

Occupational Health in the Age of Climate Change: A Review of Emerging Challenges and Strategic Interventions

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ABSTRACT

This paper explores the growing connection between occupational health and climate change, emphasizing the emerging challenges faced by workers as global temperatures rise. It highlights how extreme environmental conditions – such as heat, air pollution, and vector-borne diseases – are increasing health risks, especially for outdoor and low-income workers in developing countries. The review identifies key issues including heat stress, respiratory problems, poor infrastructure, and policy implementation gaps, particularly in informal sectors like agriculture and construction. By synthesizing literature from 2014 to 2024 and incorporating new global policy frameworks, the study reveals both physical and psychological risks, such as eco-anxiety. It underscores the urgent need for climate-adaptive occupational health policies, including risk assessments, telehealth services, and resilient workplace strategies.

INTRODUCTION

Climate change is now a problem that affects workers every day. According to the Intergovernmental Panel on Climate Change (IPCC), climate change refers to lasting changes in temperatures and weather and it is now a main cause of health and safety risks for workers in different sectors (Jia & Jia, 2024). Warming temperatures worldwide, more intense wildfires, air pollution, the movement of disease carriers and extreme weather events are causing new health risks at work, so we must rethink occupational health from a climate perspective.

Occupational health which was mainly concerned with chemical, ergonomic and mechanical hazards, is now required to address risks caused by environmental damage and unstable ecology (Applebaum et al., 2016). People working outdoors or in hard physical jobs are more likely to suffer from heat exhaustion, breathing problems and stress. This review aims to look at how climate change is affecting the field of occupational health. The conversation centers on major issues, areas where each sector is vulnerable, global climate policies and new ideas to make workplaces resistant to climate change.

LITERATURE REVIEW

Theoretical Frameworks in Occupational Climate Health

Climate change is a rising challenge that cuts across multiple areas of public health, and multi-dimensional theories are necessary to comprehend its impacts on occupational health. Ecological public health and environmental justice frameworks form a critical lens to scrutinize the health risks caused by climate change.

Ecological Public Health Theory

Ecological public health points out the dependence on human health and environmental systems. It also argues that human health cannot be comprehended without a view of the environmental setting, where individuals are exposed and act. With climatic changes comes disturbance to the ecosystem, bringing newer routes of disease spreading, changing air quality, and exposure to heat. The theory in the context of occupational health advances the notion that directly proportional to workers' health depends on the environment, including the increase in temperature and air pollution. Therefore, realize that safeguarding workers' health involves knowing and understanding the greater environmental changes caused by climate change.

Environmental Justice Theory

The environmental justice theory highlights the environmental disparities regarding social and economic divides. It points out that levels of the adverse health effects of environmental degradation are disproportionately distributed among underserved people, those in the outdoor workplaces, and the informal sector economy. Such a view will be significant in bringing about this issue in the context that some have a greater danger of having occupational health issues because of climate change, especially groups of vulnerable working conditions in developing countries. Such laborers tend to lack the resources and healthcare

and occupational safety needed to prevent the impact of climatic effects on their health. Thus, these systemic inequities must be part of any effective occupational health response.

Emerging Occupational Health Challenges from Climate Change

It is now clear from recent studies that climate variables can impact the health of workers. According to Schulte et al. (2023), the biggest risks come from warmer temperatures, changes in how diseases spread, poorer air quality and stress caused by climate change.

Extreme Heat and Heat Stress

Heat stress is one of the most common risks caused by climate change. People working in agriculture, construction and outdoor services are often exposed to temperatures that are too high. Applebaum et al. (2016) and Levi et al. (2018) point out that just a few hours of high heat can lead to dehydration, heatstroke, heart problems and a drop in mental function which can affect both safety and productivity.

Table 1. Reported Occupational Health Effects of Excessive Heat Exposure

Effect	Affected Sector	Health Outcome
Heat exhaustion	Agriculture	Dehydration, fatigue
Heatstroke	Construction	Cognitive dysfunction, potential fatality
Kidney disease	Sugarcane harvesting (Mesoamerica)	Chronic kidney failure

Source: Adapted from Levi et al. (2018); Ansah et al. (2021).

