European Journal of Sustainable Development Research
2026, 10(1), em0336
e-ISSN: 2542-4742
https://www.ejosdr.com/

MODESTUM

Research Article

OPEN ACCESS

Classifying and mitigating occupational risks for public health inspectors in the context of the global climate crisis

Ioannis Pantelis Adamopoulos [1,2,3*], Niki Fotios Syrou [4], Demetris Lamnisos [5], Antonios Valamontes [6], John T. Karantonis [7], Panagiotis Tsirkas [8], George Dounias [1]

[1] Department of Public Health Policy, Sector of Occupational & Environmental Health, School of Public Health, University of West Attica, Athens, GREECE
[2] Hellenic Republic, Region of Attica, Department of Environmental Hygiene and Sanitarian Public Health Inspections, Athens, GREECE
[3] Department of Public Health and Policies, School of Social Science, Hellenic Open University, Patra, GREECE
[4] Department of Physical Education and Sport Science, University of Thessaly, Karies, Trikala, GREECE
[5] Department of Health Sciences, European University Cyprus, Nicosia, CYPRUS
[6] Kapodistrian Academy of Science, Tampa, FL, USA
[7] Loyola University Chicago, Chicago, IL, USA
[8] Department of Gynaecological Endoscopic Surgery, Family Planning and Reproductive Health Care, Hatzikosta General District Hospital, Ioannina, GREECE
***Corresponding Author:** iadamopoulos@uniwa.gr

Citation: Adamopoulos, I. P., Syrou, N. F., Lamnisos, D., Valamontes, A., Karantonis, J. T., Tsirkas, P., & Dounias, G. (2026). Classifying and mitigating occupational risks for public health inspectors in the context of the global climate crisis. *European Journal of Sustainable Development Research, 10*(1), em0336. https://doi.org/10.29333/ejosdr/17273

ARTICLE INFO

Received: 22 Apr. 2025

Accepted: 24 Sep. 2025

ABSTRACT

The global climate crisis significantly impacts public health, requiring public health inspectors (PHIs) to manage evolving environmental, psychosocial, and organizational risks. This study examines PHIs' roles in classifying and mitigating workplace hazards exacerbated by climate change, focusing on the challenges they face, the public health implications, and the necessity for effective interventions. A mixed-methods approach was employed, integrating quantitative analysis of PHI-reported secondary data analysis with a scoping review of risk assessment frameworks studies from 2010 to 2025. Of the 185 PHIs surveyed, 87% (n = 161) reported feeling inadequately prepared to manage climate-related hazards. Additionally, 79.42% (n = 146) highlighted a lack of updated training as a critical barrier, and 78% (n = 144) cited insufficient resources as a major challenge. This study provides evidence-based recommendations to strengthen public health policies, enhance occupational safety, and equip PHIs with the necessary tools to manage environmental challenges effectively and reduce occupational risks related to climate and public health infrastructure.

Keywords: psychosocial risk, climate crisis, public health inspectors, workplace classification assessment, safety and health hazards, risk reduction

INTRODUCTION

The global climate crisis has escalated the complexity of environmental and occupational risks, posing significant challenges to public health (Levy & Roelofs, 2019). Public health inspectors (PHIs) are essential in addressing these risks by identifying hazards, ensuring compliance with environmental standards, and mitigating threats to community well-being. Their responsibilities encompass various areas, such as monitoring drinking water quality, air pollution, food safety, and workplace hazards. PHIs directly influence public health outcomes, particularly in reducing premature mortality and chronic diseases linked to environmental factors (Tustin et al., 2019).

By enforcing rigorous standards and conducting inspections, PHI protect vulnerable communities through inspections, but their own occupational risks are increasing due to climate change (Adamopoulos et al., 2023). PHIs occupational exposures include physical hazards, biological hazards, chemical hazards, and psychosocial/ergonomic hazards (EU-OSHA, 2021a, 2021b, 2023; National Institute of Health, 2025; WHO, 2023; Yang et al., 2019). These factors necessitate a re-evaluation of existing risk assessment practices (Viegas et al., 2023). PHIs must be adapted by adopting standardized tools, refining risk classification systems, and collaborating across agencies (Adamopoulos et al., 2024). Educational programs focusing on climate-related health risks are essential to equip PHIs with the skills and knowledge needed to address these evolving challenges effectively (Ahmad et al., 2020).

This study seeks to address these challenges by

(1) analyzing current PHI practices in classifying and assessing environmental and occupational risks,

(2) identifying gaps in training and resource allocation that limit PHIs' effectiveness, and

(3) proposing strategies to enhance PHI preparedness for managing climate-related hazards.

The study uses a mixed-methods approach, integrating quantitative analysis with a scoping review (Adamopoulos et al., 2022, 2023) to explore existing research, identify gaps in methodologies, and highlight challenges faced by PHIs (Adamopoulos et al., 2022; Tustin et al., 2019). The scoping review aims to evaluate the breadth of available literature, identify key methodologies, and map gaps in training, resources, and tools for managing climate-related risks (Stahl et al., 2024). This approach is particularly suited for understanding the diverse challenges faced by PHIs, including evolving workplace hazards and environmental risks caused by the global climate crisis (EU-OSHA, 2021a, 2021b; Williams & Mohammed, 2013). By synthesizing insights from the scoping review and PHI-reported data, the study provides a comprehensive overview of existing practices and proposes strategies for improving preparedness and public health outcomes (Ferari et al., 2023; Ramos et al., 2022).

This work underscores the urgent need for enhanced training, better resource allocation, and sustainable practices to empower PHIs in effectively mitigating climate-related public health challenges.

LITERATURE REVIEW

Public Health Inspectors and Climate Change Adaptation

PHIs have long played a critical role in safeguarding community health by evaluating environmental risks and ensuring compliance with public health standards. As climate change accelerates, PHIs face new and escalating challenges in managing environmental, psychosocial, and organizational risks. Climate-related risks, including rising temperatures, extreme weather events, and the emergence of novel pathogens, have amplified the demands placed on PHIs, making their role in public health more complex and essential (Adamopoulos et al., 2023; EU-OSHA, 2021a, 2021b; Flouris et al., 2018). Few studies have emphasized the importance of PHIs in adapting and correlated to the climate crisis (Adamopoulos et al., 2024, 2025a, 2025b, 2025c; Schulte et al. 2016; Tustin et al., 20219). According to Adamopoulos et al. (2024). PHIs are tasked with identifying and mitigating climate-induced health hazards, including heat-related illnesses, foodborne diseases, and mental health impacts due to extreme weather events. As noted by Schulte et al. (2016), occupational health frameworks must be updated to reflect the unique environmental stressors posed by climate change, with PHIs at the forefront of managing these risks. A significant gap exists in the literature, and this study aims to fill it by identifying and addressing climate-induced health threats, the effects of extreme weather events on overall occupational safety and health (OSH).

Frameworks for Risk Assessment in Public Health Inspections

Existing risk assessment frameworks have provided valuable guidelines for understanding and mitigating the risks faced by PHIs. EU-OSHA (2021a, 2021b) outlines a comprehensive risk assessment approach that includes physical, chemical, biological, and psychosocial hazards. However, these frameworks often fail to account for the compounded effects of climate change, which has introduced additional layers of complexity to existing hazards. For example, Schulte et al. (2016) emphasize the need for occupational health frameworks to integrate climate considerations such as heat stress, extreme weather events, and the spread of vector-borne diseases. In addition, Tustin et al. (2019) conducted a study that identified key occupational hazards among PHIs, including exposure to toxic chemicals and ergonomic risks from prolonged inspections. They also found that psychosocial hazards, such as workplace violence and stress, are common among PHIs, yet these factors are often underreported in traditional risk assessment frameworks (Adamopoulos et al., 2022). While these frameworks provide a foundation for risk management, they have been criticized for their limited applicability to climate-induced health risks. Adamopoulos et al. (2023) point out that current frameworks fail to incorporate climate-specific risks adequately, such as heat stress and the impacts of extreme weather events on PHI operations. This gap necessitates the development of updated risk assessment tools and training programs tailored to the evolving climate context.

Training and Resource Challenges for Public Health Inspectors

One of the most critical challenges faced by public health professionals in the context of climate change is inadequate training. Studies by Viegas et al. (2023) and Levy and Roelofs (2019) reveal that a significant portion of PHIs feel inadequately prepared to handle climate-related risks. In their study, Adamopoulos et al. (2022) found that 79.42% of PHIs reported lacking the necessary training to manage climate-induced hazards effectively. Moreover, Rahman and Akhter (2021) highlight that insufficient training in climate-specific risks can result in poor risk classification and delayed responses to emerging health threats. Resource limitations compound the lack of training, and Schulte and Chun (2009) found that resource shortages, including the lack of up-to-date climate data, monitoring tools, and personal protective equipment, hinder PHIs from responding to health hazards brought on by climate change. In light of resource constraints, integrating the sources is a crucial step in reducing the risks. This underscores the need for targeted resource allocation and the integration of climate change considerations into occupational health policies.

Gaps in Existing Methodologies for Managing Climate-Related Risks

While a number of studies have explored PHIs risk management, many of these studies focus primarily on traditional occupational hazards without accounting for climate-specific risks. Tustin et al. (2019) have noted the importance of expanding risk assessments to include psychosocial and organizational factors. However, there is little research on the integration of climate-specific variables, such as temperature increases and extreme weather events, into these frameworks (Marinaccio et al., 2025).

Schulte et al. (2016) argue that existing occupational health frameworks need to be more dynamic and adaptable to reflect the realities of climate change. Adamopoulos et al. (2025c) calls for a new approach to risk classification that includes the impact of climate change on PHIs roles and responsibilities, emphasizing the need for interagency collaboration and better integration of climate data.

Additionally, the effectiveness of current data collection methods in assessing climate-related risks has been questioned. According to Williams and Mohammed (2013), existing data collection tools are insufficient for capturing the full scope of climate-induced hazards and their impact on PHIs operations (Adamopoulos et al., 2025c). There is a clear need for innovative data-gathering tools and risk classification systems that are specific to climate challenges.

Need for Standardized Tools and Frameworks

There is an urgent need for standardized tools that can assist PHIs in managing the complex risks posed by climate change. EU-OSHA (2021a, 2021b) and Yang et al. (2019) have called for the development of climate-specific checklists, frameworks, and protocols to help PHIs assess and manage emerging risks more effectively.

The integration of climate science into these frameworks is crucial for ensuring that PHIs are adequately prepared for the climate-related health challenges of the future. Adamopoulos et al. (2024) suggest that standardized tools should focus on both prevention and adaptation, equipping PHIs with the necessary resources to mitigate risks while also preparing for future climate events. Furthermore, Viegas et al. (2023) advocate for the development of a climate-resilient training curriculum that can be integrated into PHI certification programs.

Summary of Literature Review

This review has highlighted several key areas for improvement in PHIs roles and risk assessment frameworks in the context of the global climate crisis. Key findings include the following:

1. There is a need for updated frameworks that incorporate climate-specific risks.
2. Gaps in training and resource allocation for PHIs in managing climate-related health hazards.
3. There is a lack of standardized tools to help PHIs assess and mitigate these emerging risks effectively.

