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HEALTH IMPACTS OF CLIMATE CHANGE ON PRECARIOUS OUTDOOR WORKERS IN URBAN ASIA:

A Systematic Review of Vietnamese-Language and Vietnam-Based Studies



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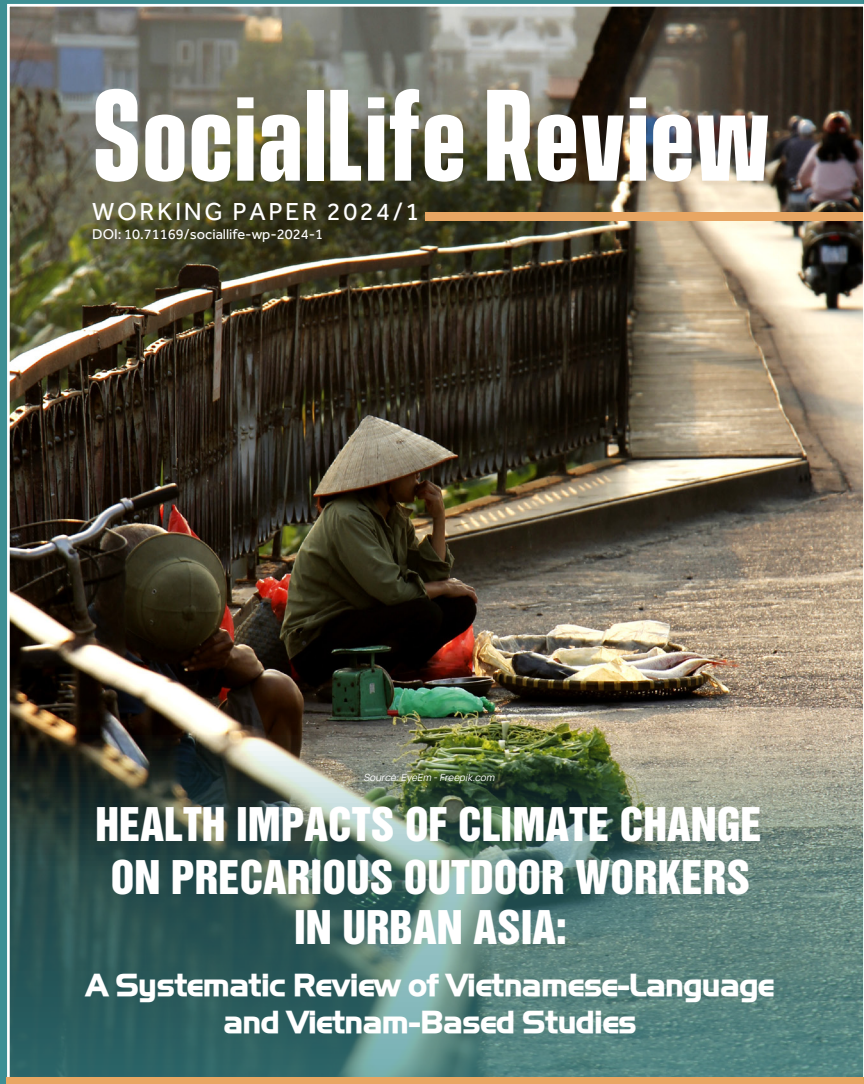
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HEALTH IMPACTS

OF CLIMATE CHANGE ON PRECARIOUS OUTDOOR WORKERS IN URBAN ASIA:

A Systematic Review of Vietnamese-Language and Vietnam-Based Studies

WRITTEN BY

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SUMMARY

Climate change poses increasingly severe challenges to nations worldwide, with developing countries being the most vulnerable due to their lack of socio-economic resources for adaptation. When discussing climate change adaptation, outdoor workers, who are directly exposed to abnormal weather phenomena in their daily work, are the most vulnerable group in terms of health impacts.

This working paper presents a systematic review of Vietnam-based literature on the health impacts of climate change on urban outdoor workers in Asia. By synthesising empirical evidence from Vietnam and comparing it with a parallel study of English-language research, we aim to identify potential gaps in the English-language literature regarding health impacts on

precarious outdoor workers in Vietnamese megacities.

Our search yielded four peer-reviewed articles and four doctoral dissertations studying the health effects of weather and climate change on outdoor workers. Seven of these were in Vietnamese language, and one was in English language published in a Vietnam-based journal. Despite expanding our search string to include publications across Asia, all eight studies we found focused on Vietnam.

Our systematic review revealed that heat stress and air pollution emerged as the main climate-related health concerns for outdoor workers, causing heat exhaustion, heatstroke, and respiratory diseases. We found no comparative evidence on health vulnerabilities across different outdoor occupations, with studies largely examining formal sector workers and only one addressing informal workers. There was limited research on workers' adaptation strategies to extreme weather. Studies focused on employer-provided protective equipment, while individual coping mechanisms and government social support, particularly for informal workers, received little attention.

This working paper contributes to the broader understanding of climate change impacts on vulnerable populations and highlights the importance of considering diverse linguistic and geographical perspectives in climate change research.

Keywords: _____

Climate change;
Health impact;
Outdoor workers;
Urban Asia;
Vietnam;
Systematic review.

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Source: Quang Huy



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INTRODUCTION

SOCIALLIFE REVIEW

Climate change has emerged as one of the most significant challenges to global public health. According to the latest report from the Intergovernmental Panel on Climate Change, the average global temperature has increased by 1.1°C since pre-industrial times. This rise in temperature is associated with an increase in extreme weather events such as heat waves, droughts, floods, and major storms, which pose risks to human health and socio-economic systems (IPCC, 2022). The impacts of climate change on health are not only direct but also indirect, presenting a significant challenge for countries worldwide.





As climate change intensifies, evidence-based interventions to build resilience and protect vulnerable populations are becoming increasingly urgent. Asian countries, including Vietnam, face the dual challenge of mitigating climate change to slow the global temperature rise while also adapting to minimise the harm from current and future impacts of climate change. Prioritising the health and livelihoods of vulnerable groups is essential for developing robust pathways to cope with climate change (Le, Le, & Nguyen, 2018).

Outdoor workers bear the brunt of climate change's extreme weather events, enduring direct exposure to sunlight, rain, wind, and fluctuating temperatures, which escalate health risks such as respiratory, gastrointestinal, and dermatological illnesses. Moreover, natural disasters like floods compound their economic hardships by disrupting income and job stability (UNDP, 2016).

The large majority of systematic reviews focus on English language sources. A study of 250 systematic reviews by Jackson and Kuriyama (2019) revealed a stark pattern: a third explicitly excluded non-English articles, another third implicitly omitted them despite no explicit exclusion, and the remaining third claimed no language restrictions but in reality included non-English studies in only a fraction of cases.

Interestingly, among the reviews that purportedly included non-English sources, a mere two per cent of the total systematic reviews actually incorporated such literature (Jackson and Kuriyama, 2019). This disparity reveals a persistent bias in database coverage, systematically excluding journals "from certain countries and/or in certain languages" (Pilkington et al., 2005, p. 207).

There is often an implicit assumption that surveying non-English language literature will yield findings similar to those from English or Latin-script sources. In this review, we challenge that assumption by conducting a parallel analysis alongside an English-language SER to critically assess whether and how the Vietnamese-language literature diverges in terms of the themes it addresses or the relative importance of those themes.

Similar to the English-language SER, this review systematically compiles evidence on the health impacts of climate change and extreme weather events on outdoor workers in urban Asia, but solely using Vietnamese database. This SER represents the first comprehensive evaluation of Vietnamese-language and Vietnam-based resources, offering critical insights into the health effects of climate change on outdoor workers in urban Asian contexts. It forms part of our 30-month research project that specifically investigates how climate change affects the health, livelihoods, and working conditions of precarious workers in Vietnam's mega-cities.

One of the project's key objectives is to develop a technological application integrating Geographic Information Systems (GIS) with early warning features for extreme weather events, thereby aiding outdoor workers in responding to and adapting to the health risks posed by climate change in a timely manner. The paper concludes by proposing an analytical framework, derived from the key findings of this SER, which will guide future research and policy interventions in this area.

PROTOCOL FOR SYSTEMATIC REVIEW

SOCIALLIFE REVIEW

This systematic review examines the impacts of climate change and extreme weather events on outdoor workers' health in urban Asia, with a particular focus on Vietnamese research articles and Vietnam-based English publications. The review addresses four key research questions:

1. Which extreme weather events affect the health of outdoor workers in urban Asia?
2. What are the specific health impacts of climate change and extreme weather events on this workforce?
3. Which types of outdoor work and groups of workers are most vulnerable?
4. What coping and adaptation strategies have these workers adopted in response to climate change?

The review followed a structured five-phase methodological approach:



Development of comprehensive search strings incorporating both English and Vietnamese keywords across six main filters: Climate, Health, Employment, Society, Urban areas, and Asia;



(v)

Systematic data extraction.

