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 ($r = 0.543$, $p < 0.001$).

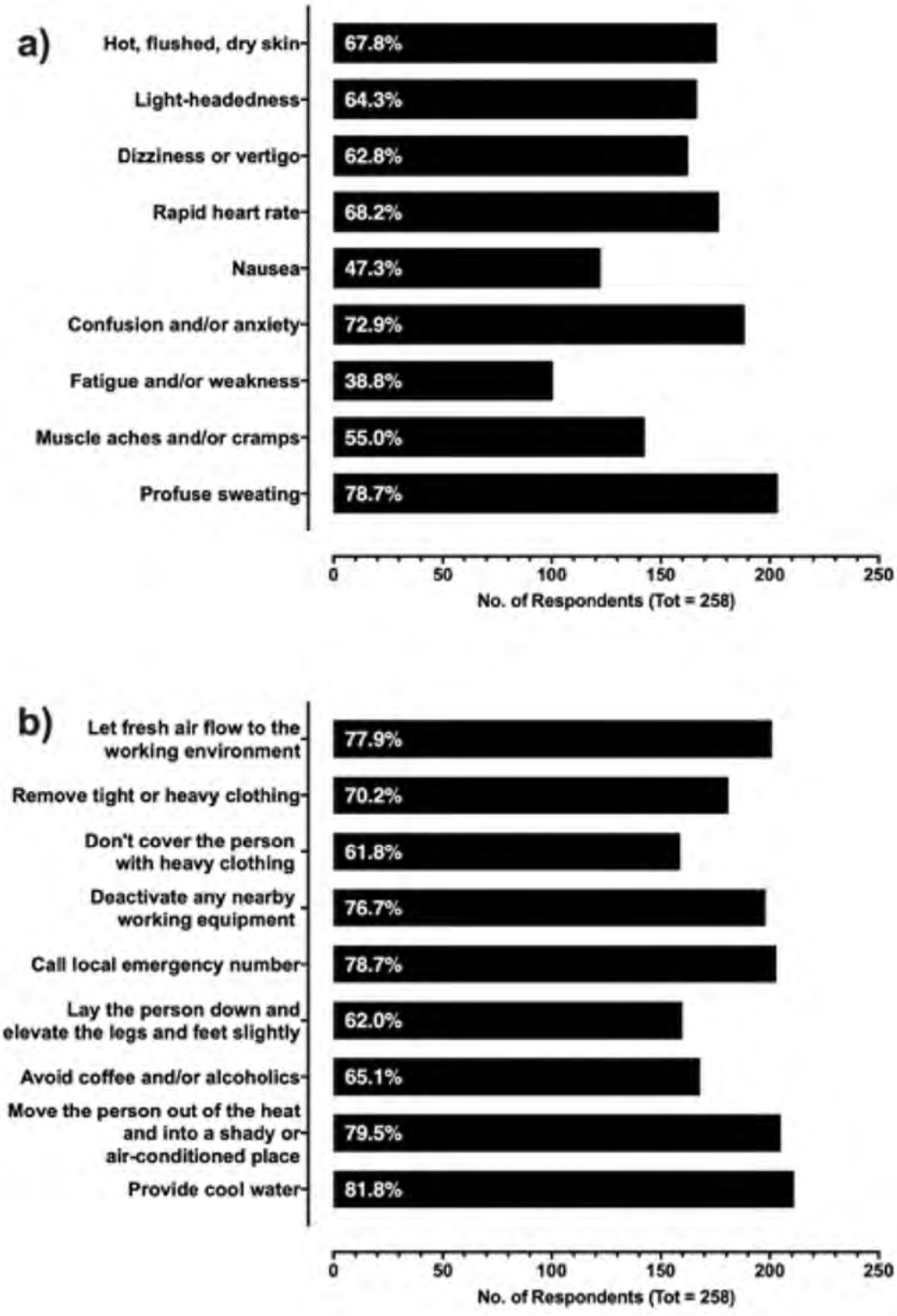
In univariate analyses (Tab. III), higher RPS (i.e. > median, 60.0%) was negatively associated with male sex (85.2% *vs* 98.7% of H&SRs scoring RPS ≤ 60.0%, $p < 0.001$), reporting a healthcare provider as main information source (26.9% *vs* 40.0%, $p = 0.028$), recalling the presence of heat sources 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.