Poor Air Quality

Ozone, fine particulate matter (PM2.5) and smoke from wildfires in the air can harm people's lungs. Those who work in cities or as firefighters are at a higher risk. Schulte et al. (2023) find that when air quality is poor, there are more hospitalizations for respiratory problems among outdoor workers. Wildfire smoke, full of PM2.5 and carbon monoxide, can cause lung problems and raise the risk of chronic bronchitis.

Vector-Borne Diseases

Higher temperatures and different patterns of rainfall have affected where mosquitoes and ticks can be found. Lyme disease, dengue and Zika virus are becoming more common for outdoor workers (Levi et al., 2018). It is especially important for people in agriculture, forestry and developing countries where disease monitoring is not strong.

Mental Health Effects

The effects of climate change on workers' mental health are becoming more important. Worrying about extreme weather, feeling sad about environmental changes and experiencing trauma from disasters (such as hurricanes and floods) can raise stress and affect how well someone does their

job. Jia & Jia (2024) point out that mental health is not given enough attention in occupational safety, even though there is clear proof that eco-anxiety and PTSD affect emergency responders and displaced workers.

Infrastructure and Emergency Burdens

Problems with infrastructure due to climate change such as power outages, broken equipment and collapsing structures, increase the risks for workers in disasters. When heatwaves, floods or wildfires occur, it is health professionals, first responders and critical utility workers who experience the most operational difficulties (Schulte et al., 2016). As a result, emergency teams are put under more pressure which increases the risk of both physical harm and mental exhaustion.

Sector-Specific Impacts of Climate Change on Occupational Health

Outdoor Workers: Construction and Agriculture

People working outdoors, mainly in agriculture and construction, are the most likely to face climate-related risks. Many of these jobs require workers to do hard labor in the heat and bright sun. Levi et al. (2018) found that when temperatures are above 32°C, labor productivity can fall by up to 14% and the losses are even greater in tropical and subtropical areas.

Construction workers face high temperatures, UV radiation, dust and the chance of being hit by sudden bad weather. In addition, climate change makes the conditions in agriculture even more hazardous. Because field workers are exposed to heat many times without proper rest or water, they may experience dehydration, acute renal injury or chronic kidney disease which is known as Mesoamerican Nephropathy (Levi et al., 2018).

Table 2. Climate-Related Hazards Faced by Outdoor Workers

Occupation	Hazard	Consequence
Agriculture	Heat stress, vector-borne diseases	Kidney failure, infectious illness
Construction	Heat, storms, UV radiation	Falls, burns, skin cancer

Source: Adapted from Levi et al. (2018) and Applebaum et al. (2016)

Along with physical health, being exposed to climate stressors for a long time can reduce attention, cause people to take more risks and increase the chance of accidents at work (Schulte et al., 2016). As a result, we should have strict heat safety rules, accessible water stations, required breaks and educate many people about climate health risks.

Industrial Workers: Power Plants, Refineries, and Manufacturing

Most industrial areas are in cities or near them and depend on cooling and electricity to ensure the safety of those working there. When heatwaves or power outages happen often, the temperature inside homes may become dangerous. The risk for workers includes both the heat in the air and the heat produced by machinery. In addition, workers at refineries and chemical plants are now more

likely to deal with climate-related risks such as greater numbers of chemical spills due to flooding or storms and unpredictable chemical reactions in hot weather (Applebaum et al., 2016). It is becoming clear that heat can make chemical toxicity worse. For instance, in hot weather, pesticides and ozone become more likely to cause respiratory illness or chemical burns (Applebaum et al., 2016).

Health Workers and Emergency Responders

Disaster response relies on healthcare professionals, firefighters and emergency service workers, but they themselves are under a lot of pressure when dealing with climate events. A combination of more patients, breakdowns in healthcare facilities and exposure to dangerous areas creates many occupational hazards for healthcare workers. Jia and Jia (2024) point out that emergency workers dealing with wildfires, floods or disease outbreaks experience both physical and mental stress. In emergencies caused by climate change such as hurricanes or heatwaves, hospitals may become very busy and lack resources, making staff work for long hours in unsafe conditions. Not having enough PPE, air filtration and temperature control increases the risk of burnout and injuries at work.