(iv)

Full database search and screening;

(iii)

Pilot search and identification process;

(ii)

Establishment of detailed inclusion and exclusion criteria;

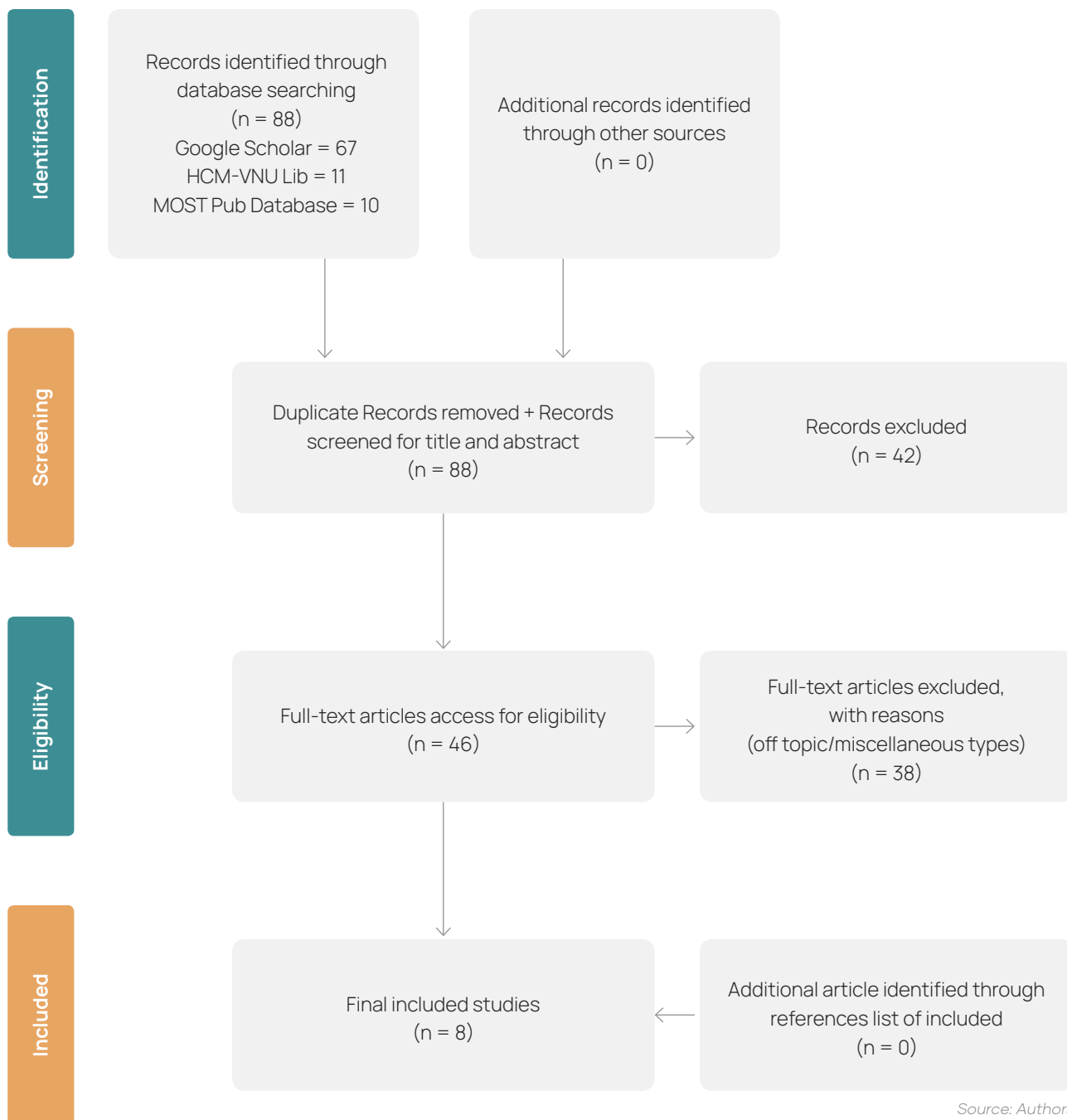
PROTOCOL FOR SYSTEMATIC REVIEW

The search was conducted across three primary Vietnamese academic databases: EBSCO Discovery Service of the Central Library (HCM VNU Lib), National Database on Science and Technology (MOST Pub Database), and Google Scholar, supplemented by additional sources including the Vietnam Medical Journal. The review identified 88 initial works, which were subsequently filtered to eight documents including four journal articles and four doctoral dissertations based on rigorous inclusion criteria (see Figure 1).



Source: Quang Huy

Figure 1. Flow diagram of screening process of included studies on the impacts of climate change on Asian urban outdoor workers’s health



The complete methodological approach, including detailed search strings, inclusion/exclusion criteria, database-specific search strategies, the full database search and screening and data extraction is presented in the appendix.

KEY FINDINGS

SOCIALLIFE REVIEW

The search results indicate that Vietnamese studies and English studies published on Vietnam-based journals are primarily geographically confined to Vietnam, rather than covering multiple countries in Asia. None of the evidence extended their research scope beyond Vietnam, despite our use of keywords related to the broader Asian region in the search strings (see Table 3). As a result, the findings will primarily reflect insights pertinent to Vietnam, including its unique challenges, policies, governance, and cultural context.

To begin this section, we reflect on the word cloud (see Figure 2) generated from the analysis of all reviewed papers. After translating the collected Vietnamese data into English and analysing the frequency of keyword occurrences using Nvivo qualitative analysis software, we observed several key trends.

The analysis revealed that the most frequently occurring keywords were 'workers' (2.40%) and 'health' (1.52%), indicating a strong focus on these core subjects. Other common but less informative terms included 'years' (1.25%), 'working' (1.21%), and 'work' (0.85%). Notably, the keyword 'factors' appeared with a frequency of 0.72%, highlighting that many studies concentrate on factor analysis, particularly on how weather and climate variables impact the health of outdoor workers in urban Vietnam.



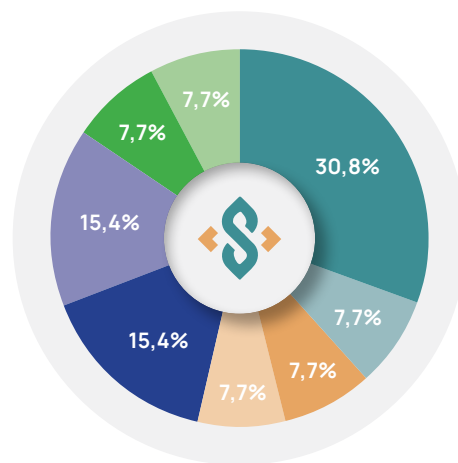
KEY FINDINGS

From Vietnam's scope to northern slope: the geographical imbalance of Vietnam studies

The studies on the impacts of climate change on the health of outdoor workers in urban Vietnam are distributed across 13 localities, with a notable concentration in the northern region, followed by the southern and central regions. In the north, Hanoi is the most frequently studied city, with four articles (Trien, 2014; Ha, 2021; Anh, 2021; Ninh, Dung, & Nhung, 2024), followed by Lang Son (Anh, 2021), Quang Ninh (Hanh, 2021), Thai Nguyen (Hanh, 2021), and Hai Phong (Nga et al., 2016; Anh, 2021). In the southern region, research focused on Ho Chi Minh City (Anh, 2021; Chau, Luan, & Tuan, 2021), Can Tho (Anh, 2021), and Long An (Suong & Thien, 2024). The central region had comparatively less coverage, with Da Nang and Dak Lak each represented by only one study (Anh, 2021) (see Figure 3). This distribution reflects the urban population density in Vietnam, with Hanoi and Ho Chi Minh City being the primary focal points of urban research due to their dominance in the urban hierarchy.

Figure 3.
Geographical distribution of identified studies

● Ha Noi ● Lang Son ● Quang Ninh ● Thai Nguyen ● Hai Phong
● Ho Chi Minh City ● Can Tho ● Long An



Source: Authors

Methodological variation: Predominant use of cross-sectional descriptive methods and quantitative approaches

Most of the studies employed a cross-sectional descriptive method with a purely quantitative approach using primary data (Nga, et al., 2016; Hanh, 2021; Ninh, Dung, & Nhung, 2024; Trien, 2014; Chau, Luan, & Tuan, 2021; Suong & Thien, 2024). A cross-sectional study is designed to collect data from a representative sample of a population at a specific point in time. This method is used to describe the characteristics of a population or phenomenon at one specific time without intervening in the process (Setia, 2023).

Among these quantitative cross-sectional studies, two mentioned the use of qualitative methods. However, we did not find qualitative data collection techniques (in-depth interviews and focus group discussions) detailed in the methodology and results sections (Chau, Luan, & Tuan, 2021; Suong & Thien, 2024). Additionally, there was one quasi-experimental study that used both quantitative and qualitative methods, including in-depth interviews and focus group discussions (Ha, 2021).

One study on outdoor workers, specifically traffic police officers, combined a cross-sectional descriptive method with a retrospective study. This approach collected both primary data and secondary data previously gathered, specifically data from the Ministry of Public Security's basic investigation project on the health, diseases, and specific working conditions of police officers (Anh, 2021).

Overall, most studies approached the topic from a medical or public health perspective, with limited interdisciplinary engagement, particularly from anthropology and sociology, which focus on the human subjects of the research.

When risks intersect: The vulnerabilities of outdoor work

The studies reveal that the primary environmental stressors impacting the health of outdoor workers in urban Vietnam are high temperatures and heat radiation (Trien, 2014; Nga et al., 2016; Hanh, 2021; Anh, 2021). This emphasis on heat is particularly noteworthy given that most research was conducted in northern Vietnam, including midland and mountainous regions like Lang Son and Thai Nguyen, which generally experience lower average annual temperatures compared to the southern provinces.

For instance, Hanh's (2021) study on steel rollers, welders, and coke oven workers in Quang Ninh and Thai Nguyen highlights that these workers endure high levels of heat and potential ultraviolet radiation while working outdoors. Similarly, Anh's (2021) research on traffic police officers across Northern, Central, and Southern Vietnam shows these officers are exposed to significantly higher temperatures during their duties than those reported by meteorological stations, with ground temperatures often reaching 50 degrees Celsius or higher during summer months.

In contrast, cold or extremely cold weather conditions are less frequently mentioned, with only two studies, both focusing on Hanoi (Trien, 2014; Ha, 2021). According to Trien (2014), most construction stages of the Nhat Tan bridge in Hanoi are performed outdoors under hot summer and cold winter conditions which are frequent working environment of Nhat Tan Bridge constructing workers. Ha's (2021) study highlights that extremely cold weather is one of the main causes of musculoskeletal disorders among solid waste collection workers in Hanoi.

