



International
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Ensuring safety and health at work in a changing climate

Global report



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List of abbreviations

ARPANSA	Australian Radiation Protection and Nuclear Safety Agency
BBC	Basal cell carcinoma
BWI	Building and Wood Workers' International
CCOHS	Canadian Centre for Occupational Health and Safety
CKDu	Chronic kidney disease of unknown aetiology
COPD	Chronic obstructive pulmonary disease
COP28	28th Conference of the Parties to the UNFCCC
DALY	Disability-adjusted life year
EU	European Union
FAO	Food and Agriculture Organization of the United Nations
GDP	Gross domestic product
GHS	Globally Harmonized System of Classification and Labelling of Chemicals
HHP	Highly hazardous pesticide
HSE	UK Health and Safety Executive
IARC	International Agency for Research on Cancer
IFA	International Framework Agreement
ILO	International Labour Organization
INAIL	Italian National Institute for Insurance against Accidents at Work
ITUC	International Trade Union Confederation
LMIC	Low- and middle-income country
MIA	Major industrial accident
NIOSH	US National Institute for Occupational Safety and Health
OEL	Occupational exposure limits
OSH	Occupational safety and health
OSHA	US Occupational Safety and Health Administration
PCBU	Person conducting a business or undertaking
PPE	Personal protective equipment
SCC	Squamous cell carcinoma
SUSESO	Chilean Social Security Superintendence Authority
UAPP	Unintentional acute pesticide poisoning
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
UV	Ultraviolet
WBGT	Wet bulb globe temperature



Executive summary

Climate change is already having serious impacts on the safety and health of workers in all regions of the world. Workers are among those most exposed to climate change hazards yet frequently have no choice but to continue working, even if conditions are dangerous. Global occupational safety and health (OSH) protections have struggled to keep up with the evolving risks from climate change, resulting in worker mortality and morbidity.



Collaborative efforts are needed to develop and implement effective mitigation and adaptation measures to protect workers across the globe. The International Labour Organization (ILO) has adopted more than 40 standards specifically related to OSH, which provide policy solutions for dealing with the effects of climate change on communities, workers and enterprises. Furthermore, the Guidelines for a Just Transition towards Environmentally Sustainable Economies and Societies for All (ILO 2015) can help to promote a safe and healthy working environment by supporting workers and employers throughout the transition to a low-carbon economy.





In June 2023, the International Labour Conference urged constituents to implement OSH measures for all workers impacted by climate-related risks and extreme weather events and asked the ILO to consider convening a tripartite meeting on OSH in extreme weather events and changing weather patterns. This report presents critical evidence related to six key impacts of climate change on OSH, which were chosen for their severity and the magnitude of their effects on workers: excessive heat, solar ultraviolet (UV) radiation, extreme weather events, workplace air pollution, vector-borne diseases and agrochemicals.

Key takeaways from the report:

- Billions of workers are exposed to hazards exacerbated by climate change.
- Workers across different sectors are exposed to these hazards but some workers, such as agricultural workers and other outdoor workers carrying out heavy labour in hot climates, may be particularly at risk.
- Strong evidence demonstrates that numerous health conditions in workers have been linked to climate change, including cancer, cardiovascular disease, respiratory illnesses, kidney dysfunction and mental health conditions, among many others.
- Every year, an estimated 22.85 million occupational injuries, 18,970 deaths and 2.09 million disability-adjusted life years (DALYs) are attributable to excessive heat alone. Thousands more die from pesticide poisoning (>300,000), workplace air pollution (>860,000), solar UV radiation (>18,960 due to non-melanoma skin cancer alone) and parasitic and vector-borne diseases (>15,170) (Jørs et al. 2018; ILO 2021a; Pega et al. 2023).
- Many countries have implemented new laws to specifically address excessive heat in the working environment. These primarily include maximum temperature limits and guidelines for adaptive measures at the workplace level. For other climate change impacts, protections for workers are mainly integrated into existing OSH or environmental regulations.
- The content of legislation varies considerably between countries, but may include medical surveillance, occupational disease lists, occupational exposure limits (OELs), training and information, risk assessment and workplace preventive measures.
- As climate change hazards evolve and intensify, it will be necessary to re-evaluate existing legislation or create new regulations and guidance. Some worker populations may be especially vulnerable to the effects of climate change and could therefore need extra protections.

- Social dialogue between governments and social partners is essential for ensuring policies are practical and effective at the workplace level.
- OSH policies and programmes should be coordinated among government departments to ensure policy coherence. For example, it may be beneficial to integrate OSH initiatives into public health campaigns.
- In addition to adapting to the climate change impacts outlined in this report, workplaces can contribute to climate mitigation strategies using measures such as improving energy efficiency.
- The scientific evidence base regarding climate change and OSH is limited in many critical areas. Further research is needed to guide policymaking and other responses. Knowledge transfer is also necessary to educate stakeholders.
- Rapid shifts to green and sustainable technologies may create new OSH challenges, especially if appropriate OSH protections have not been implemented. For example, solar panels, compact fluorescent lamps and lithium-ion batteries contain toxic chemicals which are hazardous to worker health.