Rural vs. Urban Contexts

The way climate risks appear is not the same for rural and urban jobs. Since rural areas are often not well prepared for emergencies, they may face greater damage from flooding, drought and heatwaves. People in rural areas who work in farming, herding or handicrafts usually operate in economies that are not well regulated or protected by labor laws (Ansah et al., 2021). Meanwhile, city workers enjoy improved infrastructure, but they also suffer from air pollution, hot city temperatures and overcrowded emergency services. Those who work in urban slums such as waste pickers or street vendors, are at great risk but are not recognized by formal occupational safety groups (Kadungure et al., 2023).

Developing Country Case Studies

To make the theoretical ideas applicable, this part will highlight a case study of India and Kenya, showing that climate change has become a significant challenge to workers in various industries. These case studies hint at how established occupational health risks, e.g., heat stress and disease transmission, are experienced in developing countries and how there is an unevenness in the risks experienced by applying measures or policies.

India: Heat Stress in the Construction Sector

The increase in temperature and heat waves in India has affected the outside employees, particularly the construction industry workers. It is hot in India, and heat lately in the form of heatwaves is a common occurrence; because of these heatwaves, the workers in cities such as Delhi and Mumbai city are exposed to extreme weather conditions, and more often than not, these workers are subjected to work long and direct under the sun. Levi et al. (2018) findings reveal that Indian construction workers are at risk of developing heat-related

conditions such as heat stroke and dehydration. Regrettably, no strict occupational health policies deal with heat stress, especially in the informal industry where most construction workers are hired. Most workers lack simple protective measures like water, shade, or cooling systems. As a result, the morbidity of heat is increasing, and the broader impacts on public health include a decrease in the workforce's productivity and increased healthcare expenses; even though it is evident that prevention programs against heat stress should be implemented, regulations to ensure this has not been implemented promptly.

Kenya: Vector-Borne Diseases in Agriculture

In Kenya, the effects of climate change are better felt in the farming sector, whereby the patterns of rainfall and increase in temperature have led to changes in the location and behavior of disease carriers. Diseases transmitted by mosquitoes, such as malaria and dengue fever, and Lyme disease (transmitted by ticks) are now more common in rural locations where agricultural laborers are especially susceptible. The workers in the agriculture sector are consistently exposed to these health hazards, given that outdoor labor forms a great deal of the agricultural sector. Warmer temperatures have made the malaria burden rise in Kenya, where previously it had been scarce, as it presents a favorable environment for mosquitoes (Levi et al., 2018). The Kenyan government has done a few things to curb these problems. However, challenges like lack of health facilities, poor access to health services, and little climate-resistant workplace practices have been major setbacks for rural agricultural workers. Moreover, a significant portion of the informal sector workers, such as small-scale farmers, are not covered by the formal labor legislation and thus are more exposed to climate-related and health-related risks.

Global Policy and Regulatory Responses

While international organizations are recognizing the link between occupational health and climate change, there are still gaps in both making and carrying out policies. Many international organizations have created guidelines to protect workers from climate dangers, but how well these are implemented differs greatly from one area to another and from one industry to another.

World Health Organization (WHO)

The WHO has made it clear that climate change affects health and that occupational health should be part of strategies for adapting to climate change. Their "Health and Climate Change Global Survey" urges governments to add occupational risks to their national climate policies. Most WHO policies are meant as suggestions and must be enforced by the countries themselves. Applebaum et al. (2016) report that it takes a long time for high-level occupational health frameworks to become binding regulations in low- and middle-income countries.