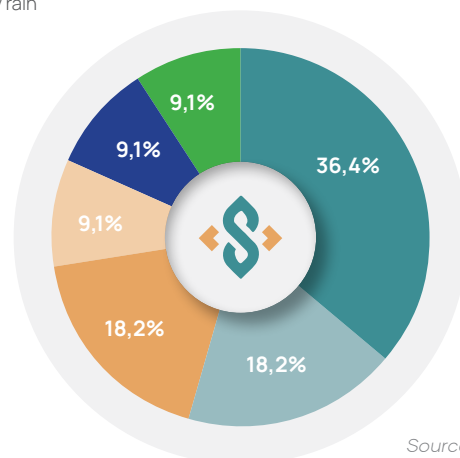


Source: Thanh Tung

Additionally, other environmental impacts on the health of outdoor workers include air pollution (Ninh, Dung, & Nhung, 2024; Anh, 2021), noise pollution (Ninh, Dung, & Nhung, 2024), bad weather in general (Suong & Thien, 2024), and heavy rain (Chau, Luan, & Tuan, 2021) (see Figure 4). Anh (2021) states that air pollution poses a significant environmental health risk, particularly in developing countries where motorcycles are the primary mode of transportation and industrialisation is rapidly increasing. This is also an environmental issue that traffic police officers frequently face while working (Anh, 2021). Also, Ninh, Dung, and Nhung's (2024) research on workers at the Thanh Tri Power Company in Hanoi reveals that working in the power industry demands high-intensity labour under harsh weather conditions and in dusty and noisy environments. Meanwhile, Suong and Thien's (2024) study on the job quality of workers at the Long An Power Company only mentions adverse weather conditions in general as a stress factor for workers (Suong & Thien, 2024, p. 27). Chau, Luan, and Tuan's (2021) work briefly discusses the health impacts on families engaged in fishing and aquaculture in Can Gio, noting that during the rainy season, households engaged in farming clams, snails, bottom fishing, and cage fish farming experience illness rates exceeding 90 per cent.

Figure 4. Types and forms of extreme weather distribution of identified studies

- Heat-related phenomenon
- Cold and extreme cold weather
- Air pollution
- Noise Pollution
- Bad weather in general
- Heavy rain



Source: Authors

The identified studies have explored various aspects of outdoor workers' vulnerability. These issues span from inadequate labour policies to severe health risks associated with strenuous working conditions (Trien, 2014; Ha, 2021; Hanh, 2021; Suong & Thien, 2024).

KEY FINDINGS

Inadequate government oversight of outdoor working standards

The identified studies have shed light on the working conditions of outdoor workers in Vietnam, revealing several areas of concern. A study by Ha (2021) in two districts of Hanoi found that nearly 10% of solid waste collection workers exceeded 8 working hours per week, with 98.1% working up to 6 days weekly (Ha, 2021). Workers in shipbuilding and steel production at the Ha Long Shipbuilding Company and Thai Nguyen Iron and Steel Company typically have shifts lasting 6 to 8 hours per day. This contrasts with practices in some developed countries, where Trien (2014) noted that workers in certain specialised professions, particularly those in strenuous outdoor jobs, have regulated work hours of 6 to 7 hours per day and a 5-day work week. The discrepancy suggests that Vietnamese outdoor workers may face longer working hours compared to international

standards for similar professions (Trien, 2014). In addition, the working environment of the construction workers lacks protective equipment against sunlight, heat, and cold, unlike indoor working conditions, which is pointed out in Trien's (2014) study.

Worker awareness of labour rights appears to be a significant issue. Ha's (2021) study revealed that less than 10% of workers were aware of their right to work fewer than 40 hours per week. Similarly low percentages were found for awareness of rights to adequate rest areas, drinking water, first aid facilities, and occupational health assessments. This lack of awareness could potentially lead to the exploitation of workers and hinder their ability to advocate for better working conditions (Ha, 2021).

Occupational hazards accelerate health deterioration

The nature of outdoor work often involves exposure to environmental elements and job-specific hazards. Different industries pose unique challenges for outdoor workers. Workers in shipbuilding and steel production, such as those at the Ha Long Shipbuilding Company and Thai Nguyen Iron and Steel Company, face regular exposure to hazardous conditions including coal dust, toxic fumes, and high heat radiation during their 6 to 8-hour shifts. Welders, as noted by Hanh (2021), often work in awkward postures and are exposed to multiple occupational hazards including toxic fumes, intense heat, and dangerous UV radiation. These findings indicate a need for improved safety measures and possibly reduced exposure times in these high-risk occupations. In the construction sector, Trien's (2014) observations of the Nhat Tan Bridge project revealed that workers lacked adequate protection against extreme weather conditions. This exposure to elements without proper safeguards could lead to increased health

risks and reduced productivity (Trien, 2014). In the electrical industry, Suong and Thien (2024) explored how age and health requirements interact with job demands (Suong & Thien, 2024). Their study found that as workers age and have underlying medical conditions, they are less likely to be assigned to work directly outdoors (Suong & Thien, 2024). Anh's (2021) research findings reveal that the vast majority of traffic police officers and personnel have Class II health status, and none have a health status of Class IV or above¹ (Anh, 2021).

It can be observed that outdoor jobs involving strenuous work lead to higher levels of health deterioration. In this systematic review, it is evident that workers in shipbuilding, power industry, and welding sectors, industries characterised by their physically demanding nature - face a higher degree of exposure to health risks compared to traffic police officers.

Circular No. 62/2023/TT-BCA of the Ministry of Public Security of Vietnam stipulates specific health standards and health examinations for the People's Public Security forces. It includes six levels from I to VI, corresponding to health statuses ranging from very healthy to very weak. Within this classification, Class II represents a rather good health condition.

Inadequate government oversight of outdoor working standards

This systematic review identified 21 types of diseases or health issues mentioned in the literature, including: heat-related problems (heat stress, heatstroke), respiratory diseases, venereal diseases, musculoskeletal problems, neuropsychiatric diseases, vestibular disorders, traffic or occupational accidents, digestive problems, heart-related problems, urinary diseases and dengue (see Figure 5).

Heat-related problems were most frequently mentioned, appearing in five sources (Trien, 2014; Nga et al., 2016; Ha, 2021; Chau, Luan and Tuan, 2021; Suong and Thien, 2024). Trien (2014) noted that the construction of the Nhat Tan bridge involved mostly outdoor work, with hot conditions in summer and cold conditions in winter. The workers' environment lacked protective equipment against sun, heat and cold, unlike indoor working conditions (Trien, 2014, p.86). In this study, over 80% of workers reported being somewhat or completely unable to tolerate the heat in their working environment. Nga et al. (2016) observed that, in addition to high temperatures, factors such as high humidity and poor ventilation could increase the likelihood of heat stress among workers at a shipyard in Hai Phong. Studies by Chau, Luan and Tuan (2021) and Suong and Thien (2024) briefly mentioned symptoms of heatstroke and sunstroke as common ailments among their research subjects.

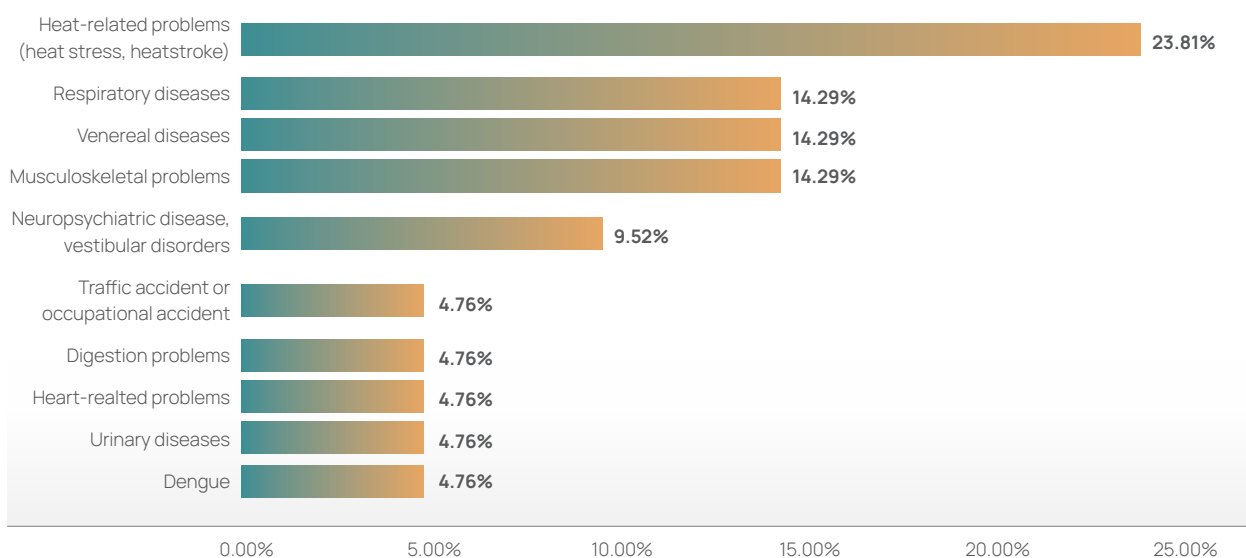


Source: Thanh Tung

Following heat-related problems were respiratory diseases (Anh, 2021; Ha, 2021; Ninh, Dung and Nhung, 2024), venereal diseases (Ha, 2021; Anh, 2021; Chau, Luan and Tuan, 2021) and musculoskeletal problems (Ha, 2021; Chau, Luan and Tuan, 2021; Ninh, Dung and Nhung, 2024), each appearing in three of the reviewed items. According to Anh (2021), respiratory diseases were the most common illnesses among traffic police officers (Anh, 2021, p.123). Respiratory issues were also the most prevalent group of diseases among workers at the Thanh Tri Power Company (Ninh, Dung and Nhung, 2024) and the second most common among solid waste collection workers in Hanoi (Ha, 2021). The risk of skin cancer and other skin diseases due to ultraviolet radiation exposure was noted among outdoor traffic police officers (Anh, 2021) and solid waste collection workers in Hanoi (Ha, 2021). In Ha's (2021) study, musculoskeletal pain, numbness and fatigue were the most widely recognised occupational health issues among solid waste collection workers in Hanoi.

Neuropsychiatric diseases and vestibular disorders both appeared in two sources but were listed in the rare disease group caused by extreme weather phenomena (Chau, Luan and Tuan, 2021; Ninh, Dung and Nhung, 2024). Finally, traffic or occupational accidents (Ha, 2021), digestive problems, heart-related problems, urinary diseases (Ninh, Dung and Nhung, 2024) and dengue (Chau, Luan and Tuan, 2021) were mentioned in just one reviewed source each.