The literature is growing in consensus that PHIs must be equipped with the tools, training, and resources necessary to adapt to the changing climate. Future research should focus on developing these tools and frameworks, ensuring that PHIs are prepared to meet the challenges posed by climate change in the public health sector.

METHODS

This study employs a mixed-methods approach, combining quantitative analysis and secondary data review through the quantitative review and secondary data analysis development model (Adamopoulos et al., 2022; Burton, 2000). The primary aim is to analyze occupational risks and environmental health incidents reported by PHIs in the context of the global climate crisis (Adamopoulos et al., 2023; Tustin et al., 2019). Three central hypotheses guide the research:

1. H1. There is a positive association between increased levels of perceived psychosocial risks and higher levels of workplace biological hazards among PHIs.
2. H2. The perceived level of job risks and environmental hazards differs significantly between urban and rural workplace environments.
3. H3. PHIs with higher levels of climate-specific training report lower perceived job risks and greater preparedness for managing climate-related hazards.

Data Collection

Data for the quantitative analysis were collected from March to June 2021 using a nationwide cross-sectional survey conducted via a web-based questionnaire closed-ended. The survey targeted 185 active PHIs across Greece, representing 27% of the total PHIs population. Participating departments included the Ministry of Health, Prefecture Regions, and the Unified Food Control Agency-Hellenic Food Authority. Participants were informed about the study's purposes and consent was acquired after participants were briefed on the goals of the study. Everyone who took part was given a unique code number, and they could stop at any moment. With the use of special codes, privacy and anonymity were guaranteed. The GDPR's data protection regulations were also explained to participants, and they were free to leave at any time without worrying about the repercussions.

Before the questionnaire was distributed, approval was obtained from the Scientific Council of the Department of Public Health Services. The research adhered to national and European data protection legislation, Bioethics standards, and the principles outlined in the Declaration of Helsinki.

Data Analysis

Descriptive statistics were used to summarize PHIs demographics and identify common challenges. Hierarchical regression analysis was employed to examine the relationships between psychosocial risks, biological hazards, and training adequacy. The Kolmogorov-Smirnov test confirmed data normality.

The data were analyzed using SPSS v.28 (Adamopoulos et al., 2023). The analytical framework focused on validating the three hypotheses and identifying key occupational health risk factors, such as psychosocial and biological risks, amplified by the climate crisis (Hoffman et al., 2019; Williams, 2022).

Scoping Review

A scoping review was conducted to evaluate the breadth of available literature on PHIs' roles in managing climate-related risks. The review focused on studies published between January 2010 and December 2024. Key databases consulted included PubMed, Medline, EMBASE, CINAHL, Web of Science, and ScienceDirect. The review aimed to identify key methodologies and frameworks, as well as gaps in training, resources, and tools for managing climate-related risks (Arksey & O'Malley, 2005; Dale et al., 2008; EU-OSHA, 2021a, 2021b; McGuinness et al., 2021; Munn et al., 2018; Page et al., 2021).

Studies addressing PHIs involvement in risk assessment and mitigation were included, while those lacking relevant data or focusing on non-PHIs roles were excluded. In order to combine findings about the roles and challenges of PHIs in climate risk management, as well as to incorporate data from 123 studies chosen based on experience gathered from the registers, thematic analysis was utilized to discover important themes from qualitative replies.

Design of the Study

This study utilizes a methodical review of the literature, employing a variety of research analysis techniques, and follows all the conventional scoping review protocols, checklists, and statements for this type of study. The study incorporates a selection of English-language studies from the search engines Scopus, PubMed, Google Scholar, and Web of Science, and analyzes thirteen studies of the literature through a review that eliminates required, predatory, and nonacademic publications. Additionally, nine recordings were found on the websites, networks, and platforms of international scientific societies, associations, and organizations such as the European Union, WHO, EUPHA, NHI, EU-OSHA, and the ILO. The selection process for the selected thirteen studies is summarized in the PRISMA flow chart diagram shown in Figure 1. To ensure rigour and relevance, the following inclusion criteria were applied for the scoping review:

1. Every study must be published in a peer-reviewed journal.
2. The studies must be written in English.
3. The studies must focus on PHIs roles related to climate change risks and occupational health.

Exclusion criteria:

1. Studies not published in English.
2. Studies focusing on non-medical or non-healthcare personnel.
3. Studies have lacked clear data on PHIs involvement in environmental risk management.

Figure 1 presents the PRISMA flow diagram used for the scoping review, illustrating the inclusion and exclusion process for articles, reviews, and reports on PHIs roles and challenges.

Table 1 shows the studies that were included in the scoping review and mixed methods research of the study.

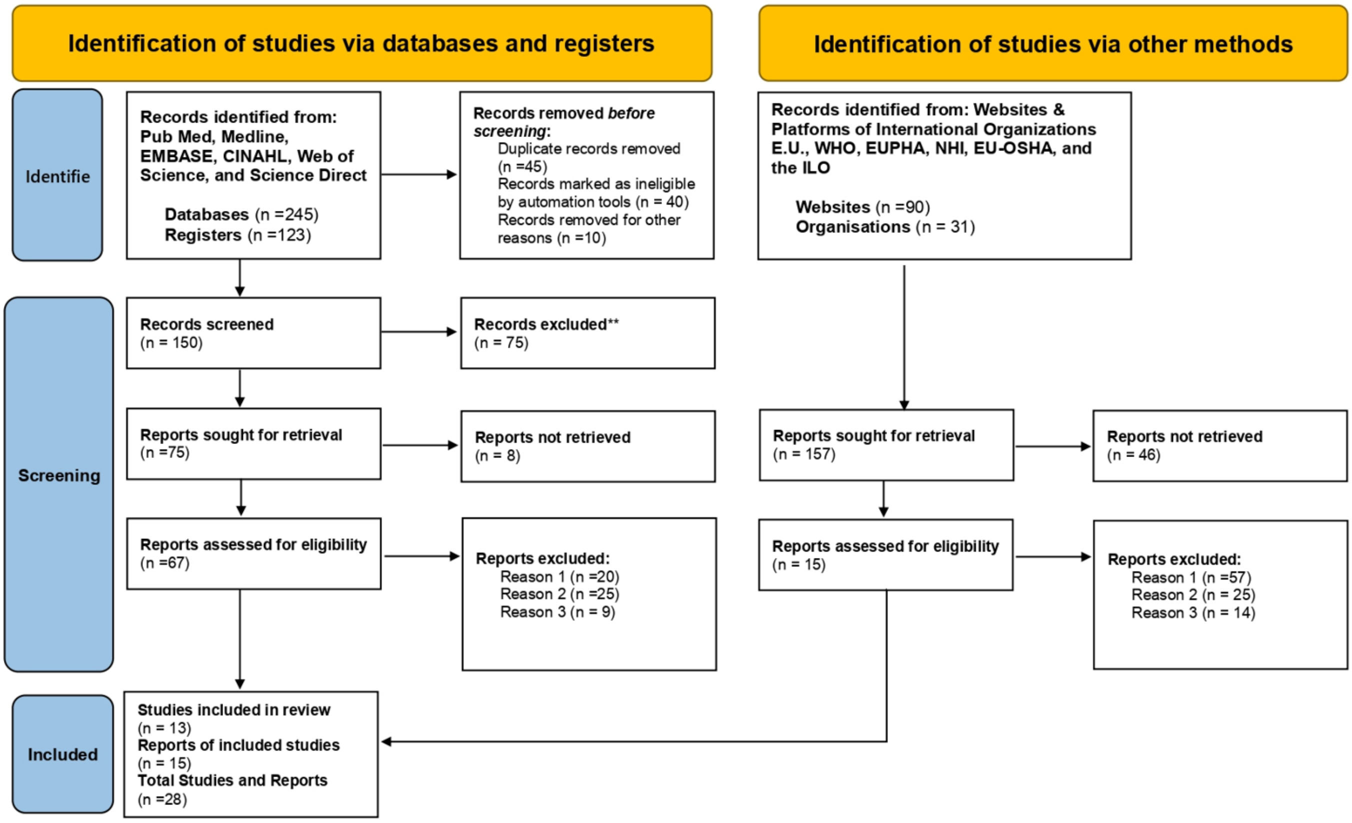

Figure 1. PRISMA flowchart diagram of this study's literature (Source: Authors' own elaboration)

Table 1. Studies on classification and assessment of the PHIs, occupational safety, and climate change risks

ID	Reference	Study title	Country	Participants/ sample	Results /key findings	Methodology
1	Adam-Poupart et al. (2015)	Effect of summer outdoor temperatures on work-related injuries in Quebec (Canada)	Canada	The 374,078 injuries by the workers', 2003-2010	Higher temperatures were found to be linked to increased work-related injuries. In the context of global warming, results can be used to estimate future impacts of summer outdoor temperatures on workers.	Retrospective study

Table 1 (Continued). Studies on classification and assessment of the PHIs, occupational safety, and climate change risks

ID	Reference	Study title	Country	Participants/ sample	Results /key findings	Methodology
2	Adamopoulos et al. (2022)	Public health and work safety pilot study: Inspection of job risks, burnout syndrome and job satisfaction of public health inspectors in Greece	Greece	46 participants	The aim of this study was to report the job risks of PHIs and investigate possible relationships with burnout and job satisfaction. The changing environmental conditions due to global climate change introduce a higher frequency and severity of extreme weather conditions (heat waves and floods), causing natural disasters.	Pilot study-cross-sectional study
3	Adamopoulos et al. (2023)	Cross-sectional study in occupational safety and health during the COVID-19 pandemic in Greece	Greece	185 participants	This study identifies job risk factors, burnout syndrome, and job satisfaction levels among PHIs during the pandemic associated with environmental risk factors.	Cross-sectional study
4	Tustin et al. (2019)	Occupational health and safety hazards encountered by Ontario public health inspectors	Canada	134 participants	Results showed PHIs reported safety hazards (e.g., slips or falls), working alone, and chemical hazards as the top three types of hazards. Inspections of food and (or) nonfood premises were the duties most associated with encountering all types of hazards.	Cross-sectional study
5	Viegas et al. (2023)	Training on the impact of climate change on public health: Reflections and lessons learnt	The impacts on human health and well-being of the world's populations, especially in the 32 EEA member countries (EEA-32)	Between 1980-2020, climate change-related fatalities in Europe amounted to 85,000 to 145,000, according to data from NatCatSERVICE and CATDAT	Future versions of the training should be included in the ENSP-NOVA formative program, according to feedback, interest, and the training's capacity to mainstream the subject. Similar training initiatives will be guided by the lessons learnt, aiding in efforts to mitigate and adapt to climate change.	Review
6	Flouris et al. (2018)	Workers' health and productivity under occupational heat strain: A systematic review and meta-analysis	Including 30 countries	111 studies done in, 447 million workers	Demonstrated that heat strain significantly reduces worker productivity and health. For a thorough evidence synthesis approach, this research considers a variety of demographics, exposures, and occupations.	Systematic review and meta-analysis
7	Ferari et al. (2023)	Impact of climate change on occupational health and safety: A review of methodological approaches	International databases to conduct the searches, each of them limited to a 10-year time cut (2010-2020)	International databases 7, scientific, resulting in 170 articles	This study explores the effects of climate change on workers' health, safety, and performance, identifying risks, workplaces, and methodological approaches used to assess this issue, providing a knowledge base for understanding its effects.	Systematic Review
8	Marinaccio et al. (2025)	Climate change and occupational health and safety. Risk of injuries, productivity loss and the co-benefits perspective	Italy	Between 2014 and 2019, an average of 4,272 cases of occupational injuries were due to heat	This study estimates work-related injury risk in Italy due to extreme temperature outdoor exposure, evaluates productivity loss, and assesses insurance costs for adaptation measures, co-benefit analysis.	The study employs a time-series approach to analyse data and generalised linear regression model.
9	Schulte et al. (2016)	Advancing the framework for considering the effects of climate change on worker safety and health	The study examines international literature review metrics and global worker populations	Literature from 2008-2014	The study examines international literature review metrics and global worker populations. Developed a framework to identify climate change impacts on workplace safety, emphasizing OSH adaptation needs.	Framework analysis-Review
10	Levy and Roelofs (2019)	Impacts of climate change on workers' health and safety	Global literature review metrics	World workers populations	Increased risks of work-related illnesses and injuries due to climate change, measures are required to improve the recognition and prevention of occupational illnesses and injuries.	Literature review
11	Schulte and Chun (2009)	Climate change and occupational safety and health: Establishing a preliminary framework	The examination of international scientific literature published between 1988-2008	Included studies from 1988-2008	Proposed a framework for understanding climate change impacts on OSH and stressed the need for further research, which could affect the workplace, workers, and occupational morbidity, mortality, and injury.	Literature review