References

[1] Binazzi A, Levi M, Bonafede M, Bugani M, Messeri A, Morabito M, Marinaccio A, Baldasseroni A. Evaluation of the impact of heat stress on the occurrence of occupational injuries: meta-analysis of observational studies. Am J Ind Med 2019;62(3):233-43. https://doi.org/10.1002/ajim.22946

[2] Kjellstrom T, Holmer I, Lemke B. Workplace heat stress, health and productivity-an increasing challenge for low and middle-income countries during climate change. Glob Health Action 2009;2. https://doi.org/10.3402/gha.v2i0.2047

[3] Xiang J, Hansen A, Pisaniello D, Bi P. Workers' perceptions of climate change related extreme heat exposure in South Australia: A cross-sectional survey. BMC Public Health 2016;16:549. https://doi.org/10.1186/s12889-016-3241-4

[4] Li J, Xu X, Ding G, Zhao Y, Zhao R, Xue F, Li J, Gao J, Yang

J, Jiang B, Liu Q. A Cross-sectional study of heat wave-related knowledge, attitude, and practice among the public in the Licheng District of Jinan City, China. Int J Environ Res Public Health 2016;13:pii:E648. https://doi.org/10.3390/ijerph13070648

[5] Chirico F, Magnavita N. The significant role of health surveillance in the occupational heat stress assessment. Int J Biometeorol 2019;63:193-4. https://doi.org/10.1007/s00484-018-1651-y

[6] Riccò M. Air temperature exposure and agricultural occupational injuries in the Autonomous Province of Trento (2000-2013, North-Eastern Italy). Int J Occup Med Environ Health 2018;31:317-31. https://doi.org/10.13075/ijomeh.1896.01114

[7] Riccò M, Garbarino S, Bragazzi NL. Migrant workers from the eastern-mediterranean region and occupational injuries : a retrospective database-based analysis from North-Eastern Italy. Int J Env Res Public Heal 2019;16. pii: E673. https://doi.org/10.3390/ijerph16040673

[8] Ciardini V, Contessa GM, Falsaperla R, Gómez-Amo JL, Meloni D, Monteleone F, Pace G, Piacentino S, Sferlazzo D, di Sarra A. Global and Mediterranean climate change: a short summary. Ann Ist Super Sanità 2016;52:325-37. https://doi.org/10.4415/ANN_16_03_04

[9] Riccò M, Vezzosi L, Bragazzi NL, Balzarini F. Heat-Related Illnesses among Pesticide Applicators in North-Eastern Italy (2017). J Agromedicine 2020;25:52-64 https://doi.org/10.1080/1059924X.2019.1606745

[10] ISTAT. Report ISTAT: Temperatura e precipitazione nelle principali città Anni 2002-2016 [Internet]. Rome; 2018. Available from: https://www.istat.it/it/files/2018/06/Report_Meteoclima.pdf

[11] Chirico F. Comments on "climate change and public health: a small frame obscures the picture." New Solut 2018;28:5-7. https://doi.org/10.1177/1048291117752463

[12] Chirico F, Magnavita N. The West Nile virus epidemic - occupational insight. Lancet 2019;393(10178):1298. https://doi.org/10.1016/S0140-6736(19)30028-5

[13] Li M, Gu S, Bi P, Yang J, Liu Q. Heat waves and morbidity: Current knowledge and further direction-a comprehensive literature review. Int J Environ Res Public Health 2015;12:5256-83. https://doi.org/10.3390/ijerph120505256

[14] Gubernot DM, Anderson GB, Hunting KL. Characterizing occupational heat-related mortality in the United States, 2000-2010: an analysis using the census of fatal occupational injuries database. Am J Ind Med. 2015;58:203-11. https://doi.org/10.1002/ajim.22381

[15] Chirico F, Taino G. Climate change and occupational health of outdoor workers: an urgent call to action for European policymakers. Env Dis. 2018;3:77-9. https://doi.org/10.4103/ed.ed_15_18

[16] Chad K, Brown J. Climatic stress in the workplace: its effect on thermoregulatory responses and muscle fatigue in female workers. Appl Erg 1995;26:29-34.