Figure 5. Health impacts on outdoor workers addressed in identified studies



Source: Authors

KEY FINDINGS

Employment status: The predominance of formal over informal

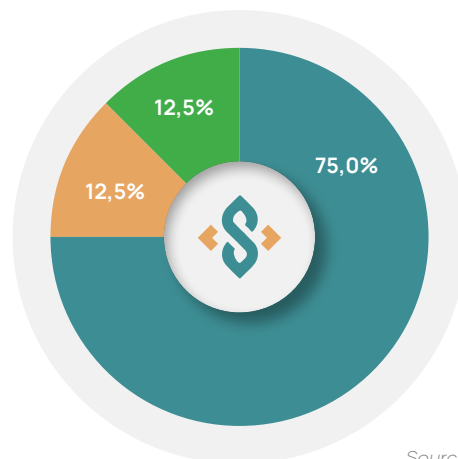


The research subjects in the systematic review mainly target formal workers (Nga, et al., 2016; Ha, 2021; Hanh, 2021; Anh, 2021; Suong & Thien, 2024; Ninh, Dung, & Nhung, 2024), including electricity company workers (Suong & Thien, 2024; Ninh, Dung, & Nhung, 2024), welders/steel rolling mill workers, coke furnace workers (Hanh, 2021); solid waste collectors (Ha, 2021); shipyard workers (Nga, et al., 2016); and traffic police officers (Anh, 2021). Only one study focused on informal workers, specifically farmers in the semi-urban Can Gio area, Ho Chi Minh City (Chau, Luan, & Tuan, 2021). One study on workers constructing the Nhat Tan Bridge (including welders, ironworkers, construction workers, machine operators, and others) did not clearly identify whether the study subjects were formal workers with employment contracts or informal workers without contracts (Trien, 2014) (see Figure 6).

Overall, informal and precarious workers in urban areas, such as street vendors, construction workers, porters, and ride-hailing drivers, remain underrepresented in domestic studies related to the health impacts of climate change and extreme weather conditions. This is despite the fact that outdoor workers in Vietnam are predominantly informal, low-income workers with limited access to social services (Pham and Coxhead, 2010, p.56).

Figure 6.
Social groups distribution of identified studies

● Formal worker ● Informal worker ● Undefined



Source: Authors

Source: Freepik.com

Outdoor workers' coping strategies: Primarily using personal protective equipment

The literature rarely mentions strategies for coping with or adapting to health risks faced by outdoor workers due to climate change and extreme weather events. Only three out of the eight documents reference this information (Trien, 2014; Hanh, 2021; Ha, 2021). These three articles discuss coping measures such as using personal protective equipment like masks, gloves, protective clothing, and reflective clothing (Ha, 2021; Hanh, 2021), as well as sun and cold protection gear (Trien, 2014). By drawing a word cloud from the extracted data from three articles that mentioned coping strategies and adaptation of outdoor workers, or 'RQ4. Coping strategies' as shown in Table 4 on page 14 of this document, we found keywords like 'protective,' 'equipment,' and 'personal' prominently appear in the word cloud (see Figure 7).

Specifically, Ha (2021) indicates that the majority of solid waste collection workers in Hanoi are equipped with high-quality and professionally regulated protective gear, including masks, gloves, work clothes, and reflective clothing (Ha, 2021). Likewise, Hanh (2021) reports that welders, steel rollers, and coke oven workers in Quang Ninh and Thai Nguyen generally use adequate personal protective equipment. This includes clothes, shoes, and cloth masks for steel rolling mill workers; protective clothing, shoes, helmets, gloves, and goggles for coke furnace workers; and protective clothing, shoes, cloth masks, hard hats, and welding masks for welders. However, there are still some shortcomings, such as steel rolling mill workers not using goggles to protect their eyes and welders frequently rolling up their sleeves, exposing their arms when working under the hot sun (Hanh, 2021, pp. 63 & 65). Both studies by Ha (2021) and Hanh (2021) were conducted on formal workers who were equipped with personal protective equipment by their companies when working under harsh weather conditions. Meanwhile, Trien (2014) points out that workers on the Nhat Tan bridge construction in Hanoi, who are unidentified whether they are formal or informal workers, were not adequately equipped with sun, heat, and cold protection gear (Trien, 2014, p.86).

Additionally, Ha's (2021) study shows that over 50per cent of solid waste collection workers in Hanoi regularly exercise to protect their health from the effects of working outdoors (Ha, 2021, p.71). The study also highlights other adaptation measures, including avoiding overexertion, taking frequent breaks every hour for five to ten minutes each, supplementing with micronutrients, and regularly changing postures while working to prevent musculoskeletal issues (Ha, 2021).

Figure 7.
Word cloud of outdoor workers' coping strategies



Source: Authors

KEY FINDINGS

Policy landscape: Current actions and recommendations

Current landscape of policy actions

There are four out of the eight studies discuss policy actions to support outdoor worker coping with health impacts of climate change (Nga, et al., 2016; Hanh, 2021; Chau, Luan, & Tuan, 2021; Ninh, Dung, & Nhung, 2024). However, most policy actions originate from employers, such as implementing various measures to help workers adapt to high temperatures, including providing drinking water, adjusting break times during summer, and offering shower facilities at the workplace (Nga, et al., 2016, p. 19). Employers also provide relatively comprehensive personal protective equipment, including protective clothing, shoes, fabric masks, and hard hats (Hanh, 2021), and ensure health care and benefits based on the primary working age group of 41-50 years (Ninh, Dung, & Nhung, 2024).

Only one article mentions policy actions from local authorities. This single source is a study of the socio-economic resources supporting livelihoods of households in the Can Gio Mangrove Biosphere Reserve, Ho Chi Minh City. It indicates that health care services for residents have generally improved, although the ratio of doctors to the population remains low (Chau, Luan, & Tuan, 2021).

Thus, policy actions to support outdoor workers in adapting to climate change and extreme weather events primarily come from employers, while government actions are mostly general policies for the public rather than specific measures for outdoor workers. In other words, informal outdoor workers seem to be outside the support network provided by both businesses and the government to cope with health impacts from climate change and extreme weather events.

Recommendations for policy improvement

Six out of eight documents provide policy recommendations, spread across four aspects including improving the working environment; health propaganda and education; applying technology to reduce human effort working outdoors; reasonable division of working shifts for workers; increasing the availability of protective equipment; and increasing the ratio of doctors per 1,000 citizens.

Improving the working environment

Nga et al. (2016), in their study of shipyard workers in Hai Phong, recommended that shipbuilding facilities should widely implement heat adaptation solutions across all production departments during hot periods to protect workers' health. Similarly, Suong & Thien (2024), researching health status of power company employees, suggested that employers should enhance both the physical and mental aspects of the working environment for their employees, particularly focusing on safety and health in high-risk sectors like the power industry. Additionally, the authors proposed that employers should improve compensation packages, provide training to enhance skills, and offer career advancement opportunities as supplementary measures to reduce stress and work pressure for power company staff.

Health promotion and education

Hanh (2021) proposed that welding workshops should intensify health education and promotion to ensure welders understand the proper use of standard welding goggles or masks for eye protection. Similarly, Ha (2021) recommended that solid waste collection companies maintain communication activities and health education programmes on the prevention of occupational diseases, particularly musculoskeletal disorders, with a special emphasis on training in correct working postures. The study also highlighted the urgency of promoting occupational health and safety and occupational disease prevention through regular team meetings within the company.

Applying technology to reduce human effort in outdoor work

Technological measures to alleviate the burden of outdoor work can be applied specifically in certain industries. For instance, Ha (2021) suggested that solid waste collection companies should gradually implement mechanisation in urban solid waste collection to reduce the physical burden on workers. Additionally, Anh (2021) proposed that the government should improve the road surveillance camera system and implement a mechanism for issuing traffic violation fines based on photographic evidence (post-incident fines) to reduce outdoor working hours for traffic police officers.

Reasonable division of working shifts for workers

Anh's (2021) study on traffic police officers recommended that traffic police units should organise shifts reasonably for traffic control, avoiding situations where a police team must stand in one fixed location for extended periods to reduce the risk of neck and back pain.

Increasing protective equipment

Anh's (2021) study on traffic police officers further recommended that these public servants should be provided with adequate protective equipment when working outdoors, including dust masks and umbrellas or parasols to reduce ultraviolet radiation exposure.

Increase the ratio of doctors per 1,000 citizens

In addition to the above recommendations, Chau, Luan, & Tuan (2021) proposed a policy solution related to upgrading the scope of service of the universal healthcare system, focusing on increasing the ratio of doctors per 1,000 residents (see Table 1).

Table 1. Policy recommendations

Policy fields	Policy details	Studies
Improving the working environment	Extensive application of thermal adaptation solutions in all production departments.	(Nga, et al., 2016)
	Improving the working environment to ensure both physical and mental health, especially safety.	(Suong & Thien, 2024)
Health propaganda and education	Regularly and strongly conduct propaganda and education about health protection for welders.	(Hanh, 2021)
	Maintaining communication and health education activities on prevention of occupational-related diseases, especially musculoskeletal disorders for workers.	(Ha, 2021)
Applying technology to reduce human effort working outdoors	Gradually implement mechanisation in urban solid waste collection to reduce the labour burden on workers.	(Ha, 2021)
	Develop projects and implement the installation of surveillance camera systems, traffic management and penalties for traffic violations through images (cold fines) to reduce road traffic police officers working outdoors.	(Anh, 2021)
Reasonable division of working shifts for workers	Organise work in reasonable shifts to control traffic, avoiding having to stand in one place for too long, and reduce rate of road traffic police suffering from neck pain and low back pain.	(Anh, 2021)
Increasing protective equipments	Equip police working in traffic control with dust masks and sunshades or umbrellas to reduce the intensity of ultraviolet rays.	(Anh, 2021)
Increase the ratio of doctors per 1,000 citizens	Raise the ratio of doctors per 1,000 people, to improve the quality of health care services for the people.	(Chau, Luan, & Tuan, 2021)

Source: Authors





CONCLUSION, KNOWLEDGE GAPS, AND PROPOSED FRAMEWORK FOR IMPACT ASSESSMENT

SOCIALLIFE REVIEW

This working paper systematically explores, reviews, and synthesises Vietnam-focused literature on the health effects of climate change on urban outdoor workers in Asia. Our paper revealed several key findings, albeit with notable limitations.

