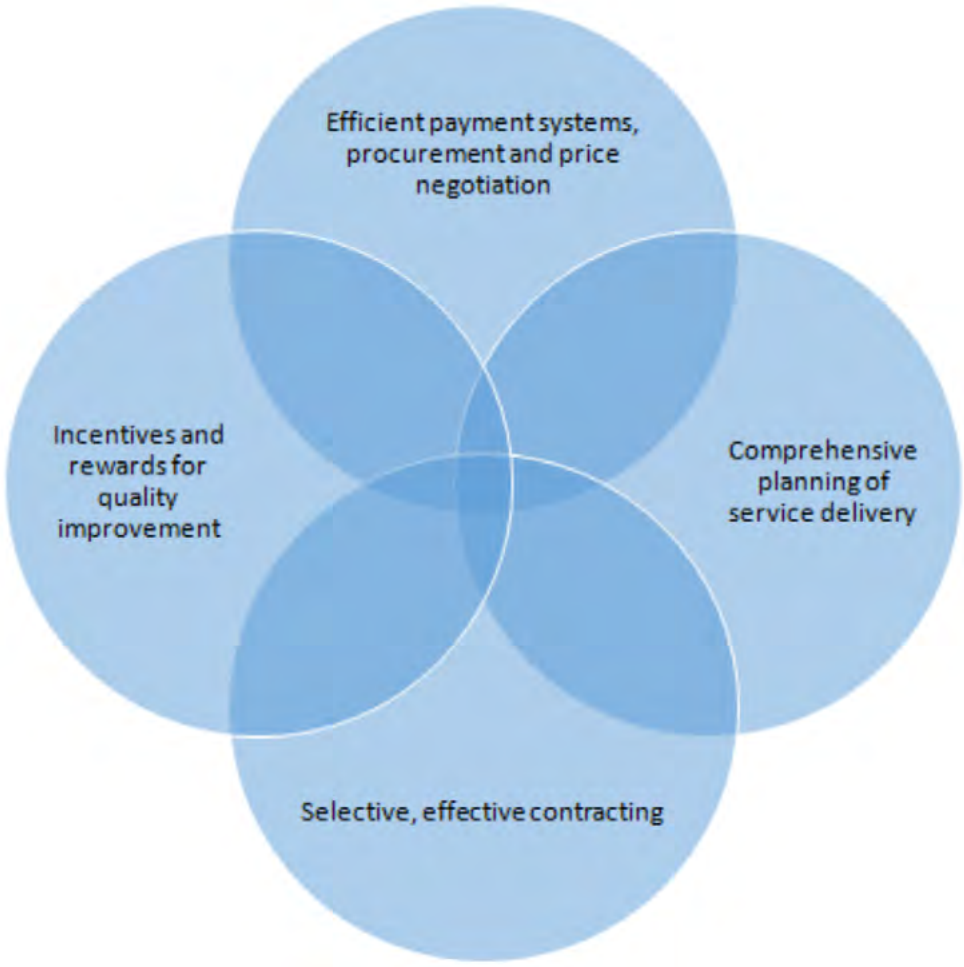
Which healthcare services should we buy?

Health systems offer a high variety of services; as such, health policy- and decision-makers are trying to provide service recipients with a suitable and comprehen-

Tab. I. An overview of the major steps in the development of strategic purchasing as a main concept for healthcare organizations and systems.

Year	Major event
1979-1990	Introduction of the concept of strategic purchasing during the Thatcher's government
2000	The WHO recommended the adoption of strategic purchasing from healthcare systems and organizations
2005	A similar recommendation is made by the RESYST consortium
2007	A similar recommendation is made by the European Observatory, the World Bank and the Department of Health of several countries, including the UK

Fig. 1. The key components of strategic purchasing.



sive package of services [22]. The precise nature of this package is one of the challenges that health managers have to face: the package of services can vary according to the specific needs and available resources and facilities of each country or setting in which they are offered, but an array of minimum essential services should be guaranteed at least. In identifying health needs, health policy- and decision-makers should combine the methodological rigor and transparency of the epidemiological surveys and investigations with fairness and equity in access to healthcare services [20].

Ethical aspects should be always considered when planning and implementing programs in the health sector, taking into account also patients' values, preferences and perspectives [2, 19].

An approach that integrates both components is, for instance, the Health Technology Assessment (HTA), which, being based on a multi-disciplinary, multi-dimensional framework, can play a major role in determining the type and number of services to offer and in providing policy- and decision-makers with valuable evidence, while ensuring economic and financial sustainability [19].

From whom should we buy healthcare services?

The relationship between purchaser and provider is of crucial importance in funding allocation in the health sector [23]. Service providers (either private or public) can have a direct impact on strategic purchasing-based strategies and policies. The number, the nature of providers and the conditions they impose are all factors that influence funding allocation [24]. Purchasers should identify and choose the best healthcare providers, but, often, information on costs is not transparent or reliable, hindering purchasers from having a full control over the procedure of providers selection [3]. This represents, indeed, a true and fundamental challenge. Failure to provide and disclose proper and relevant information regarding service costs to providers will result in a lack of strategic purchasing [4].

The criteria for selecting providers should be clearly *a priori* defined: high quality and high standards should be met, without the interference of political lobbies. Separation/split between the purchasers and the service pro-

viders is an adequate model for achieving a transparent contracting and strategic purchasing [25].

How should healthcare services be bought?