International Labour Organization (ILO)

The ILO is very important for setting standards and advocating for workers. The "Guidelines for a Safe and Healthy Working Environment" are one

of the most detailed sources on climate-related hazards (ILO, 2024). The ILO concentrates on several important areas:

- Understanding that heat stress is an occupational hazard
- Encouraging the use of PPE that can withstand climate change
- Providing workers with rights as climate changes (such as through green jobs programs)

In the interview, Cosme (2025), director of ILO France, pointed out that many workers in the Global South are not protected from climate change by either laws or safe working conditions. The ILO has stepped up its help to member states by providing technical assistance and financial support.

Occupational Safety and Health Administration (OSHA) and NIOSH

Both OSHA and NIOSH in the United States have introduced initiatives to deal with climate change. Some of the main efforts are:

- NIOSH Climate Change Initiative which is focused on studying and creating strategies that help protect workers in a changing climate (CDC, 2024).
- OSHA is urging industries that work outside to encourage their employees to drink water, rest and find shade (OSHA, 2019).

Still, many experts such as Schulte et al. (2023), believe that the rules in place are not keeping up with the speed of climate change. OSHA's rules are mostly designed for formal workplaces, not for people in the gig economy or those working informally.

Challenges in Policy Implementation

Although many nations agree on the urgency of climate-related risks at work, putting policies into action is still a problem.

- Climate policy is handled by environmental agencies and occupational health is handled by other agencies
- Developing countries are limited by their budgets and do not have access to advanced systems for monitoring risks (Ansah et al., 2021)
- Not enough local information on climate and health among workers makes it hard to design successful interventions (Schulte et al., 2023)

To address these issues, we need both cooperation between different sectors and climate-aware health monitoring. Actionable and fair protections for workers should be developed by public health professionals, urban planners, labor inspectors and environmental scientists.

Best Practices and Innovative Strategies

With climate-related threats to workers on the rise, the usual workplace health and safety systems are no longer enough. Various new strategies, including technology, behavior, policies and infrastructure, should be used to protect workplaces from climate change.

Heat Stress Prevention Programs

Heat stress is a fast-acting and serious danger to workers because of climate change. As a result, several sectors have introduced heat stress

prevention programs that are more thorough than just providing water and rest. Usually, these strategies are based on the three-pillar model: engineering, administrative and personal protective controls.

- Engineering controls involve setting up cooling fans, shaded areas and areas with climate control
- To use administrative controls, workers should follow heat acclimatization steps, work in shifts that avoid hot hours and take regular breaks
- Today, PPE includes clothing that allows air to circulate, cooling vests and hydration monitors that warn workers when they are losing fluid

For example, the U.S. Department of Labor’s Heat Illness Prevention Campaign promotes the mantra: "Water. Rest. Shade." Still, according to Applebaum et al. (2016), passive approaches are not enough in regions where humidity stays high or where workers do a lot of manual labor without machines. New biometric heat stress systems and mobile health apps can greatly enhance how prevention strategies are carried out.

Table 3. Elements of Comprehensive Heat Stress Mitigation

Strategy Type	Intervention Example	Impact
Engineering	Mobile shaded rest stations	Reduces core body temperature
Administrative	Adjusted shift patterns	Limits exposure during peak heat
Personal Equipment	Cooling vests and hydration packs	Enhances thermoregulation and hydration

Source: Adapted from Schulte et al. (2023) and Applebaum et al. (2016)

Resilient PPE and Climate-Adaptive Workplace Design

Personal protective equipment (PPE) has usually been created to protect against mechanical, chemical and biological hazards. Even so, climate change creates new issues for the effectiveness of PPE (Verbeek et al., 2020). When it is very hot, wearing standard PPE can actually make things worse by trapping heat or moisture which can cause heat exhaustion or skin irritation (Jia & Jia, 2024). As a result, manufacturers and occupational health agencies are creating PPE that can withstand climate changes:

- Uses materials that allow air to pass through and reflect heat
- It is lighter than before but still offers protection
- Works with wearable devices to keep track of health in real time

In addition to personal PPE, workplaces are being designed differently. To reduce heating and improve air quality, workspaces are now being updated with passive cooling, better ventilation, reflective roofing and green walls (Kamdin Parsakia & Tabar, 2024). Such adaptations are most important in health care, factories and places that are often hit by disasters. In the field, portable shade tents and insulated water containers are now necessary for safety.