Source: Freepik.com

CONCLUSION, KNOWLEDGE GAPS, AND PROPOSED FRAMEWORK FOR IMPACT ASSESSMENT

To begin with, the scope of existing research is geographically limited, concentrating exclusively on Vietnam, particularly its northern regions, with no representation from other Asian countries or territories.

Furthermore, the primary health impacts identified were largely linked to extreme heat and exposure to thermal radiation. The most commonly reported symptoms included heat exhaustion, heat stroke, and sunstroke. Additionally, there is a substantial gap in comparative studies assessing the varying levels of health vulnerability across different outdoor occupational groups affected by climate change. Most studies focused on formal sector workers employed by businesses or in the public sector, with only one out of eight studies examining informal workers.

Moreover, the adaptation strategies adopted by outdoor workers in response to extreme weather events were largely neglected in the literature. Only three out of eight studies considered this critical aspect, primarily addressing personal protective equipment provided by employers. There was limited exploration of individual coping mechanisms, especially in situations without company support. Lastly, the research significantly lacked discussion on governmental social welfare measures to support outdoor workers, particularly those in the informal sector.

These findings highlight the need for more comprehensive and diverse studies across urban Asia to fully understand and address the health impacts of climate change on outdoor workers. Future research should aim to include a broader geographical scope, compare different occupational groups, and examine both formal and informal sector workers. Additionally, greater attention should be paid to individual and governmental adaptation strategies to ensure the well-being of this vulnerable workforce in the face of increasing climate-related challenges.

Knowledge gaps

This review underscores significant gaps in the Vietnam-based literature on climate change impacts on outdoor workers' health in urban Asia. Our findings highlight significant gaps in current understanding and point towards areas requiring further investigation.

- **Focus on high temperatures:** Vietnamese studies predominantly concentrate on the effects of high temperatures (Trien, 2014; Nga et al., 2016; Hanh, 2021; Anh, 2021; Chau, Luan, & Tuan, 2021), with limited attention to other extreme weather events.
- **Geographical bias:** Most research has been conducted in northern Vietnam, whilst the central and southern regions—significantly affected by extreme weather events like storms, floods, and droughts—remain under-researched.
- **Limited scope of extreme weather events:** The existing literature primarily addresses temperature-related phenomena (extreme heat or cold), neglecting other weather events such as heavy rain, storms, floods, and droughts.
- **Emphasis on formal workers:** The majority of studies focus on formal workers (Nga et al., 2016; Ha, 2021; Hanh, 2021; Anh, 2021; Suong & Thien, 2024; Ninh, Dung, & Nhung, 2024), overlooking informal, precarious workers in sectors such as street vending, ride-hailing, and portering.
- **Methodological limitations:** Most studies employ cross-sectional descriptive methods and quantitative data collection and analysis (Nga, et al., 2016; Hanh, 2021; Ninh, Dung, & Nhung, 2024; Trien, 2014; Chau, Luan, & Tuan, 2021; Suong & Thien, 2024). There is a notable absence of longitudinal studies using mixed-method approaches, which could provide more comprehensive insights into long-term trends and changes over time.

- **Policy focus:** Recommendations predominantly target outdoor workers and their employers (Nga, et al., 2016; Hanh, 2021; Ha, 2021; Anh, 2021; Suong & Thien, 2024) with few policy suggestions directed at governmental bodies. Existing government policies regarding outdoor workers are minimal and lack robust implementation (Chau, Luan, & Tuan, 2021).

This review reveals significant gaps in Vietnamese literature regarding climate change impacts on outdoor workers' health in urban Asia, highlighting the need for more diverse and comprehensive research. Future studies should employ a longitudinal approach using mixed-methods, whilst there is a critical need for robust government policies to protect outdoor workers' health in the face of climate change.

Proposed framework for impact assessment

Based on the findings of our systematic review, we have developed a comprehensive analytical framework for understanding the impacts of climate change on outdoor workers in urban Vietnam (see Figure 8 and Table 2). This innovative application of the SER findings to our research design allows us to ground our study in existing evidence while addressing gaps in current knowledge, to ensure that our research questions and methodology are informed by the most up-to-date understanding of the field, and to tailor our approach specifically to the context of urban Vietnam while drawing on global evidence.

Our framework guides the design of our questionnaire to survey outdoor workers as part of our 30-month experimental research project. This project examines the specific impacts of climate change on the health,

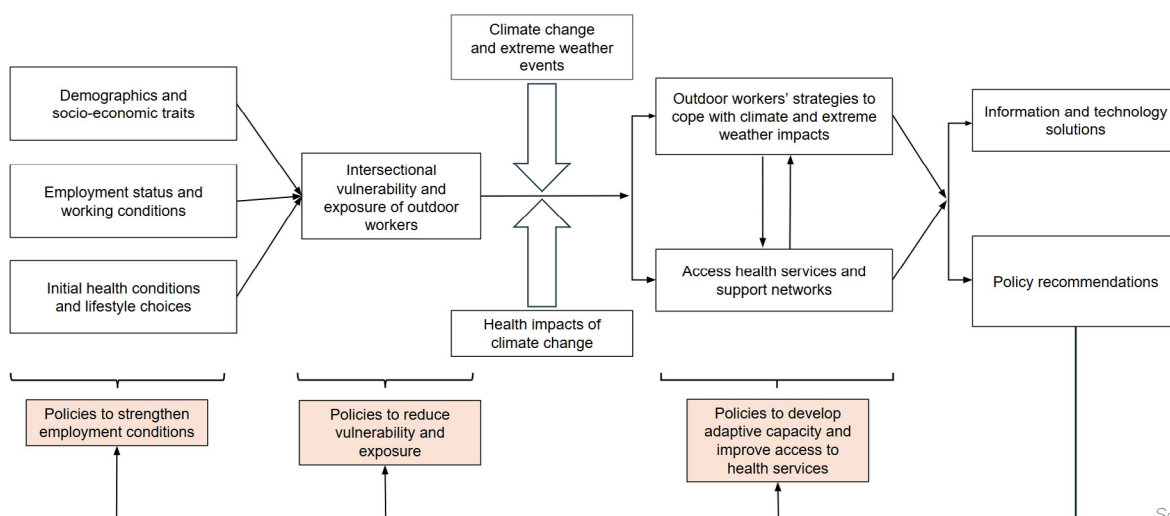
livelihoods and working conditions of outdoor workers in Vietnam's major cities. It examines the extent and duration of workers' exposure to climate change-related weather hazards and their health impacts, as well as workers' knowledge, attitudes and adaptation practices in response to climate challenges. The study also explores the relationship between these factors and workers' current health status, as well as their perspectives on and needs for a mobile application that provides early warnings of health risks.

In addition, this SER-informed framework is informing the development and impact assessment of our GIS-integrated mobile application. The application will provide real-time health information, alerts and recommendations based on our survey results and assessment of workers' needs, challenges and coping skills.

By applying the SER findings to our research design, we will ensure that our study not only builds on existing knowledge, but also addresses critical gaps in understanding the unique challenges faced by outdoor workers in urban Vietnam. This approach allows us to develop more targeted and effective solutions, providing valuable evidence for policymakers and social workers to support and protect workers' health in the face of climate change challenges.

This framework can also serve as a reference for future studies, demonstrating how SER can be creatively applied to inform research design in similar contexts or related fields. Through this innovative approach, we aim to make a significant contribution to the body of knowledge on the impacts of climate change on vulnerable workers, and to develop practical, evidence-based solutions to mitigate these impacts in urban Vietnam.

Figure 8. Proposed framework for assessment of climate change's health impacts on outdoor workers



Source: Authors

CONCLUSION, KNOWLEDGE GAPS, AND PROPOSED FRAMEWORK FOR IMPACT ASSESSMENT

Table 2. Proposed Framework for Assessment of Climate Change's Health Impacts on Outdoor Workers

Dimensions of outdoor workers	Indicators	Details	Studies
Dimensions of outdoor workers	Demographics	<ul style="list-style-type: none"> Age, gender, residence status (permanent or temporary), education attainment, marriage status 	(Suong & Thien, 2024; Nga, et al., 2016; Ha, 2021; Ninh, Dung, & Nhung, 2024; Hanh, 2021; Trien, 2014; Anh, 2021)
	Socio-economic traits	<ul style="list-style-type: none"> Education attainment 	(Hanh, 2021; Nga, et al., 2016)
		<ul style="list-style-type: none"> Wages, Payment Regularity, Additional Income 	(Suong & Thien, 2024)
		<ul style="list-style-type: none"> Years of working 	(Suong & Thien, 2024; Ha, 2021; Ninh, Dung, & Nhung, 2024; Trien, 2014; Anh, 2021)
Initial health conditions and lifestyle choices	Initial health conditions	<ul style="list-style-type: none"> Pre-existing medical conditions (e.g., cardiovascular diseases, diabetes) 	(Anh, 2021)
	Lifestyle choices	<ul style="list-style-type: none"> Fitness levels 	(Ninh, Dung, & Nhung, 2024)
		<ul style="list-style-type: none"> Good/bad habits affecting health (e.g., smoking, alcohol consumption, exercising) 	(Trien, 2014)
Employment status and working conditions	Employment status	<ul style="list-style-type: none"> Formal workers: Permanent employment contract, officially employed by a company/ business 	(Trien, 2014; Nga et al., 2016; Ha, 2021; Hanh, 2021; Anh, 2021; Suong & Thien, 2024)
		<ul style="list-style-type: none"> Informal workers: Unstable job, not employed by a company/ business 	(Chau, Luan, & Tuan, 2021)
	Working conditions	<ul style="list-style-type: none"> Average number of hours worked per day/week/month 	(Ha, 2021; Suong & Thien, 2024)
Intersectional vulnerability and exposure of outdoor workers	Policy gaps	<ul style="list-style-type: none"> Working hours regulation Protective equipment / Availability of shade/shelter, cleanliness, and safety of the work area 	(Trien, 2014; Ha, 2021)
	Environmental exposure and occupational hazards	<ul style="list-style-type: none"> Worker rights awareness Exposure to weather elements (e.g. toxic fumes, intense heat, and dangerous UV radiation) Job-specific hazards in industries characterised by their physically demanding nature (e.g. shipbuilding, power industry, and welding sectors) 	(Trien, 2014; Hanh, 2021; Suong & Thien, 2024)