Table 1 (Continued). Studies on classification and assessment of the PHIs, occupational safety, and climate change risks

ID	Reference	Study title	Country	Participants/ sample	Results /key findings	Methodology
12	Stahl et al. (2024)	Incorporating climate change model projections into ecological risk assessments to help inform risk management and adaptation strategies: Synthesis of a SETAC Pellston Workshop®	Outcomes of 14 countries	The samples of the workshop were distributed to national authorities in Australia, Norway, the UK, and the USA.	The integration of global climate change and chemical impacts on the environment. The workshop highlighted the lack of integration of global climate change and chemical impacts on the environment, with few national or international reports and peer-reviewed publications on this interaction. It emphasized the need for a problem-scoping approach and climate change accounting for chemical management.	A scoping review and climate change accounting report for chemicals management
13	Yang et al. (2019)	Health professionals in a changing climate: Protocol for a scoping review	The global effort is to identify knowledge gaps to guide the future development of research, policy, and practices	This study comprises literature on health professionals' work on climate change and health since 2002	The study examines health professionals' efforts to prepare for climate change health impacts, highlighting current global situations and gaps in preparedness, and aims to identify achievements, identify gaps, and develop effective engagement practices.	Scoping review

Quality Assessment of the Reviews

This scoping review analyzed thirteen studies with appropriate inclusion criteria and risk of bias, influencing the conclusions. The strength of the conclusions depends on the inclusion of reviews that meet a minimum standard of quality using the Robvis 2 risk-of-bias assessment figures tools (McGuinness et al., 2020). The PRISMA guidelines for scoping reviews assessment are in line with the methodological quality checklist, and the Cochrane risk of bias. The Cochrane risk of bias tool categorizes bias risk for different study domains as "low," "high," or "some conferences'', etc." without a universally accepted coefficient. Quantification can be achieved by calculating "low" risk items or collapsing categories. The quality of the reviews should be assessed to avoid being influenced by extraneous variables and focus on the quality of the review's conduct. Robvis 2, associated with PRISMA, is the selected tool validated for assessing the methodological quality of scoping and systematic reviews PRISMA (McGuinness et al., 2020; Page et al., 2021) as shown in **Figure 1** and **Figure 2**. The review identified research questions and inclusion criteria, performed data extraction, conducted a comprehensive literature review, identified key words, and assessed the included studies.

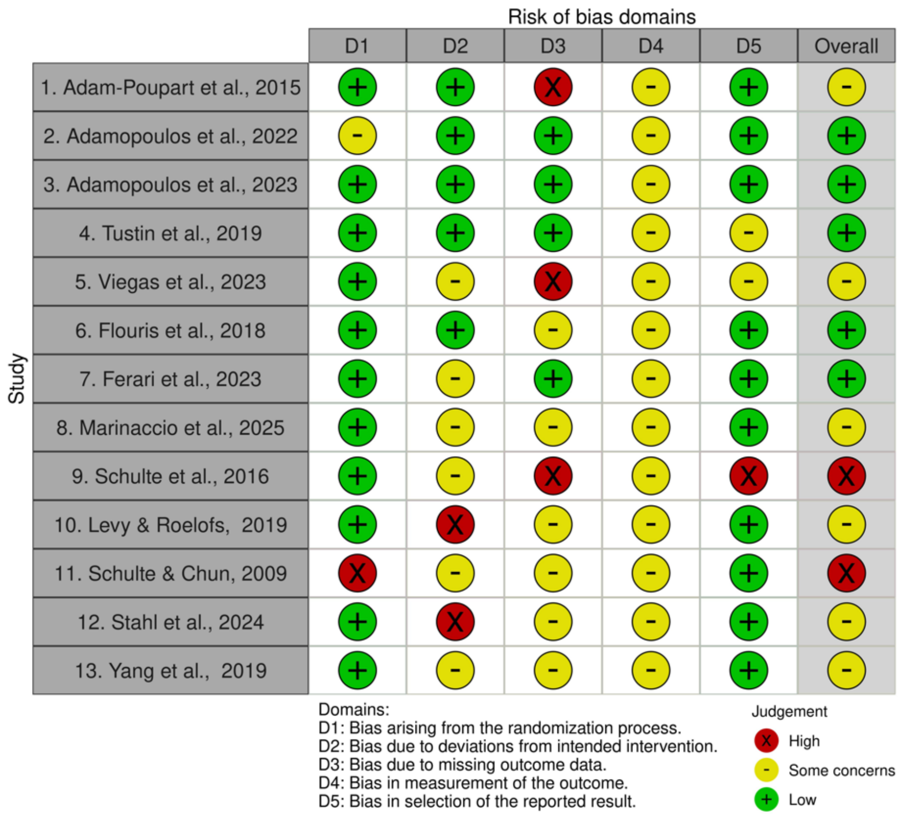

Figure 2. The review quality of the studies results on risk of bias assessment tools (Source: Authors' own elaboration)

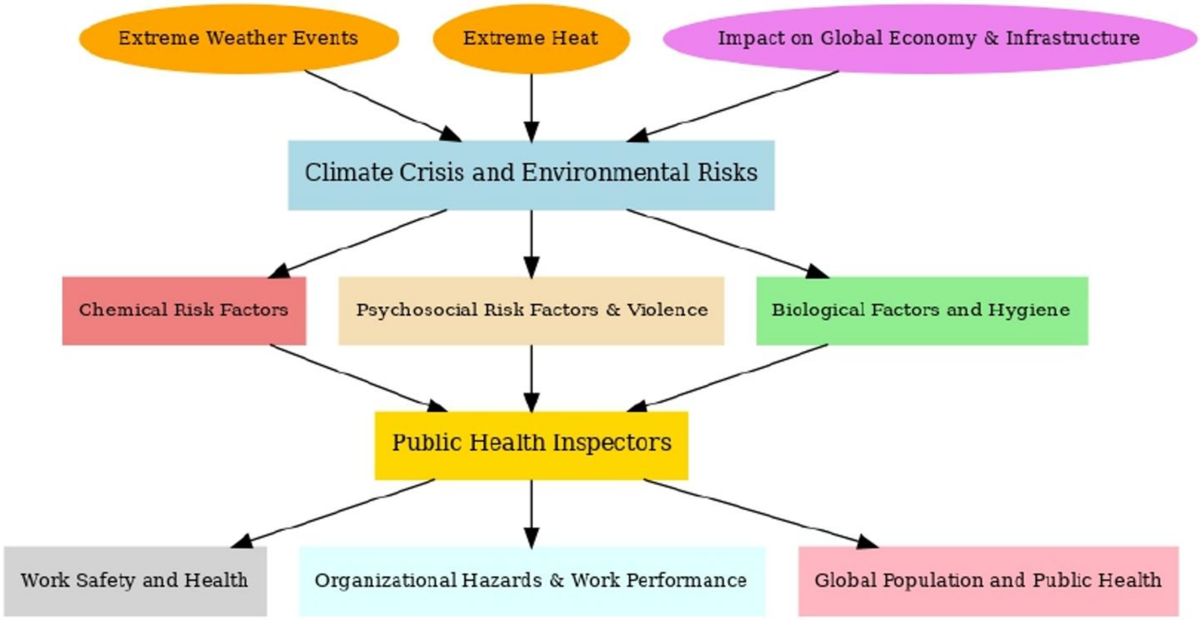

Figure 3. Public health inspectors' risk assessment framework (Source: Authors' own elaboration)

The findings of the scoping review were influenced by 13 studies that met the proper inclusion criteria and had a low risk of bias. The Robvis 2 risk-of-bias assessment figures tools ensured that the findings were considered strong. Evaluating review quality is crucial to prevent it from being impacted by unrelated factors and to concentrate on the caliber of the review's execution.

RESULTS

The role of PHIs has significantly evolved as environmental and occupational risks have become more complex. Today, PHIs are responsible not only for inspecting food safety and sanitation but also for evaluating a broader range of risks, including environmental, psychosocial, and organizational hazards. These responsibilities have become more critical in the context of the global climate crisis, which exacerbates existing workplace hazards and introduces new challenges. A substantial proportion of PHIs (87%) reported feeling inadequately prepared to manage the increasing complexity of these climate-related risks, particularly those related to food safety, air quality, and psychosocial hazards. PHIs play a crucial role in safeguarding public health by assessing and mitigating various risks. Their duties span a wide range of activities, including monitoring food safety, ensuring sanitation standards, addressing psychosocial and violent risks, evaluating organizational risks, inspecting workplaces, investigating complaints, teaching public health practices, monitoring air quality, evaluating water safety and wastewater surveillance, and conducting epidemiological investigations and research (Ramos et al., 2020). However, 79.42% of PHIs highlighted a lack of updated training as a critical barrier to fulfilling these duties, while 58% cited resource shortages.

Figure 3 presents the study's flow chart on PHIs classification and assessment of environmental, psychosocial, organizational risks, and workplace hazards in the context of the global climate crisis. This framework illustrates how external drivers, such as extreme weather and heat, contribute to risks like chemical, psychosocial, and biological hazards, with X% of PHIs reporting heat stress and Y% citing extreme weather as significant challenges. As shown in **Figure 3**, PHIs serve as critical intermediaries in addressing risks generated by these external factors, with X% indicating that climate change is intensifying workplace hazards.

These risks–chemical, psychosocial, and biological–pose significant challenges to workplace safety, organizational performance, and public health. Survey responses from N = 185 participants revealed the following key findings:

1. 87% (n = 161) of PHIs reported feeling inadequately trained to address climate-related hazards.
2. 58% (n = 107) highlighted resource shortages as major barriers to effectively managing these emerging risks.
3. 65% (n = 120) emphasized the urgent need for updated training programs and tools tailored to the specific risks posed by climate change.