Climate-Informed Occupational Risk Assessments

In most cases, traditional risk assessments for occupations do not pay enough attention to climate factors. Schulte et al. (2016) point out that including climate projections in health planning helps ensure safety for the future. This entails:

- Estimating heat indexes for the future and the limits for exposure
- Looking at chemical reactions that take place at higher temperatures
- Predicting how disease vectors move from one place to another
- Using air quality forecasts in the system

As an example, some agricultural sectors in Latin America now plan their work schedules using long-term weather forecasts to avoid days when diseases are most active and ozone levels are high (Levi et al., 2018). Furthermore, geo-mapping is now employed to locate areas where occupational risk is particularly high. NIOSH's Climate Initiative supports the use of a risk matrix that includes risks from the environment, biology and psychology in a single model. This approach allows regulators and employers to see the different ways that various factors are linked (Schulte et al., 2023).

Telehealth and Digital Support for Remote Workers

The rise of remote work, digital job sites and decentralized labor has transformed how occupational health services are delivered. As the climate becomes more unpredictable, telehealth has become very important for people who work remotely and have trouble getting to regular clinics. Telehealth services are made up of:

- Online appointments for symptoms caused by heat or pollution
- Monitoring health by wearing sensors for heart rate and hydration
- Mental health check-ups which include therapy and stress management
- Apps that send instant notifications about weather dangers and suggest what to do at work

Telehealth is useful for emergency cases (such as heatstroke) and for offering regular preventative care to informal and rural workers who are usually not included in formal systems. Kadungure et al. (2023) found that telemedicine has helped waste-pickers and informal agricultural workers in Zimbabwe who are at risk from extreme weather. Although digital strategies are promising, they still need resources for connectivity, devices and health knowledge to achieve true fairness.

Recommendations for Future Action

Since climate change is now a serious threat to workers' health, we need a new and collaborative approach. Protecting workers in all sectors requires that recommendations join research, policy, practice and advocacy.

Addressing Research Gaps

The studies examined show that there are major gaps in knowledge. While attention is growing on extreme heat and diseases spread by insects, other significant areas are not being explored enough.

- The mental health of workers who are affected by climate trauma
- The combined effects of several climate stressors (for example, heat and wildfire smoke)
- Cost-benefit comparisons of preventive and reactive occupational health approaches
- The field of geoengineering and occupational exposure is new and its effects are still unknown (Schulte et al., 2016)

More studies are required that follow the health effects of work over time, with a special focus on older workers, migrants and those working in the informal economy. Bentley et al. (2023) point out that more studies are required on interventions for older workers, who are both more sensitive to heat and less studied.

Table 4. Priority Research Areas for Climate-Affected Occupational Health

Domain	Gap Identified	Recommended Research
Mental Health	Underreporting of climate stress	Longitudinal mental wellness assessments
Informal Sector	Lack of occupational data	Participatory research in informal economies
Built Environment	Limited adaptation data	Evaluations of passive cooling architecture

Source: Compiled from Jia & Jia (2024); Schulte et al. (2016); Bentley et al. (2023)

Policy Development and Institutional Reform

Policies should be designed to address the many challenges in climate-related occupational health. The rules in place are scattered and tend to react to problems. A holistic framework should cover all of the following:

- Climate risk assessments should be required in all workplace safety audits
- Ensuring that climate-sensitive jobs are included in labor laws
- Subsidies from the government for climate-adaptive infrastructure in small enterprises
- Organizations that combine health, labor and environmental management

In Zimbabwe, early efforts at collaborative governance prove that when workers, municipal governments and NGOs join forces to create policies, they can address weaknesses more successfully than a single top-down approach (Kadungure et al., 2023). It is important for international organizations to urge the creation of a Global Occupational Climate Standard that unites actions worldwide but still allows for local differences. Foster (2022) believe that climate change is a very difficult problem and requires policies that prevent future harm and encourage everyone to be sustainable.