This is another important challenge for health decision- and policy-makers. The solution can also vary, depending on the type of insurance system adopted in each country [12]. The involvement of insurers makes it possible for health managers to develop and implement high-quality packages of healthcare services and provisions. Negotiations can, indeed, have a major role in contracting and strategic purchasing [26].
Government institutions, the intrinsic duty of which is to monitor and guarantee high quality, should be involved in all the steps and stages of the process of strategic purchasing [7]. The use of electronic records, quality indicators and appropriate feedback systems can be extremely helpful in monitoring and keeping track of the buying process [27].

How much money should we pay for buying healthcare services?

Economical and financial resources for properly implementing and making effective contracting and strategic purchasing are another big issue that should be taken into serious consideration [28]. Since the amount of money available is limited, the principle of cost-effectiveness should be adopted in order to prioritize the healthcare services offered in the package of provisions [21].

Barriers and obstacles to the full implementation of strategic purchasing

The shift from passive (or traditional) purchasing to strategic active purchasing is not without any barrier or obstacle [15]. First, health policy- and decision-makers need a specific framework that can be implemented: as such, the existence of a precise definition of what contracting and strategic purchasing-based processes are is of crucial importance [3, 15].
Recently, Klasa and colleagues [15], synthesizing and harmonizing the various definitions of strategic purchasing from the WHO, the Word Bank, the RESYST consortium, the European Observatory and the UK Department of Health, have proposed to define strategic purchasing as "an evidence-based process that sculpts health care systems by prioritizing the financing of certain goods and services over others through collaborative planning across various healthcare stakeholders while incorporating the needs and priorities of citizens in the distribution of health care and promoting equity, quality of care, efficiency, and responsiveness in the provision of health services" [4, 15].
This conceptual framework can be the basis for reaching a consensus among scholars and different health-related organisms, paving the way for conducting *ad hoc* studies and establishing adequate measures and interventions for reaching the ambitious goal [4, 8, 15].
Other factors that prevent the full implementation of strategic purchasing can be collected from the existing scholarly literature. For instance, our group has recently performed a qualitative study and framework analysis in Iran in 2014-15, sampling 34 individuals from decision- and policy-makers and executives of the "Iran Health Insurance Organization" (IHIO), stakeholders involved in the purchasing process, and university experts [3]. We were able to identify 12 main themes: namely, i) the regulatory aspect (laws and regulations for purchasing), ii) the organizational aspects of the purchasing process and how strategic purchasing is structured and implemented, iii) the choice of qualified and authorized providers (healthcare services providers selection), iv) the identification of the right type of health services and provisions, v) the design and development of the right type of contracts, vi) the identification of the target group(s) for purchasing, vii) the financial and economical schemes and constraints (in terms of funding and resources allocation, financing and pricing systems), viii) strategic purchasing as a way for improving performance and increasing the quality of health services offered, ix) strategic purchasing as a strategy for shaping the market and increasing competition, x) strategic purchasing as a tool for ensuring good health state for people and society, xi) guided strategic purchasing and governmental stewardship, and xii) the political and organizational issues (in terms of structure of the decision-making process implemented in the health and welfare ministries).
Always in Iran, Kalantari et al. [25] have recently conducted a similar study, finding 5 main concepts: namely, i) political economy, ii) policy design, iii) organizational/logistic structure, iv) organizational environment, and v) management capacity. A study by Ghoddoosi-Nejad and coworkers [23] has identified stewardship as a major challenge in fully implementing the strategic purchasing process of healthcare services and provisions. More in detail, this challenge has been classified into three main themes and nine subthemes, with a lack of adequate management information systems, enforcement for rules and laws, stewardship units, and the conflict of interest between the Ministry of Health and insurers as purchasers being the major obstacles.
Similar findings have been found in other countries. For instance, in Mexico [24], the major barriers to strategic purchasing are represented by the lack of specific funds allocated by the system of social protection in health and the autonomy of healthcare service providers, in order to reduce out-of-pocket (OOP) expenditure and to ensure equity in access to high-quality services.
Similar problems have been described in Cambodia [20] where the establishment of *ad hoc* funds (the health equity funds, or HEQs) has curbed the phenomenon of

OOP expenses from patients and facilitated the achievement the goal of strategic purchasing.
On the other hand, also in developed countries, strategic purchasing is yet to be fully implemented [15]. As maintained by Klasa and collaborators [15] as of today, there is little evidence of the positive impact and benefits of strategic purchasing in terms of improved health at the population level, and citizen empowerment and self-management.

Conclusions

Strategic purchasing is a concept introduced in Western Europe in the sixties [29]: since then, despite impressive efforts in order to improve healthcare systems responsiveness and effectiveness and efficiency in funding allocation, there is still a long and winding road towards the full implementation of strategic purchasing. On the one hand, health policy- and decision-makers need to pay attention to the different components of health and healthcare services delivery, in terms of policies and strategies. On the other hand, further scholarly research in the field is urgently needed to collect and provide stronger evidence of the impact and effects of strategic purchasing.

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Conflict of interest statement

The authors declare no conflict of interest.

Authors' contributions

HAG, NLB designed the study. MasB, MM and HAG conceived the study; MasB, NLB and MM drafted the manuscript; MM, MB and MeyB revised the manuscript. MB, NLB and AR performed a search of the literature. All authors critically revised the manuscript. All authors have read and approved the latest version of the paper for publication.

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