These findings underscore the necessity for strengthening interventions as outlined in the proposed framework. This includes developing enhanced training programs that incorporate climate science, improving resource allocation to manage climate-related challenges, and fostering interagency collaboration between public health and environmental agencies (Adamopoulos et al., 2022, 2023; EU-OSHA, 2021a, 2021b; ILO, 2024; Tustin et al., 2019). Such efforts are critical to enhancing the ability of PHIs to assess and mitigate environmental risks effectively.

Statistical Analysis and Quantitative Findings

The analysis revealed a significant increase in reported environmental health incidents over the past decade, particularly with respect to heat stress and air quality-related issues. These findings highlight the growing challenges PHIs face in managing climate-induced health risks.

Three keys from the analysis:

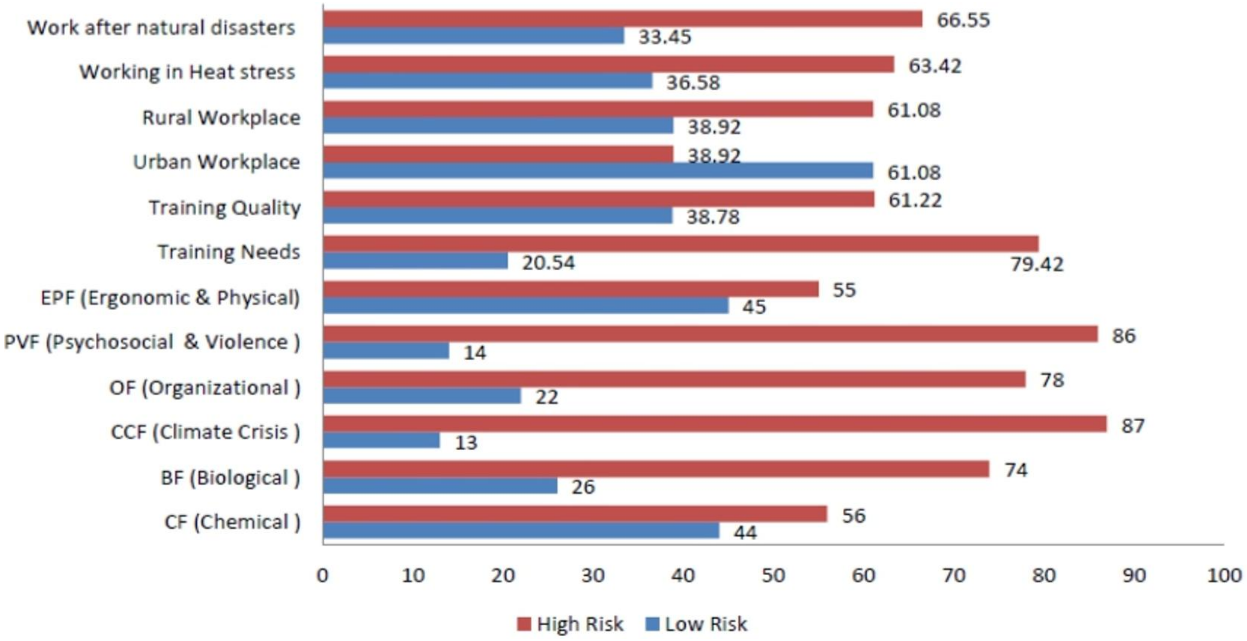

Figure 4. High and low-risk ratios of participants reporting above-average frequency/severity of occupational risk, training factors, and workplace area (Source: Authors' own elaboration)

Table 2. Lillie for the significance correction test of normality

Risk factors	Kolmogorov–Smirnov			Shapiro-Wilk		
	Statistics	df	Significance	Statistics	df	Significance
EPF (ergonomic & physical)	0.120	185	0.000	0.975	185	0.002
CF (chemical)	0.080	185	0.005	0.973	185	0.001
BF (biological)	0.144	185	0.000	0.916	185	0.001
CCF (climate crisis)	0.081	185	0.005	0.965	185	0.001
PVF (psychosocial & violence)	0.092	185	0.001	0.951	185	0.001
OF (organizational)	0.071	185	0.024	0.952	185	0.001

1. There is a need for enhanced training on climate-related risks.
2. The importance of interagency collaboration in managing emerging risks effectively.
3. The challenges are associated with resource allocation, particularly in addressing climate-related hazards.

A substantial proportion of PHIs (87%) reported feeling inadequately prepared to manage climate-related hazards. Additionally, 79.42% cited the lack of updated training as a significant barrier to effective risk management, while 78% pointed to insufficient resources as a major challenge. Moreover, PHIs emphasized the need for more comprehensive and real-time data on environmental changes to improve their assessments and actions better. **Figure 4** illustrates the high and low-risk ratios of occupational hazards reported by PHIs, segmented by frequency, severity, and the quality of training received.

Figure 4 also highlights disparities across different workplace environments, with urban settings showing notably higher risk ratios compared to rural and semi-rural environments. These variations are consistent with survey findings, where a significant number of PHIs reported challenges stemming from inadequate training and resource gaps. Addressing these gaps will be crucial for improving PHIs effectiveness in managing the unique challenges posed by diverse workplace environments.

Table 2 presents the results of the normality test for the survey data, including the significance correction.

Hierarchical Linear Regression Analysis for Climate Crisis and Heat Stress

Table 3 presents the results of the hierarchical linear regression analysis examining the impact of various job risk variables on climate crisis and heat stress (CCF). The analysis explores the influence of chemical, biological, ergonomic, psychosocial, and organizational risks, while also accounting for demographic factors such as marital status and workplace location (urban vs. rural).

In the unadjusted model, psychosocial risk emerged as the strongest predictor of CCF among PHIs. After adjusting for demographic factors, psychosocial risk remained a significant predictor ($\beta = 0.484$, $p < 0.001$, confidence interval [CI] [0.276, 0.627]), emphasizing its critical role in climate-related stress. Furthermore, marital status and working in urban environments were negatively associated with CCF ($\beta = -0.263$, $p = 0.017$, CI [-0.479, -0.047]), while working in rural environments was positively associated with CCF ($\beta = 0.0294$, $p = 0.031$, CI [0.027, 0.561]).

This suggests that PHIs in rural areas face distinct challenges related to the climate crisis and heat stress, validating H3: Workplace environment influences perceived

Table 3. Hierarchical regression analysis for climate crisis and heat stress

		Unstandardized regression coefficient B	Standardized regression coefficient β	p	95.0% CI	
					Lower	Upper
Model A: R^2 = 0.2841	(Risks factors-constant)	1.3021	-	0.001	0.915	1.6891
	CF (chemical)	-0.064	-0.077	0.354	-0.200	0.072
	BF (biological)	0.131	0.166	0.080	-0.016	0.278
	EPF (ergonomic & physical)	0.096	0.100	0.261	-0.072	0.263
	PVF (psychosocial & violence)	0.451	0.484	0.001	0.276	0.627
	OF (organizational)	-0.128	-0.149	0.088	-0.275	0.019
Model B: R^2 = 0.4491	(constant)	1.413	-	0.001	0.656	2.171
	CF (chemical)	-0.037	-0.044	0.570	-0.163	0.090
	BF (biological)	0.004	0.005	0.960	-0.143	0.151
	EPF (ergonomic & physical)	0.122	0.128	0.125	-0.034	0.279
	PVF (psychosocial & violence)	0.424	0.455	0.001	0.262	0.586
	OF (organizational)	-0.056	-0.065	0.447	-0.202	0.089
	Occupational experience (years)	0.003	0.038	0.611	-0.009	0.015
	Training quality	0.151	0.185	0.440	-0.214	0.269
	Training needs	0.124	-0.065	0.380	0.932	0.130
	Educational level	-0.060	-0.048	0.440	-0.214	0.094
	Urban workplace	-0.263	-0.184	0.017	-0.479	-0.047
	Rural workplace	0.0294	0.167	0.031	0.027	0.561

Table 4. Univariate analyses of job risks by workplace environment using Kruskal-Wallis test

Workplace environment	EPF (ergonomic & physical)	CF (chemical)	BF (biological)	CCF (climate crisis)	PVF (psychosocial & violence)	OF (organizational)
Urban environment						
Mean	2.2670	2.0088	2.5605	2.9189	2.7588	2.6781
Standard deviation	0.73717	0.82409	0.90195	0.73196	0.75563	0.83395
Median	2.3333	2.1429	2.7500	3.0000	2.8333	2.8125
Range	3.33	3.57	4.00	3.33	3.33	3.88
Provincial city (semi-urban)						
Mean	1.8889	1.7222	2.4514	2.7361	2.8264	2.4427
Standard deviation	0.77049	0.97097	0.89606	0.74149	0.65203	0.85113
Median	1.8333	2.0714	2.5833	2.8333	2.8750	2.5000
Range	3.33	3.43	3.33	3.17	3.25	3.06
Village-town (rural)						
Mean	1.7639	2.1706	3.1389	2.9815	2.8333	2.5590
Standard deviation	0.86316	0.70199	0.63870	0.71022	0.83023	0.68936
Median	2.0833	2.3571	3.2917	3.2500	3.0417	2.5625
Range	3.00	2.79	2.50	2.67	3.33	2.75
Kruskal-Wallis (χ^2)	11.925	4.480	14.826	2.466	0.415	3.134
p-value	0.003	0.106	0.001	0.291	0.813	0.209

job risks and biological hazards, with distinct patterns observed in urban and rural settings.

These findings support the hypotheses:

1. H1. Psychosocial risks significantly predict workplace biological hazards.
2. H3. Workplace environment influences perceived job risks and biological hazards, with distinct patterns observed in urban and rural settings.

The results of the Kruskal-Wallis test for workplace environment risks, presented in **Table 4**, reveal significant differences across urban, semi-urban, and rural settings. Urban environments recorded the highest climate crisis (CCF) risk scores, while rural environments showed significantly higher biological risk (BF) scores X^2 = 14.826 (p = 0.001, test statistics).

These findings highlight the variability of job risks based on workplace location. The results emphasize the unique challenges faced by PHIs in different environments, validating H3.1 and H3.2, which hypothesize that rural environments are associated with higher biological hazards and distinct workplace risks compared to urban environments.

These survey results support the hypotheses tested in this study, which aimed to examine the relationship between psychosocial risks, biological hazards, and workplace environment (urban vs. rural) for PHIs. The following results directly relate to the hypotheses outlined in the study:

H1. Increased levels of perceived psychosocial risk are associated with higher levels of biological hazards in the workplace environment.

The regression analysis results confirmed that psychosocial risk was a significant predictor of climate crisis-related heat stress ($\beta = 0.484$, $p < 0.001$, CI [0.276, 0.627]). This supports H1, indicating that as psychosocial risks increase, biological hazards in the workplace are perceived to be more severe, particularly in response to climate-related stressors.

H2. Increased levels of perceived overall job risk and environmental hazards are associated with greater biological hazards in the workplace.