Source: Thanh Tung

Dimensions of outdoor workers	Indicators	Details	Studies
Climate change and extreme weather events	Types of extreme weather impact on the health of outdoor workers	<ul style="list-style-type: none"> Heat-related phenomenon Cold or extreme cold weather Air pollution Noise pollution Bad weather in general 	(Trien, 2014; Nga, et al., 2016; Hanh, 2021; Anh, 2021; Chau, Luan, & Tuan, 2021; Ha, 2021; Ninh, Dung, & Nhung, 2024; Suong & Thien, 2024)
Health impacts of climate change	Types of health impacts	<ul style="list-style-type: none"> Mental health: Heat stress, stuffy feel Physical health: Heat-related problems; Respiratory diseases; Venereal diseases; Musculoskeletal problems; Neuropsychiatric diseases, vestibular disorders; Traffic accident or occupational accident; Digestion problems; Heart-related problems; Urinary diseases; Dengue 	(Trien, 2014; Nga, et al., 2016) (Trien, 2014; Nga, et al., 2016; Ha, 2021; Chau, Luan, & Tuan, 2021; Suong & Thien, 2024; Anh, 2021; Ninh, Dung, & Nhung, 2024; Hanh, 2021)
Strategies to cope with climate and extreme weather impacts	Coping strategies adopted to escape from and/or adapt to weather extremes	<ul style="list-style-type: none"> Equipping with personal protective means Exercising regularly Taking breaks regularly Supplying with micronutrient supplementation Maintaining appropriate working posture / Regularly change working posture 	(Ha, 2021; Hanh, 2021; Trien, 2014)
Access health services and support networks	Register for medical insurance Support networks for health protection	<ul style="list-style-type: none"> Medical insurance registration status Access to health protection support networks for outdoor workers 	(Nga, et al., 2016; Chau, Luan, & Tuan, 2021)
Information and technology solutions	Information and technology solutions to support workers in minimising health risks from climate change	<ul style="list-style-type: none"> Apply technology to reduce human effort when workers working outdoors Develop an early alert application of extreme weather events for outdoor workers 	(Ha, 2021; Anh, 2021)

Source: Authors

CONCLUSION, KNOWLEDGE GAPS, AND PROPOSED FRAMEWORK FOR IMPACT ASSESSMENT

Dimensions of outdoor workers	Indicators	Details	Studies
Policy Recommendations	Policies to strengthen employment conditions	<ul style="list-style-type: none"> Improve working environment 	(Nga, et al., 2016; Suong & Thien, 2024; Hanh, 2021; Ha, 2021; Anh, 2021; Chau, Luan, & Tuan, 2021)
	Policies to reduce vulnerability and exposure	<ul style="list-style-type: none"> Apply technology to reduce human effort working outdoors Divide work shifts reasonably Increase the use of protective equipment 	
	Policies to develop adaptive capacity and improve access to health services	<ul style="list-style-type: none"> Health propaganda and education Increase the number of doctors per population 	

Source: Authors

Demographics and socio-economic traits

The demographics and socio-economic traits of outdoor workers can be summarized through two main dimensions: demographics and socio-economic characteristics.

Demographics are indicated by several factors: age, gender, residence status (whether permanent or temporary), education attainment, and marital status. These demographic indicators provide a comprehensive profile of the outdoor workforce and can highlight potential vulnerabilities or disparities among different groups (Suong & Thien, 2024; Nga, et al., 2016; Ha, 2021; Ninh, Dung, & Nhung, 2024; Hanh, 2021; Trien, 2014; Anh, 2021).

Socio-economic traits are characterized by indicators such as education attainment, which appears as both a demographic and socio-economic factor, emphasizing its importance (Hanh,

2021; Nga, et al., 2016). Other key socio-economic indicators include wages, payment regularity, and additional income sources, which directly impact workers' financial stability and quality of life (Suong & Thien, 2024). Years of working experience is another crucial indicator, potentially influencing job security, skill level, and exposure to occupational hazards (Suong & Thien, 2024; Ha, 2021; Ninh, Dung, & Nhung, 2024; Trien, 2014; Anh, 2021).

Including this dimension reflects the perspectives of many authors on the importance of these foundational factors in determining the vulnerability of workers (Anh, 2021; Chau, Luan, & Tuan, 2021). This approach helps to explore the differential health impacts of climate change on outdoor workers across various working groups with different demographic characteristics and socio-economic statuses.

Employment status and working conditions

The employment status and working conditions of outdoor workers can be categorized into two main dimensions: employment status and working conditions.

Employment status is characterized by two primary categories: (1) Formal workers: This group includes those with permanent employment contracts and who are officially employed by a company or business. These workers typically have more job security and access to benefits (Trien, 2014; Nga et al., 2016; Ha, 2021; Hanh, 2021; Anh, 2021; Suong & Thien, 2024). (2) Informal workers: This category

encompasses workers with unstable jobs who are not employed by a formal company or business. These workers often face greater job insecurity and may lack access to standard labor protections (Chau, Luan, & Tuan, 2021).

Working conditions are primarily indicated by the average number of hours worked per day, week, or month. This factor is crucial in assessing the intensity of work and potential for overexertion or burnout among outdoor workers (Ha, 2021; Suong & Thien, 2024), all of which contribute to their overall vulnerability and exposure to occupational risks

Initial health conditions and life style choices

Initial health conditions and lifestyle choices play a crucial role in determining the resilience and adaptive capacity of outdoor workers exposed to extreme weather conditions. A systematic review of English-language evidence reveals that not only individual factors such as age and gender, but also pre-existing medical conditions (e.g., cardiovascular diseases, diabetes), fitness levels, and lifestyle choices (e.g., smoking, alcohol consumption) significantly influence workers' vulnerability (Habibi, Moradi, Dehghan, Moradi, & Heydari, 2021). However, criteria related to pre-existing conditions, fitness levels, and health-

related habits were seldom addressed in the eight identified documents. Only the study by Ninh, Dung, & Nhung (2024) briefly mentioned a binary classification of health status (good or poor) in their sample description. Trien (2014) included a survey question regarding outdoor workers' smoking habits, while Anh (2021) examined pre-existing medical conditions among road traffic police officers. This paucity of data suggests a need for more comprehensive research incorporating these health-related factors in assessments of outdoor workers' vulnerability to extreme weather conditions.

Intersectional vulnerability and exposure of outdoor workers

The intersectional vulnerability and exposure of outdoor workers can be analyzed through two main dimensions: policy gaps and environmental exposure and occupational hazards.

Policy gaps are characterized by several indicators: working hours regulation, which often exceeds international standards for similar professions; the availability and quality of protective equipment, shade/shelter, and work area safety; and the level of worker rights awareness, which is often found to be inadequate (Trien, 2014; Ha, 2021).

Environmental exposure and occupational hazards are indicated by workers' exposure to weather elements, including toxic fumes, intense heat, and dangerous UV radiation. Additionally, job-specific hazards are particularly prevalent in physically demanding industries such as shipbuilding, power industry, and welding sectors. These factors contribute significantly to the health risks faced by outdoor workers (Trien, 2014; Hanh, 2021; Suong & Thien, 2024).

CONCLUSION, KNOWLEDGE GAPS, AND PROPOSED FRAMEWORK FOR IMPACT ASSESSMENT

Climate change and extreme weather events

Climate change and extreme weather events significantly impact the health and working conditions of outdoor workers. The types of extreme weather impacts on the health of outdoor workers can be categorized as heat-related phenomena, cold or extreme cold weather, air pollution, noise pollution, and bad weather in general. These factors have been identified and discussed in multiple studies (Trien, 2014; Nga, et al., 2016; Hanh, 2021; Anh, 2021; Chau, Luan, & Tuan, 2021; Ha, 2021; Ninh, Dung,

& Nhung, 2024; Suong & Thien, 2024), highlighting the diverse and significant impacts of climate change and extreme weather events on outdoor workers across various sectors and regions.

This dimension broadens the scope of weather phenomena considered, not just limiting to heat and high temperatures as in some current studies (Trien, 2014; Nga et al., 2016; Hanh, 2021; Anh, 2021; Chau, Luan, & Tuan, 2021).

Health impacts of climate change

This dimension includes indicators of impacts on physical health (Trien, 2014; Nga et al., 2016; Hanh, 2021; Anh, 2021; Chau, Luan, & Tuan, 2021; Ha, 2021; Ninh, Dung, & Nhung, 2024; Suong & Thien, 2024) and mental health (Trien, 2014; Nga et al., 2016), reflecting the findings of many authors on the diverse health issues related to weather (Ha, 2021; Chau, Luan, & Tuan, 2021; Ninh, Dung, & Nhung, 2024; Trien, 2014; Nga, et al., 2016). Mental health impacts may include heat stress and stuffy feel (Trien, 2014; Nga, et al., 2016). Physical health impacts encompass a wide range of conditions such as heat-related problems (heat exhaustion

and heat stroke), respiratory diseases, venereal diseases, musculoskeletal problems, neuropsychiatric diseases and vestibular disorders, traffic accidents or occupational accidents, digestion problems, heart-related problems, urinary diseases, and dengue (Trien, 2014; Nga, et al., 2016; Ha, 2021; Chau, Luan, & Tuan, 2021; Suong & Thien, 2024; Anh, 2021; Ninh, Dung, & Nhung, 2024; Hanh, 2021). These health impacts highlight the diverse and significant ways in which climate change affects the well-being of outdoor workers, emphasizing the need for comprehensive health protection strategies.