Multidisciplinary Collaboration

Successful actions are possible when different sectors cooperate. The relationship between climate, health, labor, economics and social justice is so

complex that it cannot be handled by separate institutions. Important strategies are:

- Setting up regional centers for monitoring occupational health and the climate
- Involving urban planners and architects in designing offices
- Working together with universities, unions and public health agencies to improve worker education
- Adding climate-health topics to both medical and vocational training

Monroe et al. (2019) point out in climate education research that giving individual's information they can use makes them more prepared and able to respond to climate risks. They should be ready to use both diagnostic tools and climate adaptation frameworks to address all types of emerging issues.

METHODOLOGY

This literature review follows a structured approach to gather, analyze, and synthesize relevant studies on the intersection of occupational health and climate change. Below is a breakdown of the methodology, using both narrative and tables to clarify the process.

Search Strategy

A comprehensive search was conducted using several academic databases. The search aimed to identify relevant articles published between **2014 and 2024**, focusing on the impacts of climate change on occupational health. Key search terms included:

- "Climate change and occupational health"
- "Heat stress and outdoor workers"
- "Air quality and workplace health"
- "Vector-borne diseases and labor sectors"
- "Mental health and climate change in workplaces"

Table 5. Search Terms

Database	Search Terms	Timeframe	Language
PubMed	Climate change and occupational health	2014-2024	English
Scopus	Heat stress, outdoor workers	2014-2024	English
Google Scholar	Vector-borne diseases, mental health and climate change	2014-2024	English

Selection Criteria

Inclusion Criteria:

- Peer-reviewed journal articles and reports published between **2014 and 2024**.
- Studies that explicitly address the effects of climate change on occupational health.
- Research focusing on various worker sectors, particularly those in developing countries or vulnerable populations.

Exclusion Criteria:

- Articles that do not focus on occupational health or climate change impacts.
- Non-peer-reviewed literature (e.g., opinion pieces, non-scholarly reports).
- Studies outside the selected timeframe.

Data Extraction and Analysis

Data extraction was done systematically, focusing on the following risks:

Table 6. Data extraction

Risk Factor	Affected Sectors	Health Impact
Heat-related impacts	Agriculture, Construction, Outdoor services	Heat exhaustion, heatstroke, dehydration
Air quality	Industrial workers, Firefighters	Respiratory illness, chronic bronchitis
Vector-borne diseases	Agriculture, Forestry	Malaria, Zika, Lyme disease
Mental health effects	Emergency responders, outdoor workers	Eco-anxiety, PTSD, stress

Analytical Approach

The literature synthesis comprised a qualitative thematic analysis establishing central themes and trends. Such themes were grouped according to climate-related risks, workers sector affected, and geographical regions. Statistics such as heart diseases and work rate loss due to heat were considered, though they were not thoroughly examined or compared with other sectors.

RESULTS AND DISCUSSION

Overview of Key Findings

Both literature and case studies show that climate change is already changing the field of occupational health worldwide. Heat stress, poor air quality, diseases spread by insects and stress caused by climate change are happening more often and are getting worse. These dangers in occupational health are more common among outdoor workers, those with low incomes and people working in informal sectors in developing countries.

Schulte et al. (2023) point out that although some countries are adjusting their occupational health policies for climate change, the world's efforts are still spread out and not enough. Both the ILO and WHO have developed international guidance, yet its application at the local and national levels is not always consistent, especially where there are weak regulations.

The review points out that there is not enough connection between public health policy and occupational safety systems. Such a divided system has slowed the response to climate risks, made monitoring difficult and limited how much the public knows. Additionally, a lot of existing occupational health interventions were not built to be climate-resilient and only a small number have been updated or changed.

Table 5. Summary of Key Findings

Domain	Finding	Implication
Policy	Fragmented and under-enforced frameworks	Requires integrated, binding climate-health policies
Research	Gaps in mental health and informal worker data	Future research needed to address equity and inclusion
Practice	Promising tools (e.g., telehealth, PPE) not yet scalable	Calls for investment and capacity building
Exposure	Disproportionate burden on outdoor/informal workers	Equity-focused protections are essential

Source: Author's synthesis based on Schulte et al. (2023), Jia & Jia (2024), Ansah et al. (2021)

Heat Stress and Productivity Loss

Heat stress is the occupational health effect that is easiest to measure and happens most quickly. Levi et al. (2018) present strong evidence that rising ambient temperatures cause both economic losses and harm to health. Exposure to temperatures above 32°C in farming and construction reduces work by about 10–15% and the losses are greater in tropical regions and for tasks that require a lot of effort.