The analysis showed that overall job risk and environmental hazards had a moderate positive relationship with biological hazards in the workplace (β = 0.294, p = 0.042, CI [0.046, 0.552]). This result supports H2, showing that higher levels of perceived job risk are associated with an increased perception of biological hazards related to climate change.

H2.1. The level of perceived job risk has a negative effect on psychosocial violence and organizational risk factors (factor 1).

The regression model for factor 1, which includes psychosocial violence and organizational risks, showed a negative association with overall job risk (β = -0.312, p = 0.021, CI [-0.556, -0.068]). This result supports H2.1, confirming that higher perceived job risks are associated with lower levels of psychosocial violence and organizational risk factors in the workplace.

H2.2. The level of the workplace environment associated with biological hazards has a negative effect on psychosocial violence and organizational risk factors (factor 1).

Further analysis showed that workplace environment (urban vs. rural) was significantly linked to psychosocial violence and organizational risks (β = -0.283, p = 0.038, CI [-0.527, -0.039]). The results support H2.2, demonstrating that the rural workplace environment, which is linked to higher biological hazards, is negatively associated with psychosocial violence and organizational risk factors.

H3. The workplace environment (rural or urban) affects perceived levels of job risk, biological hazards in the workplace, psychosocial violence, and organizational risk factors (factor 1).

As hypothesized, rural environments were associated with higher perceived levels of biological hazards (β = 0.325, p = 0.013, CI [0.089, 0.561]), while urban environments showed higher levels of psychosocial violence (β = -0.176, p = 0.045, CI [-0.348, -0.004]). This supports H3, confirming that the workplace environment significantly influences both biological hazards and psychosocial risks in urban vs. rural settings.

H3.1. Employees in rural environments perceive higher levels of biological risk compared to those in urban environments, due to the climate crisis and extreme weather events (factor 2).

Rural PHIs reported significantly higher biological risk scores related to climate-induced health hazards such as heat stress and flooding (p = 0.002). This result supports H3.1, confirming that rural workers are more vulnerable to biological risks arising from climate change.

H3.2. Employees in rural environments report higher levels of workplace biological hazards compared to those in urban environments, arising from the climate crisis and extreme weather events (factor 2).

Similarly, PHIs in rural environments reported higher levels of biological hazards linked to extreme weather events (β = 0.452, p = 0.017, CI [0.093, 0.811]), which supports H3.2.

H3.3. Employees in rural environments report lower levels of psychosocial violence and organizational risk factors than those in urban environments, linked to the climate crisis and extreme weather events (factor 1 and factor 2).

Interestingly, rural workers reported lower levels of psychosocial violence and organizational risk factors, despite the higher levels of biological hazards (β = -0.218, p = 0.039, CI [-0.410, -0.026]).

This result partially supports H3.3, suggesting that rural workers experience different psychosocial challenges compared to their urban counterparts, possibly due to different coping mechanisms or support structures in rural areas.

The Classification of Job Risk for Public Health Inspectors

The taxonomy of public health workforce roles has evolved globally, with supervision officers, PHIs, and environmental health inspectors united in their shared mission to safeguard public health through effective inspections (Adamopoulos et al., 2022; Ferrari et al., 2023; Tustin et al., 2019). Research highlights the diverse occupational hazards encountered by PHIs, stemming from the complex and multifaceted demands of their roles.

Studies by Adamopoulos et al. (2022, 2023) and Tustin et al. (2019) emphasize persistent safety challenges faced by PHIs, including exposure to toxic chemicals and the risks associated with working alone in the field.

PHIs also face biological, ergonomic, physical, and psychosocial hazards, often manifesting as incidents of aggression, harassment, and inadequate resources (Schulte et al., 2016; Tustin et al., 2019; Yang et al., 2019).

Chemical and biological hazards–such as inadequate ventilation, exposure to toxic agents, and poor workplace hygiene–remain significant threats to PHI occupational health (Elayan et al., 2021; EU-OSHA, 2021a, 2021b; Levy & Roelofs, 2019; Wirsching et al., 2021). Moreover, psychosocial risks, including excessive workloads, stress, workplace harassment, and corruption, further compound the challenges faced by PHIs (Adamopoulos et al., 2025c). Insufficient training and resource shortages often exacerbate these risks.

The European Agency for Safety and Health at Work categorizes occupational hazards into biological, chemical, ergonomic, psychosocial, and organizational risks, providing valuable frameworks for assessing and mitigating these risks (EU-OSHA, 2021a, 2021b, 2023; National Institute of Health, 2025; WHO, 2023).

Similarly, guidance from the National Institute of Health (2021) aids in managing chemical and biological risks, while Tuckey et al. (2012) emphasize the importance of addressing workplace violence and harassment (Fisher et al., 2021; Rahman et al., 2021; Tuckey et al., 2012; WHO, 2021a, 2021b).

This study proposes an integrated classification framework for these risks, as outlined in **Figure 5**. The framework aims to assist PHIs in identifying, assessing, and mitigating occupational hazards effectively, particularly in the context of climate-induced challenges.

The global climate crisis has introduced a critical exacerbating factor that complicates the assessment of environmental, psychosocial, and workplace hazards. Extreme weather events, heat stress, and natural disasters add additional burdens on PHIs, necessitating the development of innovative tools and strategies for effective risk mitigation.

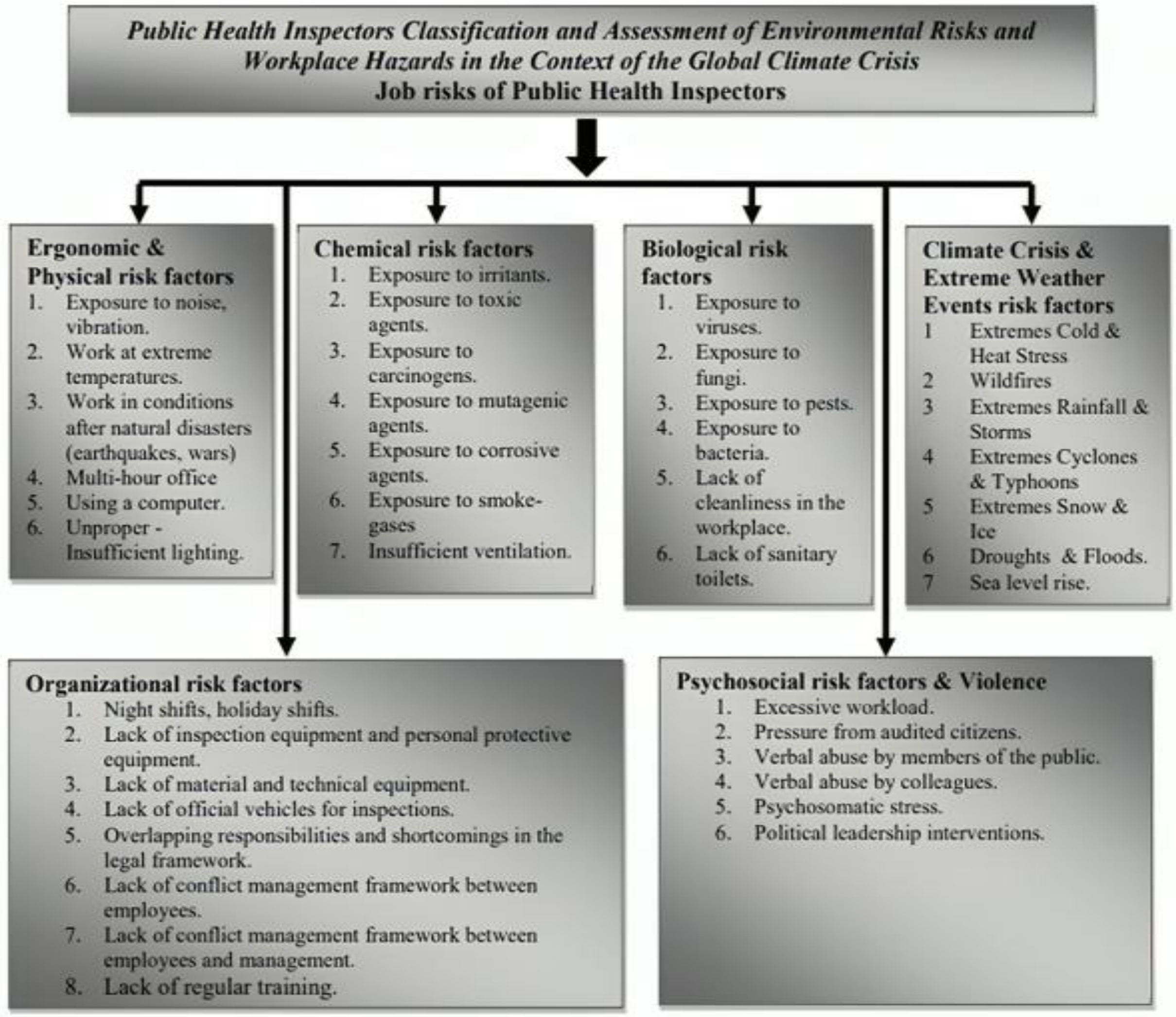

Figure 5. Schematic representation of the flow chart of the study: PHIs classification and assessment of environmental, psychosocial, and organizational risks and workplace hazards in the context of the global climate crisis (Source: Authors' own elaboration)

As illustrated in **Figure 6**, the job-related risks faced by PHIs are categorized into two primary factors: psychosocial violence and organizational risks (factor 1), and climate crisis and extreme weather-related risks (factor 2).

Notably, factor 1, which includes psychosocial violence and organizational risks, was excluded from the exploratory factor analysis (EFA) due to its focus on workplace dynamics and mental health challenges, which are distinct from the climate-related factors being analyzed.

Figure 6 presents the results of the EFA, highlighting these two major risk categories. In the study, Factor 1 represents psychosocial violence and organizational risks, such as excessive workload, workplace harassment, and inadequate conflict management systems.

These factors directly relate to the well-being challenges faced by PHIs. Factor 2, on the other hand, encompasses risks arising from the climate crisis, including heat stress, flooding, and other environmental hazards that are becoming increasingly prominent in the workplace due to changing climate conditions.

The analysis reveals a moderate correlation between these two factors, with a correlation coefficient of $r = 0.63$, suggesting an interaction between psychosocial/organizational risks and the environmental risks linked to climate change. The factor loadings for individual items in factor 1 range from 0.32 to 0.76, while for factor 2, they range from 0.42 to 0.74, indicating moderate to strong internal consistency within each category.

Figure 6 visually represents how job-related risks, including psychosocial violence (factor 1) and environmental risks (factor 2) arising from the climate crisis, are assessed and classified within the study framework.

This provides a clear illustration of the interplay between organizational and climate-related risks faced by PHIs in their work environment, as presented in the EFA model of the study.