Climate change and environment-related risks	Examples of workers at high risk	Primary health impacts	Global burden of occupational exposures	Work-related health impacts	Selected responses and progress
1. Excessive heat 	Workers in agriculture, environmental goods and services (natural resource management), construction, refuse collection, emergency repair work, transport, tourism and sports.	Heat stress, heatstroke, heat exhaustion, rhabdomyolysis, heat syncope, heat cramps, heat rash, cardiovascular disease, acute kidney injury, chronic kidney disease, physical injury.	At least 2.41 billion workers exposed annually to excessive heat.	Every year, 22.85 million occupational injuries, 18,970 work-related deaths, and 2.09 million DALYs attributable to excessive heat.	General OSH laws often include basic measures to protect workers from extreme temperatures. However new laws and regulations have already been implemented in many countries as a specific response to excessive heat and are far more comprehensive. These commonly include maximum temperature limits and guidelines for adaptive measures at the workplace level. In line with the ILO List of Occupational Diseases, a number of countries recognize excessive heat-related diseases as occupational diseases. Simple, evidence-based workplace protective measures include acclimatization, self-pacing, hydration, mechanization and clothing.
2. UV radiation 	Outdoor workers, including in construction and agriculture, lifeguards, power utility workers, gardeners, postal workers and dock workers.	Sunburn, skin blistering, acute eye damage, weakened immune systems, pterygium, cataracts, skin cancers.	1.6 billion workers exposed annually to solar UV radiation (Pega et al. 2023).	Over 18,960 work-related deaths annually due to non-melanoma skin cancer alone (Pega et al. 2023).	Some general OSH laws refer to the protection of workers against non-ionizing radiation, including solar UV radiation. However more specific legislation typically focuses on ionizing radiation or artificial radiation, thus excluding solar UV radiation. In line with the ILO List of Occupational Diseases, some countries have included diseases caused by solar UV radiation in their national lists. Simple workplace protective measures include PPE, sunscreen and shaded rest areas.

3. Extreme weather events	 <p>Medical personnel, firefighters, other emergency workers, construction workers involved in clean-up, agricultural and fishing workers.</p>	<p>Various.</p>	<p>Limited data.</p>	<p>2.06 million deaths due to weather, climate and water hazards (not just occupational exposures) from 1970 to 2019 (WMO 2021).</p>	<p>Limited legislation was found protecting workers from the effects of extreme weather events. Some general OSH legislation requires emergency response plans for crisis situations, which include natural disasters, but these are quite broad and do not address new challenges effectively. In a few cases, new regulations have been adopted as a response to a specific issue, such as wildfires. Emergency prevention, preparedness and response are critical components of a national OSH management system.</p>
4. Workplace air pollution	 <p>All workers, with a focus on outdoor workers, transport workers and firefighters.</p>	<p>Cancer (lung), respiratory disease, cardiovascular disease.</p>	<p>Increased risk of exposure to air pollution for the 1.6 billion outdoor workers.</p>	<p>860,000 work-related deaths annually attributable to air pollution (outdoor workers only) (ILO 2021a).</p>	<p>Measures to reduce air pollution are mostly integrated into overall climate change mitigation or public health policies. Traditionally OSH legislation addresses air quality, however predominantly in the context of preventing dust and fumes in indoor facilities, rather than in outdoor work environments. OELs exist for some air pollutants, but again are mainly linked to indoor work. Engineering controls (e.g., adequate ventilation systems) are not usually applicable outdoors, but administrative controls, such as rotating job roles, may be effective.</p>
5. Vector-borne diseases	 <p>Outdoor workers including farmers, foresters, landscapers, groundskeepers, gardeners, painters, roofers, pavers, construction workers, firefighters, among others.</p>	<p>Diseases such as malaria, Lyme disease, dengue, schistosomiasis, leishmaniasis, Chagas disease and African trypanosomiasis, among others.</p>	<p>Limited data.</p>	<p>Over 15,170 work-related deaths each year attributable to parasitic and vector diseases.</p>	<p>Where it exists, legislation protecting workers from vector-borne diseases is mainly included in legislation covering biological hazards. Diseases caused by biological hazards are frequently listed as notifiable occupational diseases, although vector-borne diseases are not always mentioned. Extremely limited research exists regarding protection measures for workers specifically.</p>
6. Agrochemicals	 <p>Workers in agriculture, plantations, chemical industries, forestry, pesticide sales, green space and vector control.</p>	<p>Poisoning, cancer, neurotoxicity, endocrine disruption, reproductive disorders, cardiovascular disease, chronic obstructive pulmonary disease (COPD), immune suppression.</p>	<p>Increased risk of exposure to agrochemicals for a significant number of the 873 million workers employed in agriculture.</p>	<p>Over 300,000 deaths annually due to pesticide poisoning (Jørs et al. 2018).</p>	<p>There are numerous examples of national legislation covering the safe manufacture, storage, use and disposal of agrochemicals. Some countries have recognized pesticide-related health concerns in occupational disease lists. There is limited legislation regarding OELs and to date there is no harmonized, internationally agreed list of highly hazardous pesticides (HHPs).</p>