In addition to lost work, there are growing health-related costs. Many workers who are exposed to heat for a long time without proper protection often suffer from dehydration, heart strain and kidney damage (Chapman et al., 2021). In Central America, sugarcane workers are often affected by Mesoamerican nephropathy which is caused by the dangerous mix of climate, heavy work and insufficient safety measures (Levi et al., 2018). This research highlights the need for better heat-acclimatization programs, better buildings and maps that show risks related to climate.

Climate-Linked Air Quality Hazards

More frequent and stronger wildfires, along with higher emissions from industry and cities, have led to poorer air quality everywhere. Schulte et al. (2023) found that air pollution is now considered one of the top five environmental causes of death and outdoor workers and residents of crowded cities are especially at risk. However, most occupational health policies do not monitor air quality or set exposure guidelines that react to current levels of PM2.5 (Kelly & Fussell, 2015).

Respiratory distress can happen quickly when people are exposed to airborne irritants and it may also lead to chronic conditions such as asthma and COPD. When heat and pollution are found together in industrial areas, the combination can raise the risks of breathing in chemicals and regulating body temperature (Applebaum et al., 2016). This points out that many occupational

safety programs often miss the impact of several climate stressors working together.

Vector-Borne Disease and Disease Ecology

Due to higher temperatures and different rainfall patterns around the globe, diseases such as malaria, dengue, chikungunya and Lyme disease are moving into new areas. Agriculture and forestry workers are more likely to be infected because they work outdoors for longer periods. Jia & Jia (2024) and Levi et al. (2018) point out that changes in disease ecology such as more places for vectors to live, longer breeding seasons and less effective pesticides, require a fresh look at disease prevention at work.

Although the risks are well known, many occupational health programs do not actively control vectors or teach workers how to spot and deal with symptoms of vector-borne diseases. For disease ecology to be part of occupational health planning, environmental scientists, epidemiologists and labor safety experts must collaborate closely.

Mental Health and Psychosocial Effects

Most of the discussion about climate-occupational health focuses on physical health, but psychosocial issues such as anxiety, depression and trauma are being recognized more often. People affected by climate disasters, those responding to emergencies and those in unstable jobs are all exposed to ongoing mental health issues. Kamdin Parsakia & Tabar (2024) explain that being exposed to climate-related stress over time can cause people to have trouble concentrating, miss work, use drugs or alcohol or even consider suicide. The issue is made worse by the stigma that exists around mental health in areas like construction and mining that are mostly staffed by men (Vergunst et al., 2022). It is now important to make mental health support a standard part of occupational health. Anonymous tele-counseling, peer support groups and climate grief workshops should be tested and expanded especially in areas where burnout is common.