Risk Factors Linked to Occupational Safety, Health, and Hygiene for PHIs

Risk factors related to enhancing occupational safety, health, and hygiene for PHIs involve classifying and evaluating environmental, psychosocial, and organizational risks, as well as workplace hazards in the context of the global climate crisis. **Figure 7** illustrates the research process, including how these risks are categorized and assessed. The study's research model and hypotheses are as follows:

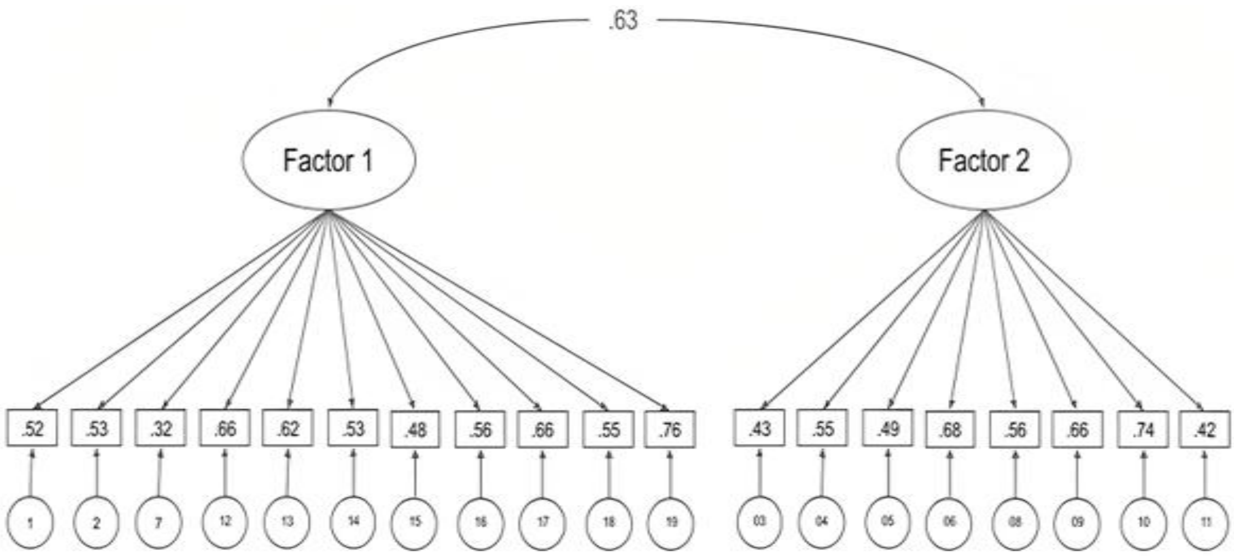

Figure 6. Job-related risks faced by PHIs, including psychosocial violence (factor 1), organizational risk factors (factor 1), and risks stemming from the climate crisis and extreme weather events (factor 2), as presented in the EFA model of the study (Source: Authors' own elaboration)

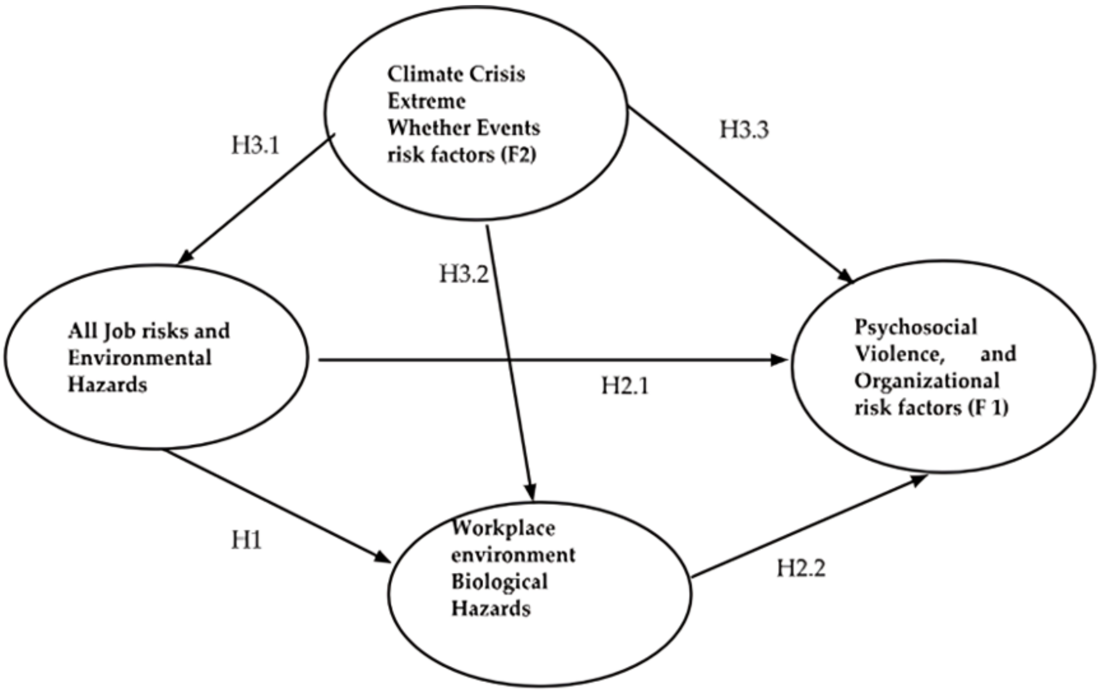

Figure 7. Research model and hypotheses of this study (Source: Authors' own elaboration)

H1. Increased levels of perceived psychosocial risk are associated with higher levels of biological hazards in the workplace environment.

H2. Increased levels of perceived overall job risk and environmental hazards are associated with greater biological hazards in the workplace.

H2.1: The level of perceived job risk negatively affects psychosocial violence and organizational risk factors (factor 1).

H2.2: The level of the workplace environment associated with biological hazards negatively affects psychosocial violence and organizational risk factors (factor 1).

H3. The workplace environment (rural or urban) affects perceived levels of job risk, biological hazards in the workplace, psychosocial violence, and organizational risk factors (factor 1).

H3.1: Employees in rural environments perceive higher levels of biological risk compared to those in urban environments, due to the climate crisis and extreme weather events (factor 2).

H3.2: Employees in rural environments report higher levels of workplace biological hazards compared to those in urban environments, arising from the climate crisis and extreme weather events (factor 2).

H3.3: Employees in rural environments report lower levels of psychosocial violence and organizational risk factors than those in urban environments, linked to the climate crisis and extreme weather events (factor 1 and factor 2).

DISCUSSION

The intersection of climate change and public health has garnered increasing attention in recent years, particularly regarding the role of PHIs in managing climate-induced risks and workplace hazards (Adamopoulos et al., 2022; EU-OSHA, 2021a, 2021b; Tustin et al., 2019; WHO, 2021a, 2021b). PHIs are tasked not only with managing illnesses caused by environmental risks but also with evaluating operational practices and ensuring environmental compliance in various settings, such as water wells, plants, and care facilities (Adamopoulos et al., 2023; Schulte & Chun, 2009; Tustin et al., 2019).

Existing literature emphasizes the growing need to understand how climate change influences OSH, as well as the broader public health implications (Flouris et al., 2018; Schulte et al., 2016; Stahl et al., 2024). Schulte et al. (2016) underscore the necessity for enhanced surveillance and risk assessment frameworks to manage climate-related occupational health hazards. Integrating climate change into occupational health frameworks is essential for improving health outcomes and implementing prevention measures (EU-OSHA, 2021a, 2021b; Watts et al., 2021). Therefore, integrating climate considerations into OSH frameworks is critical for protecting worker health (Ahmad et al., 2020; Ahmad et al., 2024; EU-OSHA, 2021a, 2021b). This study proposes practical tools and strategies to facilitate this integration, such as using climate-specific checklists to assess OSH hazards. These tools can improve PHIs' ability to classify and address risks posed by the climate crisis (EU-OSHA, 2023; Taylor & Henderson, 2022; WHO, 2023). The inclusion of climate crisis considerations in OSH frameworks also provides actionable recommendations to enhance public health and occupational safety (Adamopoulos et al., 2023; Marselle et al., 2022; Mora et al., 2022).

Workforce shortages and limited support exacerbate critical gaps in climate-related public health preparedness. A substantial proportion of PHIs (87%) reported feeling inadequately trained to address climate-related hazards, emphasizing the urgent need for updated training and resource allocation (Adamopoulos et al., 2023). Local governments must prioritize environmental health strategies by training PHIs to manage emerging risks and ensuring effective resource allocation (Jepson et al., 2022; Lemke & Kjellstrom, 2024; Tustin et al., 2019). This study contributes to the growing body of research by proposing practical tools and strategies to facilitate the integration of climate considerations into OSH frameworks. These tools can improve PHIs' ability to classify and address risks posed by the climate crisis, such as heat stress, extreme weather events, and emerging pathogens (EU-OSHA, 2023; Taylor & Henderson, 2022; WHO, 2023). In line with objective 1, our study highlights the urgent need for climate-specific guidelines and updated training programs to better prepare PHIs for climate-induced health risks.

Theoretical Implications

This study expands the understanding of public health and occupational health frameworks by integrating climate change as a central factor in the risk assessment process. Our findings propose an expanded role for PHIs in climate adaptation and mitigation strategies, with significant implications for public health policy. By incorporating climate-induced risks into occupational health models, the study offers new pathways for developing policy frameworks that are more resilient to climate change.

Practical Implications

The findings emphasize the need for practical tools, such as climate-specific checklists, to assess hazards and risks faced by PHIs. Moreover, interagency collaboration is critical for ensuring that PHIs are equipped with adequate resources to address these challenges. Policymakers must prioritize the development of targeted training programs, ensuring that resource allocation is streamlined to meet the emerging risks posed by climate change. This study highlights the importance of integrating climate change adaptation into public health infrastructure to safeguard worker health and public health systems.

Future Research

Future research should focus on the long-term impacts of climate-related hazards on PHIs and other frontline workers. Exploring predictive indicators and early warning systems could help guide preventive measures and improve workplace safety in response to climate-induced risks. Additionally, interdisciplinary studies on the integration of climate change into public health education and training frameworks would provide valuable insights for policymakers and practitioners. Future studies should also explore data-driven approaches to enhance the effectiveness of climate-specific risk assessments. Emphasis should also be placed on developing predictive indicators, early warning systems, and further integration of climate change into public health education and training frameworks to better prepare for future climate-related challenges.

CONCLUSION

The global climate crisis has significantly impacted both public and occupational health, exacerbating existing risks and introducing new challenges. This study investigates the growing complexities faced by PHIs in managing climate-related hazards, such as heat stress, extreme weather events, and emerging pathogens. The findings reveal that 87% of PHIs feel inadequately trained to address these climate-induced risks, and 79.42% report a lack of updated training programs as a critical barrier to effectively managing these emerging hazards. The lack of adequate resources further complicates PHIs' ability to respond to these challenges, emphasizing the urgent need for climate-specific guidelines and enhanced resource allocation. In response to the study's objectives, we identified several key contributions. The Theoretical contribution of this study extends existing theories on public and occupational health by integrating climate change as a central factor in risk assessment frameworks. It highlights the need for a more dynamic approach to risk classification, particularly in light of the climate crisis. The Practical contribution of the study provides actionable recommendations to strengthen the effectiveness of PHIs, including updated training programs, resource allocation, and climate-specific hazard assessment frameworks. These measures are vital for equipping PHIs with the tools necessary to manage emerging climate-related risks effectively. The study's findings underscore the need for policymakers to prioritize both public health and occupational health, ensuring that the systems in place are adaptable to the evolving risks posed by climate change. Integrating predictive indicators, early warning systems, and interagency collaboration will be crucial to safeguard public health in the face of these challenges.