[17] Lugo-Amador NM, Rothenhaus T, Moyer P. Heat-related illness. Emerg Med Clin North Am 2004;22:315-27.

[18] Singh S, Hanna EG, Kjellstrom T. Working in Australia's heat: Health promotion concerns for health and productivity. Health Promot Int 2015;30:239-50. https://doi.org/10.1093/heapro/dat027

[19] Varghese BM, Hansen A, Bi P, Pisaniello D. Are workers at risk of occupational injuries due to heat exposure? A comprehensive literature review. Saf Sci 2018;110:380-392. https://doi.org/10.1016/j.ssci.2018.04.027

[20] Xiang J, Hansen A, Pisaniello D, Bi P. Extreme heat and occupational heat illnesses in South Australia, 2001-2010. Occup Environ Med 2015;72:580-6. https://doi.org/10.1136/oemed-2014-102706

[21] Xiang J, Bi P, Pisaniello D, Hansen A. The impact of heatwaves on workers' health and safety in Adelaide, South Australia. Environ Res 2014;133:90-95. https://doi.org/10.1016/j.envres.2014.04.042

[22] Bouchama A, Knochel JP. Heat Stroke. N Eng J Med 2002;346(25):1978-88.

[23] Riccò M, Vezzosi L, Gualerzi G. Health and safety of pesticide applicators in a high income agricultural setting: a knowledge, attitude, practice, and toxicity study from North-Eastern Italy. J Prev Med Hyg 2018;59:E200-11. https://doi.org/10.15167/2421-4248/jpmh2018.59.3.934

[24] Riccò M, Razio B, Poletti L, Panato C. Knowledge, attitudes, and sun-safety practices among agricultural workers in the Autonomous Province of Trento, North-Eastern Italy (2016). G Ital Dermatol Venereol 2020;155:13-20. https://doi.org/10.23736/S0392-0488.17.05672-3

[25] Jay O, Brotherhood JR. Occupational heat stress in Australian workplaces. Temperature 2016;3:394-411. https://doi.org/10.1080/23328940.2016.1216256

[26] Chirico F, Magnavita N. New and old indices for evaluating heat stress in an indoor environment: some considerations. Comment on "Kownacki L, Gao C, Kuklane K, Wierzbicka A. Heat stress in indoor environments of Scandinavian urban areas: a literature review. Int J Environ Res Public Health 2019;16:560. https://doi.org/10.3390/ijerph16040560". Int J Environ Res Public Health 2019;16:10-2. https://doi.org/10.3390/ijerph16081444

[27] Kownacki KL, Gao C, Kuklane K, Wierzbicka A. Heat stress in indoor environments of scandinavian urban areas: a literature review. Int J Environ Res Public Health 2019;16:560. https://doi.org/doi:10.3390/ijerph16040560

[28] Lam M, Krenz J, Palmández P, Negrete M, Perla M, Murphy-Robinson H, Spector JT. Identification of barriers to the prevention and treatment of heat-related illness in Latino farmworkers using activity-oriented, participatory rural appraisal focus group methods. BMC Public Health 2013;13:1004. https://doi.org/10.1186/1471-2458-13-1004

[29] Messeri A, Morabito M, Bonafede M, Bugani M, Levi M, Baldasseroni A, Binazzi A, Gozzini B, Orlandini S, Nybo L, Marinaccio A. Heat stress perception among native and migrant workers in italian industries – case studies from the construction and agricultural sectors. Int J Environ Res Public Health 2019;16:1090. https://doi.org/10.3390/ijerph16071090