Access to health services and support networks

This dimension includes indicators on outdoor workers' medical insurance registration status and their ability to access to healthcare services and support networks for health protection, reflecting findings on the importance of the healthcare system in supporting workers (Nga, et al., 2016; Chau, Luan, & Tuan, 2021). These indicators highlight the importance of both formal

healthcare systems (through medical insurance) and broader support networks in addressing the health needs and vulnerabilities of outdoor workers. The presence or absence of these services can significantly impact workers' ability to manage health risks associated with their occupations and cope with the effects of climate change and extreme weather events.

Strategies to cope with climate and extreme weather impacts

This dimension focuses on the awareness, knowledge, and personal protective measures of workers, based on current coping strategies. Coping strategies adopted by outdoor workers to escape from or adapt to weather extremes can include equipping with personal protective means, exercising regularly, taking breaks regularly, supplying micronutrient supplementation, maintaining appropriate working posture or regularly changing working posture (Ha, 2021; Hanh, 2021; Trien, 2014). These strategies

represent a combination of personal protective measures, health maintenance practices, and work routine adjustments aimed at mitigating the impacts of climate change and extreme weather on outdoor workers. They highlight the importance of both individual and organizational efforts in protecting worker health and safety in the face of challenging environmental conditions.

Experimental research can supplement the gaps identified in the systematic review related to this dimension.

Information and technology solutions

This dimension emphasizes the role of information and technology in coping with climate change, an aspect not extensively covered in current studies but with great potential in supporting workers (Ha, 2021; Anh, 2021). Information and technology solutions to support workers in minimizing health risks from climate change can include two key strategies: applying technology to reduce human effort when working outdoors (Ha, 2021;

Anh, 2021) and developing an early alert application for extreme weather events specifically designed for outdoor workers to provide them with timely warnings and safety recommendations. These technological interventions represent promising avenues for enhancing the resilience and adaptability of outdoor workers in the face of increasing climate-related challenges.

Policy recommendations

The final dimension synthesises policy recommendations from various studies (Nga et al., 2016; Hanh, 2021; Ha, 2021; Anh, 2021; Chau, Luan, & Tuan, 2021; Suong & Thien, 2024), as well as new recommendations based on experimental research findings, including suggestions for both businesses and governments. The policy recommendations should address three key areas as mentioned in Table 6 including policies to strengthen employment conditions, policies to

reduce vulnerability and exposure, and policies to develop adaptive capacity and improve access to health services (see Table 6).

This analytical framework not only synthesises key findings from existing studies but also extends the scope of research through experimental data to cover unexplored aspects. As a result, it offers a more comprehensive understanding of the issue at hand.

APPENDIX: METHODOLOGICAL APPROACH

SOCIALLIFE REVIEW

The objective of this working paper is to conduct a systematic review of Vietnam-based studies on the impact of climate change and extreme weather events on the health of outdoor workers in urban Asia. Four key questions have guided both systematic reviews:

1. What extreme weather events affect the health of outdoor workers in workers in urban Asia?
2. What are the health impacts of climate change and extreme weather events on outdoor workers in urban Asia?
3. Which types of outdoor work and which groups of outdoor workers are most vulnerable to extreme weather in urban Asia?
4. What strategies have outdoor workers in urban areas of Asia adopted to cope with and adapt to the impacts of climate change and extreme weather events?



Source: Thanh Tung

The process of identifying and evaluating literature for inclusion in this systematic review follows a five-phase approach.

1

Development of search strings

Based on the research questions, a series of keywords were used to search for relevant Vietnamese language literature in the two areas of “climate change” and “health.” These search strings encompass topics related to Climate, Health, Employment, Society, Urban areas, and Asia (see Table 3).

Table 3. Initial search strings

	Main keywords		Vietnamese synonyms/ relevant keywords
	English	Vietnamese	
Filter	Climate	Khí hậu	"Khí hậu" OR "thời tiết" OR "lũ lụt" OR "hạn hán" OR "nắng nóng" OR "nóng" OR "lạnh" OR "nóng lên toàn cầu" OR "bão" OR "gió mùa" OR "lượng mưa" OR "thích ứng" OR "giảm thiểu" OR "khí nhà kính" OR "lốc xoáy" OR "xói mòn bờ biển" OR "rủi ro" OR "thiên tai" OR "cháy rừng"
AND	Health	Sức khỏe	"Sức khỏe" OR "bệnh tật" OR "truyền nhiễm" OR "phúc lợi" OR "chất lượng cuộc sống" OR "tử vong" OR "tai nạn" OR "hạnh phúc" OR "bị thương" OR "bệnh viện" OR "tâm thần" OR "y tế" OR "cấp cứu" OR "đột quỵ" OR "kiệt sức" OR "chuột rút" OR "mang thai" OR "sốt" OR "mệt mỏi" OR "bông rớt" OR "căng thẳng" OR "da"
AND	Work	Việc làm	"Công việc" OR "ngoài trời" OR "khuôn vác" OR "xây dựng" OR "người bán hàng" OR "bán hàng rong" OR "người lái xe" OR "công việc ngoài trời"
AND	Society	Xã hội	"Giới tính" OR "tuổi tác" OR "thế hệ" OR "người già" OR "trẻ" OR "già" OR "nghèo đói" OR "loại trừ" OR "bấp bênh" OR "người di cư" OR "thiếu số" OR "dễ bị tổn thương" OR "phi chính thức" OR "bình thường" OR "hợp đồng" OR "thỏa thuận"
AND	Urban	Đô thị	"Thành phố" OR "thị trấn" OR "đô thị" OR "thị xã"
AND	Asia	Châu Á	"Châu Á" OR "Việt Nam" OR "Trung Quốc" OR "Timor Leste" OR "Đông Timor" OR "Indonesia" OR "Philippines" OR "Campuchia" OR "Thái Lan" OR "Lào" OR "CHDCND Lào" OR "Myanmar" OR "Miến Điện" OR "Malaysia" OR "Brunei" OR "Brunei Darussalam" OR "Ấn Độ" OR "Sri Lanka" OR "Nepal" OR "Pakistan" OR "Bangladesh" OR "Bhutan" OR "Afghanistan" OR "Bắc Triều Tiên" OR "Cộng hòa Dân chủ Nhân dân Triều Tiên" OR "Mông Cổ"

Source: Authors

Our first research question focuses on 'climate' and the types of extreme weather that affect the health of outdoor workers in Asian cities. The selected Vietnamese search terms include "khí hậu", "thời tiết", "lũ lụt", "hạn hán", "nắng nóng", "nóng", "lạnh", "nóng lên toàn cầu", "bão", "gió mùa", "lượng mưa", "thích ứng", "giảm thiểu", "khí nhà kính", "lốc xoáy", "xói mòn bờ biển", "rủi ro", "thiên tai", and "cháy rừng".

The second research question aims to identify the health impacts of extreme weather related to climate change on outdoor workers in Asian cities. To capture existing literature related to this health-focused research question, we combined search terms including "Sức khỏe", "bệnh tật", "truyền nhiễm", "phúc lợi", "chất lượng cuộc sống", "tử vong", "tai nạn", "hạnh phúc", "bị thương", "bệnh viện", "tâm thần", "y tế", "cấp cứu", "đột quỵ", "kiệt sức", "chuột rút", "mang thai", "sốt", "mệt mỏi", "bông rớt", "căng thẳng", and "da".

Our third research question focuses on the 'employment' category of the project, aiming to identify the forms of outdoor work where workers face extreme

weather. The selected search terms include "Công việc", "ngoài trời", "khuôn vác", "xây dựng", "người bán hàng", "bán hàng rong", "người lái xe", and "công việc ngoài trời".

The keyword string also includes the 'society' category to capture the project's interest in the social vulnerabilities of working groups. Specific terms include "Giới tính", "tuổi tác", "thế hệ", "người già", "trẻ", "già", "nghèo đói", "loại trừ", "bấp bênh", "người di cư", "thiếu số", "dễ bị tổn thương", "phi chính thức", "bình thường", "hợp đồng", and "thỏa thuận".

To ensure geographical coverage of urban Asia in our literature search, we included a range of terms to capture the 'urban' concerns of the study, such as "Thành phố", "thị trấn", "đô thị", "thị xã". We also included terms related to 'Asia', including "Châu Á", "Việt Nam", "Trung Quốc", "Timor Leste", "Đông Timor", "Indonesia", "Philippines", "Campuchia", "Thái Lan", "Lào", "CHDCND Lào", "Myanmar", "Miến Điện", "Malaysia", "Brunei", "Brunei Darussalam", "Ấn Độ", "Sri Lanka", "Nepal", "Pakistan", "Bangladesh", "Bhutan", "Afghanistan", "Bắc Triều Tiên", "Cộng hòa Dân chủ Nhân dân Triều Tiên", and "Mông Cổ".

APPENDIX: METHODOLOGICAL APPROACH

2 Development of inclusion and exclusion criteria

The assessment of each piece of evidence was guided by established inclusion and exclusion criteria (see Table 2). These criteria were applied to screen papers for eligibility at the title, abstract, and full-text stages. The review encompassed Vietnamese and English academic research papers published in Vietnam, including original research papers and systematic literature reviews, scoping reviews, rapid evidence assessments, meta-analyses, and narrative analyses. Relevant grey literature, such as dissertations and

conference papers, was also considered. The review's scope was confined to papers examining climate change and its health implications for workers in urban Asia. Furthermore, studies addressing the impacts of climate change adaptation and mitigation on workers' health and well-being were incorporated. Sources focusing on rural areas, regions outside Asia, or indoor workers were not included. The review also omitted opinion pieces and popular media, such as blogs, social media content, or newspaper articles.