Author contributions: IPA, NFS, DL, AV, JTK, PT, & GD: conceptualization, methodology, writing–original draft, and writing–review & editing; **IPA, NFS, DL, AV, JTK, & GD:** software; **IPA, NFS, JTK, & GD:** formal analysis; **IPA, NFS, JTK, & AV:** visualization; **IPA, DL, & GD:** investigation; **IPA, AV, & PT:** resources; **IPA & AV:** data curation; & **IPA:** validation, supervision, and project administration. All authors agreed with the results and conclusions.

Funding: No funding source is reported for this study.

Acknowledgments: The authors would like to thank the Editor-in-Chief, editors, and reviewers for their valuable feedback and insightful suggestions for improving this study.

Ethical statement: The authors stated that the study was approved by the Institutional Review Board and Ethics Committee of the Department of Public Health Policy, Sector of Occupational & Environmental Health, School of Public Health, University of West Attica. Written informed consents were obtained from the participants.

AI statement: The authors stated that they have not used any generative AI or AI-assisted technologies, including ChatGPT or any other similar services.

Declaration of interest: No conflict of interest is declared by the authors.

Data sharing statement: Data supporting the findings and conclusions are available upon request from corresponding author.

REFERENCES

Adamopoulos, I. P., Frantzana, A., & Syrou, N. F. (2024). Climate crises associated with epidemiological, environmental, and ecosystem effects of a storm: Flooding, landslides, and damage to urban and rural areas (extreme weather events of Storm Daniel in Thessaly, Greece). *Medical Sciences Forum, 25*(1), Article 7. https://doi.org/10.3390/msf2024025007

Adamopoulos, I. P., Lamnisos, D., Syrou, N. F., & Boustras, G. (2022). Public health and work safety pilot study: Inspection of job risks, burnout syndrome, and job satisfaction of public health inspectors in Greece. *Safety Science, 147*, Article 105592. https://doi.org/10.1016/j.ssci.2021.105592

Adamopoulos, I. P., Syrou, N. F., & Vito, D. (2025b). Climate change risks and impacts on public health correlated with air pollution–African dust in South Europe. *Medical Sciences Forum, 33*(1), Article 1. https://doi.org/10.3390/msf2025033001

Adamopoulos, I. P., Syrou, N. F., Lamnisos, D., & Boustras, G. (2023). Cross-sectional nationwide study in occupational safety and health: Inspection of job risks, burnout syndrome, and job satisfaction of public health inspectors during the COVID-19 pandemic in Greece. *Safety Science, 158*, Article 105960. https://doi.org/10.1016/j.ssci.2022.105960

Adamopoulos, I. P., Syrou, N. F., Mijwil, M., Thapa, P., Ali, G., & Dávid, L. D. (2025a). Quality of indoor air in educational institutions and adverse public health in Europe: A scoping review. *Electronic Journal of General Medicine, 22*(2), Article em632. https://doi.org/10.29333/ejgm/15962

Adamopoulos, I. P., Valamontes, A., Tsirkas, P., & Dounias, G., (2025c). Predicting workplace hazard, stress and burnout among public health inspectors: An AI-driven analysis in the context of climate change. *European Journal of Investigation in Health, Psychology and Education, 15*(5), Article 65. https://doi.org/10.3390/ejihpe15050065

Adam-Poupart, A., Smargiassi, A., Busque, M. A., Duguay, P., Fournier, M., Zayed, J., & Labrèche, F. (2015). Effect of summer outdoor temperatures on work-related injuries in Quebec (Canada). *Occupational and Environmental Medicine, 72*(5), 338-345. https://doi.org/10.1136/oemed-2014-102428

Ahmad, F., Ahmad, F. A., Alsayegh, A. A., Zeyaullah, AlShahrani, A. M., Muzammil, K., Saati, A. A., Wahab, S., Elbendary, E. Y., Kambal, N., Abdelrahman, M. H., & Hussain, S. (2024). Pesticides impacts on human health and the environment with their mechanisms of action and possible countermeasures. *Heliyon, 10*(7), Article e29128. https://doi.org/10.1016/j.heliyon.2024.e29128

Ahmad, Y. S., Hamid, A., Saif, S., & Mehmood, A. (2020). Assessment of health and safety risks in a textile industry. *Journal of Natural and Applied Sciences Pakistan, 2*(1), 350-369.

Aranda, M. P., Kremer, I. N., Hinton, L., Zissimopoulos, J., Whitmer, R. A., Hummel, C. H., Trejo, L., & Fabius, C. (2021). Impact of dementia: Health disparities, population trends, care interventions, and economic costs. *Journal of the American Geriatrics Society, 69*(7), 1774-1783. https://doi.org/10.1111/jgs.17345

Arksey H., & O'Malley, L. (2005). Scoping studies: Towards a methodological framework. *International Journal of Social Research Methodology, 8*(1), 19-32. https://doi.org/10.1080/1364557032000119616

Barron, G. C., Laryea-Adjei, G., Vike-Freiberga, V., Abubakar, I., Dakkak, H., Devakumar, D., Johnsson, A., Karabey, S., Labonté, R., Legido-Quigley, H., Lloyd-Sherlock, P., Olufadewa, I. I., Ray, H. C., Redlener, I., Redlener, K., Serageldin, I., Lima, N. T., Viana, V., Zappone, K., … Lancet Commission on COVID-19: Task Force on Humanitarian Relief, Social Protection and Vulnerable Groups. (2022). Safeguarding people living in vulnerable conditions in the COVID-19 era through universal health coverage and social protection. *The Lancet: Public Health, 7*(1), e86-e92. https://doi.org/10.1016/S2468-2667(21)00235-8

Beck, J. E., Chang, K. M., Mostow, J., & Corbett, A. (2008). Does help help? Introducing the Bayesian evaluation and assessment methodology. In B. P. Woolf, E. Aïmeur, R. Nkambou, & S. Lajoie (Eds.), *Intelligent tutoring systems. ITS 2008. Lecture notes in computer science, vol 5091* (pp. 383-394). Springer. https://doi.org/10.1007/978-3-540-69132-7_42

Burton, D., & Burton, D. (2000). *Secondary data analysis*. SAGE. https://doi.org/10.4135/9780857028051.d34

Dale, A., Wathan, J., & Higgins, V. (2008). The secondary analysis of quantitative data sources. In P. Alasuutari, L. Bickman, & J. Brannen (Eds.), *The SAGE handbook of social research methods* (pp. 520-535). SAGE. https://doi.org/10.4135/9781446212165.n31

Dimitroulopoulou, S., Dudzińska, M. R., Gunnarsen, L., Hägerhed, L., Maula, H., Singh, R., Toyinbo, O., & Haverinen-Shaughnessy, U. (2023). Indoor air quality guidelines from across the world: An appraisal considering energy saving, health, productivity, and comfort. *Environment International, 178*, Article 108127. https://doi.org/10.1016/j.envint.2023.108127

Elayan, H., Aloqaily, M., & Guizani, M. (2021). Digital twin for intelligent context-aware IoT healthcare systems. *IEEE Internet of Things Journal, 8*(23), 16749-16757. https://doi.org/10.1109/JIOT.2021.3051158

Esmaeilzadeh, P. (2020). Use of AI-based tools for healthcare purposes: A survey study from consumers' perspectives. *BMC Medical Informatics and Decision Making, 20*, Article 170. https://doi.org/10.1186/s12911-020-01191-1

EU-OSHA. (2021a). *Climate change and workplace hazards: A policy framework for Europe*. EU-OSHA. https://climate-adapt.eea.europa.eu/en/metadata/organisations/european-agency-for-safety-and-health-at-work-eu-osha

EU-OSHA. (2021b). *Policy brief: Impact of climate change on occupational safety and health*. EU-OSHA. https://oshwiki.osha.europa.eu/en/themes/climate-change-impact-occupational-safety-and-health-osh

EU-OSHA. (2023). *The intersection of workplace safety and sustainability in Europe*. EU-OSHA. https://osha.europa.eu/en/about-eu-osha

Ferrari, G. N., Leal, G. C. L., Thom de Souza, R. C., & Galdamez, E. V. C. (2023). Impact of climate change on occupational health and safety: A review of methodological approaches. *WORK, 74*(2), 485-499. https://doi.org/10.3233/WOR-211303

Fisher, M. C., Alastruey-Izquierdo, A., Berman, J., Bicanic, T., Bignell, E. M., Bowyer, P., Bromley, M., Brüggemann, R., Garber, G., Cornely, O. A., Gurr, S. J., Harrison, T. S., Kuijper, E., Rhodes, J., Sheppard, D. C., Warris, A., White, P. L., Xu, J., Zwaan, B., & Verweij, P. E. (2022). Tackling the emerging threat of antifungal resistance to human health. *Nature Reviews: Microbiology, 20*(9), 557-571. https://doi.org/10.1038/s41579-022-00720-1

Flouris, A. D., Dinas, P. C., Ioannou, L. G., Nybo, L., Havenith, G., Kenny, G. P., & Kjellstrom, T. (2018). Workers' health and productivity under occupational heat strain: A systematic review and meta-analysis. *The Lancet: Planetary Health, 2*(12), e521-e531. https://doi.org/10.1016/S2542-5196(18)30237-7

Gasser, U., Ienca, M., Scheibner, J., Sleigh, J., & Vayena, E. (2020). Digital tools against COVID-19: Taxonomy, ethical challenges, and navigation aid. *The Lancet: Digital Health, 2*(8), e425-e434. https://doi.org/10.1016/S2589-7500(20)30137-0

Gilmore, A. B., Fabbri, A., Baum, F., Bertscher, A., Bondy, K., Chang, H. J., Demaio, S., Erzse, A., Freudenberg, N., Friel, S., Hofman, K. J., Johns, P., Abdool Karim, S., Lacy-Nichols, J., de Carvalho, C. M. P., Marten, R., McKee, M., Petticrew, M., Robertson, L., … Thow, A. M. (2023). Defining and conceptualising the commercial determinants of health. *The Lancet, 401*(10383), 1194-1213. https://doi.org/10.1016/S0140-6736(23)00013-2

Hallioui, A., Herrou, B., Polinpapilinho, F. K., Santos, R. S., Egbue, O., Jasiulewicz-Kaczmarek, M., Soares, J. M., & Marques, P. C. (2023). A review of sustainable total productive maintenance (STPM). *Sustainability, 15*(16), Article 12362. https://doi.org/10.3390/su151612362

Hegedűs, M., Szivós, E., Adamopoulus, I. P., & Dávid, L. D. (2024). Hospital integration to improve the chances of recovery for decubitus (pressure ulcer) patients through centralised procurement procedures. *Journal of Infrastructure, Policy and Development, 8*(10), Article 7273. https://doi.org/10.24294/jipd.v8i10.7273

Henderson, J., Ward, P. R., Tonkin, E., Meyer, S. B., Pillen, H., McCullum, D., Toson, B., Webb, T., Coveney, J., & Wilson, A. (2020). Developing and maintaining public trust during and post-COVID-19: Can we apply a model developed for responding to food scares? *Frontiers in Public Health, 8*. https://doi.org/10.3389/fpubh.2020.00369

ILO. (2022). Workplace safety standards in the age of climate change. *ILO Global Reports, 21*(7), 540-560.