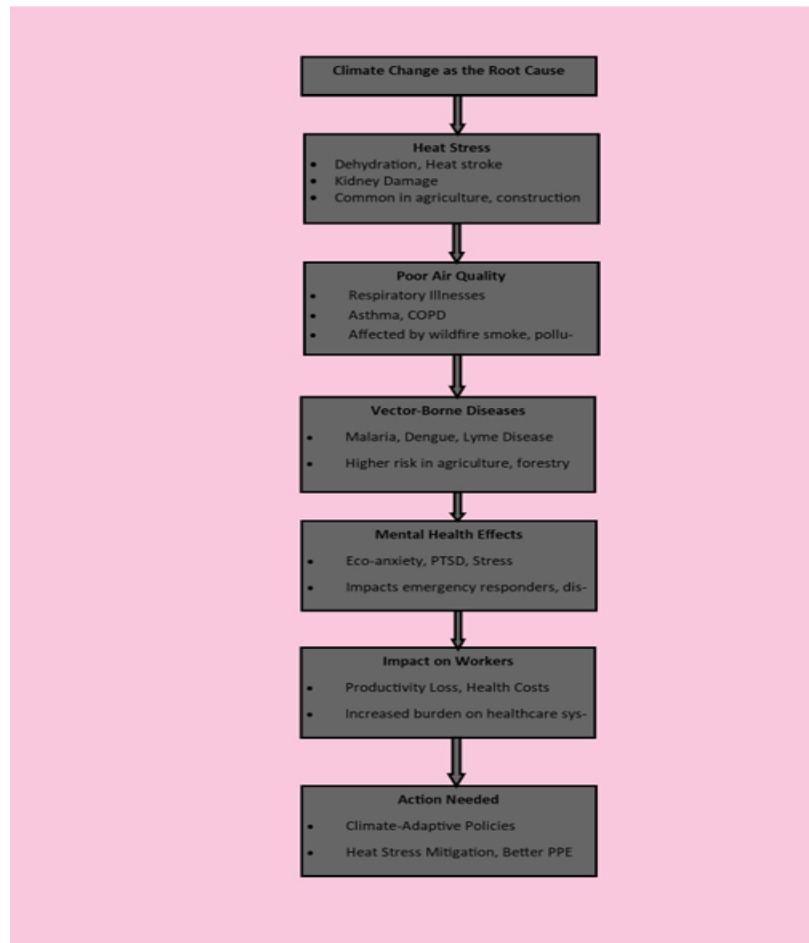


Figure 1. Research Concept

CONCLUSIONS AND RECOMMENDATIONS

Climate change is already causing problems for worker safety, health, productivity and human dignity. The findings from the review make it obvious that workers in outdoor, industrial and informal sectors are exposed to more risks from heat stress, poor air quality, infectious diseases and mental stress than other workers. Such risks are made worse by unequal social and economic situations, poor enforcement of rules and scattered approaches to policies.

While the WHO, ILO, OSHA and NIOSH have helped raise awareness of the link between climate change and workers' health, the actions taken so far are not enough. In many cases, policies are only suggestions; there are innovative ideas, but they lack funding; and those most at risk are not involved in planning or protected. Going ahead, climate adaptation and mitigation efforts should put occupational health at their core. As a result, we should reconsider the way we design offices, defend workers, train staff, make laws and cooperate (Ansah et al., 2021). Both employers and governments should be responsible for climate resilience and governments should also fill in regulatory gaps and invest in data, education and infrastructure. A better future for workers requires different fields to join forces, fair health policies and a lasting effort to include climate science in occupational health (Jain et al., 2024). Only after that can we ensure that workers' health and safety are protected as the world warms rapidly.

ADVANCE RESEARCH

Even with the wide range of evidence examined, there are still some issues that need to be acknowledged and handled in future studies.

Methodological Constraints

The main sources for this review are recent peer-reviewed studies and reports from institutions. Even though it is comprehensive, it may not fully reflect:

- Views from less studied regions in the Global South
- Information from grassroots organizations in the form of grey literature and policy briefs
- Information collected in real time from informal and rural areas

Also, while secondary data synthesis helps us see the big picture, studying specific groups of people over time and monitoring health in different jobs would give us a clearer view of how climate hazards change.

Underexplored Populations

The needs of older workers, women working in the informal economy, people with disabilities and indigenous workers are not well documented. Bentley et al. (2023) note that older adults need special interventions that address their sensitivity to heat, health problems and reduced ability to cope with physical work. In the same way, Kadungure et al. (2023) state that informal urban workers are often overlooked in occupational health discussions and need their own research and policy focus.

Future Research Priorities

Going ahead, future research should focus on:

- The overall effect of several climate stresses
- Studies on how much adaptive workplace interventions cost
- Geoengineering and the move to new industries and how it affects jobs
- How people at work react to climate risk (for example, following rules and noticing risks)
- The use of AI and digital tools for both risk prediction and mental health support

Researchers should move away from responding to disasters and instead use anticipatory, inclusive and fair models that focus on the health and safety of workers.

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