Table 4. Inclusion and exclusion criteria

Criterion	Inclusion	Exclusion
Content	<ul style="list-style-type: none"> • Research on climate/weather change and events and health impacts • With a focus on workers (especially outdoor workers) in urban Asia • Research on the impacts of climate change adaptation and mitigation on health/well-being 	<ul style="list-style-type: none"> • Studies with a rural focus • Studies not in urban Asia • Studies on indoor workers
Types of literature	<ul style="list-style-type: none"> • Original research papers (including qualitative studies and quantitative research) • Systematic literature reviews (including scoping reviews, rapid evidence assessments, meta-analyses, narrative analyses) • Relevant grey literature (dissertations and conference papers) 	<ul style="list-style-type: none"> • Opinion pieces • Popular media (e.g. blogs, social media feeds and / or newspaper articles)
Date of publication	<ul style="list-style-type: none"> • January 2000 – present (April 2024) 	<ul style="list-style-type: none"> • Any research published before January 2000
Geography	<ul style="list-style-type: none"> • Studies from urban Asia 	<ul style="list-style-type: none"> • Any research not from urban Asia
Language	<ul style="list-style-type: none"> • Vietnamese • English research articles published in academic journals based in Vietnam 	<ul style="list-style-type: none"> • Other cases

Source: Authors

3

Pilot search and identification

This systematic review draws from three academic databases in Vietnam, which house the majority of publications in Vietnamese or in English but published by a Vietnam-based journal: the EBSCO Discovery Service of the Central Library of Vietnam, National University Ho Chi Minh City (HCM VNU Lib); the National Database on Science and Technology of the Ministry of Science and Technology of Vietnam (MOST Pub Database); and Google Scholar. To ensure comprehensive coverage, we also included supplementary sources, particularly sources identified through the online open access Vietnam Medical Journal.

One of the main challenges we faced was the restrictive keyword limits imposed by Vietnamese databases. Google Scholar allows a maximum of 16 keywords per search, HCM VNU Lib limits searches to 12 keywords, and the MOST Pub Database caps searches at 8 keywords. Additionally, both HCM VNU Lib and the MOST Pub

Database do not support full-text searches, making it impractical to use highly specific or detailed keywords.

To address these constraints, we refined our search strings, focusing on the most general terms related to our research topics—climate, health, employment, society, and urban areas—resulting in a total of 15 keywords (see Table 3). For the HCM VNU Lib and MOST Pub Database, we split the searches into smaller groups to accommodate their keyword restrictions, then manually filtered the results to isolate studies specifically focused on urban areas in Asia.

It's important to note that due to these limitations, we were unable to exactly replicate the approach used for the English-language systematic review. Our search strategy had to be adapted to the constraints of the Vietnamese databases.

Table 5. Final search strings

Filter	Main keywords		Vietnamese synonyms and relevant keywords	
	English	Vietnamese		
All main keywords were combined for searching in one string with synonyms and relevant keywords included.	AND	Climate	Khí hậu	"khí hậu" OR "thời tiết" OR "thiên tai"
	AND	Health	Sức khỏe	"sức khỏe" OR "bệnh" OR "triệu chứng"
	AND	Work	Việc làm	"làm việc ngoài trời" OR "lao động ngoài trời" OR "việc làm ngoài trời"
	AND	Society	Xã hội	"xã hội" OR "con người" OR "yếu thế"
Each word in this group was manually added along with the string of keywords above for searching.	AND	Urban	Đô thị	"đô thị" OR "thành phố" OR "thị xã"
	AND	Asia	Châu Á	"Châu Á" OR "Việt Nam" OR "Trung Quốc" OR "Timor Leste" OR "Đông Timor" OR "Indonesia" OR "Philippines" OR "Campuchia" OR "Thái Lan" OR "Lào" OR "CHDCND Lào" OR "Myanmar" OR "Miến Điện" OR "Malaysia" OR "Brunei" OR "Brunei Darussalam" OR "Ấn Độ" OR "Sri Lanka" OR "Nepal" OR "Pakistan" OR "Bangladesh" OR "Bhutan" OR "Afghanistan" OR "Bắc Triều Tiên" OR "Cộng hòa Dân chủ Nhân dân Triều Tiên" OR "Mông Cổ"

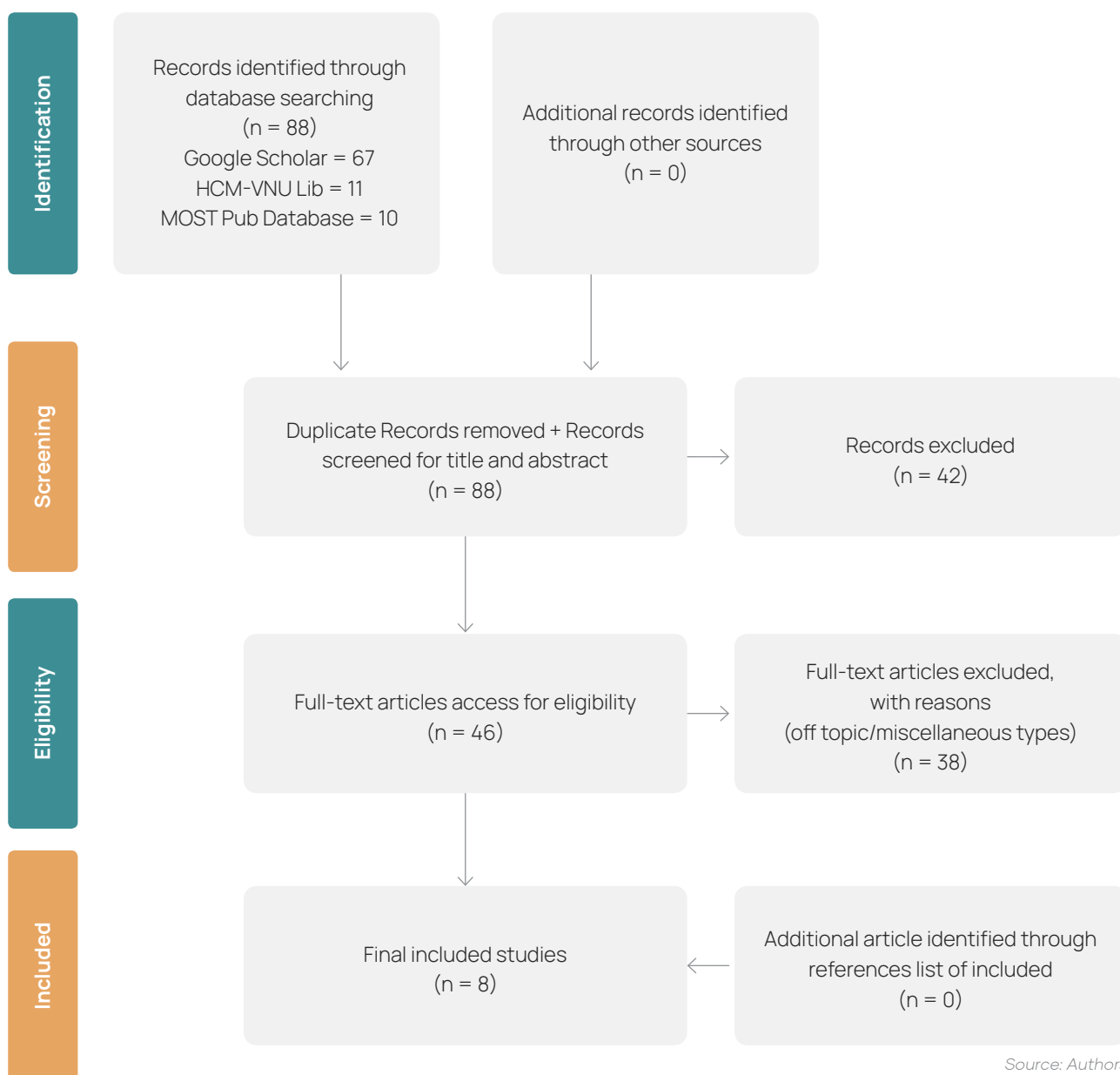
Source: Authors

APPENDIX: METHODOLOGICAL APPROACH

4 Full database search and screening

The process of searching, identifying and screening documents was based on the following Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) diagram. Through our search strings, we identified 88 works related to the research topic, including research articles, books, and dissertations. After filtering these works based on the criteria listed in Table 4, by reviewing all titles, abstracts, and full texts, we retained eight documents for the systematic review.

Figure 1. Flow diagram of screening process of included studies on the impacts of climate change on Asian urban outdoor workers's health



5

Data extraction

After full text screening, the final set of eight studies was systematically extracted into a data extraction Excel sheet. This structured approach allowed for data to be organised in a tabular format, with rows representing individual papers and columns delineating key themes and sub-themes. These themes were derived from the research questions and emergent patterns within the literature (see Table 6). The key themes included the following: Article reference; Methodology and abstract; Health Impacts of weather extremes for outdoor workers; Types of extreme weather impact on the health of outdoor workers; Forms of outdoor working that are most health exposed to weather extremes; Coping strategies; Policy actions and recommendations; and Reflections. Each theme comprised several subthemes that represented the columns in the extraction document.

This tabular organisation facilitated efficient data interpretation by linking summaries of the papers to specific research questions, thereby making it easier to locate and view evidence related to individual research objectives. Additionally, the extraction document provided a means for reviewers to revisit original sources if summaries were ambiguous or additional information was required.

To ensure comparability between the Vietnamese and English-language systematic reviews, the data extraction sheets were designed to follow a consistent format, allowing for direct comparison of findings across both reviews.

Table 6. Data extraction framework: column groups and columns

Themes (column groups)	Sub-themes (columns)
Article reference	Author(s)
	Title
	Date (year)
	Journal / Source
	Full reference
Methodology and abstract	Abstract
	Summary of key findings and arguments
	Methods used
	Themes covered in depth
RQ1. Health impacts of weather extremes for outdoor workers	Demographics of the sample
	Health impacts – Type
	Health impacts – Severity
	Nature of societal vulnerabilities identified
RQ2. Types of extreme weather impact on the health of outdoor workers	Impacts of climate adaptation/mitigation
	Extreme weather - Type and Forms
RQ3. Forms of outdoor working that are most health exposed to weather extremes	Outdoor work – Types;
	Outdoor work - Social groups
RQ4. Coping strategies	What coping strategies are adopted to escape from weather extremes
	What coping strategies are adopted to adapt to weather extremes
Policy recommendations	Actions
	Recommendations
Reflections	Gaps and limitations
	Suggestions for future research

Source: Authors



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Source: Freepik.com

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