ILO. (2024). *Ensuring safety and health at work in a changing climate*. International Labour Organization. https://www.ilo.org/publications/report-glance-ensuring-safety-and-health-work-changing-climate

Jepson, P. C., Murray, K., Bach, O., Bonilla, M. A., & Neumeister, L. (2020). Selection of pesticides to reduce human and environmental health risks: A global guideline and minimum pesticides list. *The Lancet: Planetary Health, 4*(2), e56-e63. https://doi.org/10.1016/S2542-5196(19)30266-9

Karimi-Maleh, H., Ghalkhani, M., Dehkordi, Z. S., Singh, J., Wen, Y., Baghayeri, M., Rouhi, J., & Rajendran, S. (2024). MOF-enabled pesticides as a developing approach for sustainable agriculture and reducing environmental hazards. *Journal of Industrial and Engineering Chemistry, 129*, 105-123. https://doi.org/10.1016/j.jiec.2023.08.044

Lemke, B., & Kjellstrom, T. (2012). Calculating workplace WBGT from meteorological data: A tool for climate change assessment. *Industrial Health, 50*(4), 267-278. https://doi.org/10.2486/indhealth.ms1352

Levy, B. S., & Roelofs, C. (2019). Impacts of climate change on workers' health and safety. *Oxford Research Encyclopedia of Global Public Health*. https://doi.org/10.1093/acrefore/9780190632366.013.39

Mannan, M., & Al-Ghamdi, S. (2021). Indoor air quality in buildings: A comprehensive review on the factors influencing air pollution in residential and commercial structures. *International Journal of Environmental Research and Public Health, 18*(6), Article 3276. https://doi.org/10.3390/ijerph18063276

Marinaccio, A., Gariazzo, C., Taiano, L., Bonafede, M., Martini, D., D'Amario, S., de'Donato, F., Morabito, M., & Worklimate Working Group. (2025). Climate change and occupational health and safety. Risk of injuries, productivity loss and the co-benefits perspective. *Environmental Research, 269*, Article 120844. https://doi.org/10.1016/j.envres.2025.120844

Marselle, M. R., Hartig, T., Cox, D. T. C., de Bell, S., Knapp, S., Lindley, S., Triguero-Mas, M., Böhning-Gaese, K., Braubach, M., Cook, P. A., de Vries, S., Heintz-Buschart, A., Hofmann, M., Irvine, K. N., Kabisch, N., Kolek, F., Kraemer, R., Markevych, I., Martens, D., ... Bonn, A. (2021). Pathways linking biodiversity to human health: A conceptual framework. *Environment International, 150*, Article 106420. https://doi.org/10.1016/j.envint.2021.106420

McGuinness, L. A., & Higgins, J. P. T. (2020). Risk-of-bias VISualization (robvis): An R package and Shiny web app for visualizing risk-of-bias assessments. *Research Synthesis Methods, 12*(1), 55-61. https://doi.org/10.1002/jrsm.1411

Mora, C., McKenzie, T., Gaw, I. M., Dean, J. M., von Hammerstein, H., Knudson, T. A., Setter, R. O., Smith, C. Z., Webster, K. M., Patz, J. A., & Franklin, E. C. (2022). Over half of known human pathogenic diseases can be aggravated by climate change. *Nature Climate Change, 12*(9), 869-875. https://doi.org/10.1038/s41558-022-01426-1

Munn, Z., Peters, M. D., Stern, C., Tufanaru, C., McArthur, A., & Aromataris, E. (2018). Systematic review or scoping review? Guidance for authors when choosing between a systematic or scoping review approach. *BMC Medical Research Methodology, 18*(1), Article 143. https://doi.org/10.1186/s12874-018-0611-x

National Institute of Health. (2021). *Climate change and health: A global perspective*. National Institute of Health; 2021. https://www.niehs.nih.gov/newsreleases/nihs-climate-and-health-initiative-tackles-global-health-effects-associated-with-a-changing-climate

National Institute of Health. (2025). *A research agenda to protect human health and build resilience in the face of a changing climate*. National Academies Press. https://doi.org/10.17226/28669

Page, L. A., & Howard, L. M. (2010). The impact of climate change on mental health (but will mental health be discussed at Copenhagen?). *Psychological Medicine, 40*(2), 177-180. https://doi.org/10.1017/S0033291709992169

Page, M. J., McKenzie, J. E., Bossuyt, P. M., Boutron, I., Hoffmann, T. C., Mulrow, C. D., Shamseer, L., Tetzlaff, J. M., Akl, E. A., Brennan, S. E., Chou, R., Glanville, J., Grimshaw, J. M., Hrobjartsson, A., Lalu, M. M., Li, T., Loder, E. W., Mayo-Wilson, E., McDonald, S., ... Moher, D. (2021). The PRISMA 2020 statement: An updated guideline for reporting systematic reviews. *BMJ, 372*, Article n71. https://doi.org/10.1136/bmj.n71

Rahman, A., Hamdani, S. U., Awan, N. R., Bryant, R. A., Dawson, K. S., Khan, M. F., Azeemi, M. M., Akhtar, P., Nazir, H., Chiumento, A., Sijbrandij, M., Wang, D., Farooq, S., & van Ommeren, M. (2021). Effect of a multicomponent behavioral intervention in adults impaired by psychological distress in a conflict-affected area of Pakistan: A randomized clinical trial. *JAMA, 316*(24), 2609-2617. https://doi.org/10.1001/jama.2016.17165

Raihan, A. (2023). A comprehensive review of the recent advancement in integrating deep learning with geographic information systems. *Research Briefs on Information and Communication Technology Evolution, 9*, 98-115. https://doi.org/10.56801/rebicte.v9i.160

Ramos, D., Afonso, P., & Rodrigues, M. A. (2020). Integrated management systems as a key facilitator of occupational health and safety risk management: A case study in a medium-sized waste management firm. *Journal of Cleaner Production, 262*, Article 121346. https://doi.org/10.1016/j.jclepro.2020.121346

Schulte, P. A., & Chun, H. (2009). Climate change and occupational safety and health: Establishing a preliminary framework. *Journal of Occupational and Environmental Hygiene, 6*(9), 542-554. https://doi.org/10.1080/15459620903066008

Schulte, P. A., Bhattacharya, A., Butler, C. R., Chun, H. K., Jacklitsch, B., Jacobs, T., Kiefer, M., Lincoln, J., Pendergrass, S., Shire, J., Watson, J., & Wagner, G. R. (2016). Advancing the framework for considering the effects of climate change on worker safety and health. *Journal of Occupational and Environmental Hygiene, 13*(11), 847-865. https://doi.org/10.1080/15459624.2016.1179388

Sharma, P., Adamopoulos, I. P., Syrou, N. F., Budhathoki, C. B., & Thapa, P. P. (2025). The impact of health-caregivers' emotional nurturance on cognitive development in preschoolers: A nationwide public health cross-sectional study. *Electronic Journal of General Medicine, 22*(3), Article em643. https://doi.org/10.29333/ejgm/16184

Stahl, R. G., Boxall, A. B. A., Brix, K. V., Landis, W. G., Stauber, J. L., & Moe, S. J. (2024). Incorporating climate change model projections into ecological risk assessments to help inform risk management and adaptation strategies: Synthesis of a SETAC Pellston Workshop®. *Integrated Environmental Assessment and Management, 20*(2), 359-366. https://doi.org/10.1002/ieam.4883

Taylor, A., & Henderson, J. (2022). Lessons learned from telehealth adoption during COVID-19: Future implications for public health systems. *Public Health Policy Review, 24*(3), 180-192. https://doi.org/10.1089/tmr.2023.0001

Taylor, A., Caffery, L. J., Gesesew, H. A., King, A., Bassal, A. R., Ford, K., Kealey, J., Maeder, A., McGuirk, M., Parkes, D., & Ward, P. R. (2021). How Australian health care services adapted to telehealth during the COVID-19 pandemic: A survey of telehealth professionals. *Frontiers in Public Health, 9*. https://doi.org/10.3389/fpubh.2021.648009

Tuckey, M. R., Winwood, P. C., & Dollard, M. F. (2011). Psychosocial culture and pathways to psychological injury within policing. *Police Practice and Research, 13*(3), 224-240. https://doi.org/10.1080/15614263.2011.574072

Tustin, J., Hau, J., & Hon, C. (2019). Occupational health and safety hazards encountered by Ontario public health inspectors. *Environmental Health Review, 62*(1), 14-19. https://doi.org/10.5864/d2019-004

Viegas, S., Santos, J. A., Kazmierczak, A., Assunção, R., Viegas, C., & Martins, C. (2023). Training on the impact of climate change on public health: Reflections and lessons learnt. *Portuguese Journal of Public Health, 41*(3), 230-234. https://doi.org/10.1159/000533973

Watts, N., Amann, M., Arnell, N., Ayeb-Karlsson, S., Beagley, J., Belesova, K., Boykoff, M., Byass, P., Cai, W., Campbell-Lendrum, D., Capstick, S., Chambers, J., Coleman, S., Dalin, C., Daly, M., Dasandi, N., Dasgupta, S., Davies, M., ... Costello, A. (2021). The 2020 report of the Lancet Countdown on health and climate change: Responding to converging crises. *Lancet, 397*(10269), 129-170. https://doi.org/10.1016/S0140-6736(20)32290-X

WHO. (2021a). *Climate change and health: A global perspective*. World Health Organization; 2021. https://www.who.int/news-room/fact-sheets/detail/climate-change-and-health

WHO. (2021b). *Health and climate: A shared responsibility*. World Health Organization; 2021. https://iris.who.int/bitstream/handle/10665/348068/9789240038509-eng.pdf

WHO. (2023). *Building sustainable public health systems: Lessons from global climate crises*. World Health Organization; 2023. https://www.who.int/news/item/24-05-2023-wha76-strategic-roundtable-on-health-and-climate

Williams, D. R., & Mohammed, S. A. (2013). Racism and health I: Pathways and scientific evidence. *The American Behavioral Scientist, 57*(8). https://doi.org/10.1177/0002764213487340

Winwood, P. C., Colon, R., & McEwen, K. (2013). A practical measure of workplace resilience: Developing the resilience at work scale. *Journal of Occupational and Environmental Medicine, 55*(10), 1205-1212. https://doi.org/10.1097/JOM.0b013e3182a2a60a

Wirsching, J., Graßmann, S., Eichelmann, F., Harms, L. M., Schenk, M., Barth, E., Berndzen, A., Olalekan, M., Sarmini, L., Zuberer, H., & Aleksandrova, K. (2018). Development and reliability assessment of a new quality appraisal tool for cross-sectional studies using biomarker data (BIOCROSS). *BMC Medical Research Methodology, 18*(1), Article 122. https://doi.org/10.1186/s12874-018-0583-x

Yang, L., Liu, C., Hess, J., Phung, D., & Huang, C. (2019). Health professionals in a changing climate: Protocol for a scoping review. *BMJ Open, 9*(2), Article e024451. https://doi.org/10.1136/bmjopen-2018-024451