[30] Bonafede M, Marinaccio A, Asta F, Schifano P, Michelozzi P, Vecchi S. The association between extreme weather conditions and work-related injuries and diseases. A systematic review of epidemiological studies. Ann Ist Super Sanità 2016;52:357-67. https://doi.org/10.4415/ANN_16_03_07

[31] Yaqub B, Al Deeb S. Heat strokes: aetiopathogenesis, neurological characteristics, treatment and outcome. J Neurol Sci 1998;156:144-51.

[32] Ossicini A, Bindi L, Casale M. Fundamental role of the workers' activity. G Ital Med Lav Erg 2003;25:124-6.

[33] Gross F, Papale A. Worker participation-Italy [Internet]. OSHWiki 2013 [cited 2019 May 4]. p. 1-7. Available from: https://oshwiki.eu/wiki/Worker_participation_-_Italy

[34] Hudspith B, Hay A. Information needs of workers. Ann Occup Hyg 1998;42:401-6.

[35] García AM, López-Jacob MJ, Dudzinski I, Gadea R, Rodrigo F. Factors associated with the activities of safety representatives in Spanish workplaces. J Epidemiol Community Health. 2007;61(9):784-790.

[36] Walters D. One Step Forward, Two Steps Back: Worker Representation and Health and Safety in the United Kingdom. Int J Heal Serv. 2006;36(1):87-111.

[37] Milgate N, Innes E, O'Loughlin K. Examining the effectiveness of health and safety committees and representatives: a review. Work [Internet]. 2002;19(3):281-290.

[38] Italian National Institute of Statistics. Italy in figures [Internet].

2016. Available from: https://www.istat.it/en/files/2017/06/Italy_in_figures_16.pdf

[39] Agnolin C, Ioriatti C, Pontalti M, Venturelli MB. IFP Experiences in Trentino, Italy. Acta Hortic 2000;525,45-50. https://doi.org/10.17660/ActaHortic.2000.525

[40] Gubernot DM, Anderson GB, Hunting KL. The epidemiology of occupational heat exposure in the United States: a review of the literature and assessment of research needs in a changing climate. Int J Biometeorol 2014;58:1779-88. https://doi.org/10.1007/s00484-013-0752-x

[41] Adam-Poupart A, Smargiassi A, Busque MA, Duguay P, Fournier M, Zayed J, et al. Effect of summer outdoor temperatures on work-related injuries in Quebec (Canada). Occup Environ Med 2015;72:338-45. https://doi.org/10.1136/oemed-2014-102428

[42] Jay O, Kenny GP. Heat Exposure in the Canadian Workplace. Am J Ind Med 2010;53:842-853. https://doi.org/10.1002/ajim.20827

[43] Xiang J, Hansen A, Pisaniello D, Bi P. Perceptions of workplace heat exposure and controls among occupational hygienists and relevant specialists in Australia. PLoS One. 2015;10:e0135040. https://doi.org/10.1371/journal.pone.0135040

[44] Xiang J, Bi P, Pisaniello D, Hansen A. Health impacts of workplace heat exposure: an epidemiological review. Ind Health 2014;52:91-101. https://doi.org/10.2486/indhealth.2012-0145

[45] Zingg A, Siegrist M. Measuring people's knowledge about vaccination: developing a one-dimensional scale. Vaccine 2012;30:3771-7. https://doi.org/10.1016/j.vaccine.2012.03.014

[46] Yates FJ, Stone ER. The risk construct. In: Yates FJ, ed. Risk-taking behaviour. 1st ed. Chichester (UK): John Wiley and Sons 1992, pp. 1-25.

[47] Jackson LL, Rosenberg HR. Preventing heat-related illness among agricultural workers. J Agromedicine 2010;15:200-15. https://doi.org/10.1080/1059924X.2010.487021

[48] Ibrahim JE, McInnes JA, Andrianopoulos N, Evans S. Minimising harm from heatwaves: a survey of awareness, knowledge, and practices of health professionals and care providers in Victoria, Australia. Int J Public Health 2012;57:297-304. https://doi.org/10.1007/s00038-011-0243-y

[49] Akerlof KL, Delamater PL, Boules CR, Upperman CR, Mitchell CS. Vulnerable populations perceive their health as at risk from climate change. Int J Environ Res Public Health. 2015;12:15419-15433. https://doi.org/10.3390/ijerph121214994

[50] Akompab DA, Bi P, Williams S, Grant J, Walker IA, Augoustinos M. Heat waves and climate change: applying the health belief model to identify predictors of risk perception and adaptive behaviours in Adelaide, Australia. Int J Environ Res Public Health 2013;10:2164-84. https://doi.org/10.3390/ijerph10062164

[51] Arjona RH, Piñeiros J, Ayabaca M, Freire FH. Climate change and agricultural workers' health in Ecuador: occupational exposure to UV radiation and hot environments. Ann Ist Super Sanita. 2016;52:368-73. https://doi.org/10.4415/ANN_16_03_08

[52] Mirabelli MC, Quandt SA, Crain R, Grzywacz JG, Robinson EN, Vallejos QM, Arcury TM. Symptoms of heat illness among Latino farm workers in North Carolina. Am J Prev Med 2010;39:468-71. https://doi.org/10.1016/j.amepre.2010.07.008

[53] Maeda T, Kaneko SY, Ohta M, Tanaka K, Sasaki A, Fukushima T. Risk factors for heatstroke among Japanese forestry workers. J Occup Health 2006;48:223-9.

[54] Fall E, Izaute M, Baggioni NC. How can the health belief model and self-determination Theory predict both influenza vaccination and vaccination intention? A longitudinal study among university students. Psychol Health 2018;33:746-64. https://doi.org/10.1080/08870446.2017.1401623

[55] Kalkstein AJ, Sheridan SC. The social impacts of the heat-health watch/warning system in Phoenix, Arizona: assessing the perceived risk and response of the public. Int J Biometeorol 2007;52:43-55 https://doi.org/10.1007/s00484-006-0073-4

[56] Semenza JC, Rubin CH, Falter KH, Selanikio JD, Flanders DW, Howe HL, Wilhelm JL. Heat-related deaths during the July 1995 heat wave in Chicago. N Eng J Med 1996;335:84-90. https://doi.org/10.1056/NEJM199607113350203

[57] Abbritti G, Apostoli P, Iavicoli S, Murgia N, Persechino B, Soleo L, Ambrosi L. Needs, education and accreditation in occupational medicine in Italy. Int Arch Occup Environ Health 2005;78:75-8. https://doi.org/10.1007/s00420-004-0552-z

[58] Giraudo M, Bena A, Costa G. Migrant workers in Italy: an analysis of injury risk taking into account occupational characteristics and job tenure. BMC Public Health 2017;17:351. https://doi.org/10.1186/s12889-017-4240-9

[59] Manzoli L, Sotgiu G, Magnavita N, Durando P, Barchitta M, Carducci A, Conversano M, De Pasquale G, Dini G, Lizza M, Messineo A, Nicosia V, Riccò M, Toletone A. Evidence-based approach for continuous improvement of occupational health. Epidemiol Prev 2015; 39(4 Suppl 1):81-5.

[60] Stoecklin-Marois M, Hennessy-Burt T, Mitchell D, Schenker M. Heat-related illness knowledge and practices among california hired farm workers in The MICASA Study. Ind Health 2013;51:47-55. https://doi.org/10.2486/indhealth.2012-0128

[61] Betsch C, Schmid P, Korn L, Holtmann C, Böhm R. Beyond confidence: development of a measure assessing the 5C psychological antecedents of vaccination. PLoS One 2018;13:e0208601. https://doi.org/10.1371/journal.pone.0208601

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