Introduction

Earth's average surface temperature in 2023 was the warmest on record, with July 2023 being the hottest month ever recorded (NASA 2024). Between 2011 and 2020, the average temperature of the Earth's surface was 1.1°C warmer than the average temperature in the late 19th century (IPCC 2022). This has caused widespread and rapid changes to the atmosphere, land, ocean and ice regions. Climate change has resulted in weather and climate extremes on all continents, as evidenced by the increase in the frequency and severity of heatwaves, heavy precipitation, wildfires, droughts and tropical cyclones (IPCC 2021). An analysis by the World Economic Forum found that by 2050, climate change is likely to result in 14.5 million additional deaths worldwide (WEF 2024).

Workers, especially those working outdoors, are frequently the first to be exposed to the consequences of climate change, often for longer periods and at greater intensities than the general population (ILO 2023). They frequently face conditions that the public can choose to avoid (Kiefer et al. 2016). For air pollution alone, more than 1.2 billion workers are exposed and there are over 860,000 deaths annually (ILO 2021a). Occupational safety and health (OSH) policies and practices have struggled to keep up, and workers continue to be exposed to various climate-related hazards. Numerous health effects on workers have been linked to climate change, including injuries, cancer, cardiovascular disease, respiratory conditions, macular degeneration and mental health issues.

Vulnerable populations of workers, for example many migrant workers engaged in construction and agriculture in informal settings, are particularly at risk. Those in the emergency services will work in increasingly hazardous conditions as extreme weather events become more frequent and severe. Currently, 1.2 billion jobs rely directly on the effective management and sustainability of a healthy environment, in particular jobs in farming, fishing and forestry (ILO 2018a). As ecosystems are disrupted and essential resources become scarcer, many jobs in these and other sectors are now at risk.

The financial implications for employers must also be considered, for example due to lost productivity, business disruption and damaged infrastructure, as well as the costs associated with climate change mitigation and adaptation measures as new regulations come into force. Some industries, such as agriculture, conventional energy, heavy industry and manufacturing, transport and construction are projected to be substantially affected by climate change and the net-zero transition (Deloitte 2022).

The time to act is now. Whilst reducing greenhouse gas emissions through mitigation strategies such as those outlined in the United Nations Framework Convention on Climate Change (UNFCCC) remains a global priority, actions should also be taken to address the multifaceted challenge climate change poses for the workplace and OSH. The inclusion of the first ever Health Day at the UNFCCC 28th Conference of the Parties (COP28) creates the opportunity for positioning health, and in particular worker health, at the forefront of the climate change agenda. COP28 resulted in a Declaration on Climate and Health by over 120 countries, with over US\$1 billion pledged to fund projects related to health and climate change (WEF 2024).

In June 2023, the International Labour Conference's General Discussion Committee on Just Transition¹ highlighted the need to "urgently implement OSH measures for all workers impacted by climate-related risks and extreme weather events, addressing the consequences on mental and physical health and promoting safe and healthy working environments." It was consequently proposed that a tripartite meeting on OSH in extreme weather events and changing weather patterns be organized.

Despite this new focus on climate change concerns, it is important to be aware that many of the workplace hazards covered in this report are not themselves new. The ILO has already developed tripartite responses to protect workers against such risks, in the form of international labour standards and other guidance. Furthermore, the inclusion of a safe and healthy working environment as a fundamental principle and right at work means addressing dangerous climate change impacts in the workplace is now a top priority.

¹ ILC.111/ Record No. 7B.

Targeted policies are needed at the national level alongside effective workplace preventive measures to protect workers from the serious impacts of climate change. These include excessive heat, extreme weather events, exposure to hazardous chemicals, air pollution and infectious diseases, among others. There is an urgent need to address these escalating threats, through the integration of climate and environment concerns into OSH policy and practice at all levels, as well the mainstreaming of OSH concerns into climate change action. This is crucial to protect the safety and health of workers and contribute to the ultimate goal of advancing social justice for all.

Aim of this report

This report presents critical evidence related to the impacts of climate change on OSH, to bring attention to the global health threat workers are currently facing. A scoping exercise was conducted to identify the most recent trends and priorities for climate change and worker safety and health. Based on the available evidence, the report addresses the following key issues:

- Excessive heat
- Ultraviolet (UV) radiation
- Extreme weather events
- Workplace air pollution
- Vector-borne diseases
- Agrochemicals

Whilst some of these risks may be considered as primary consequences of climate change (for example excessive heat), others can be regarded as secondary impacts (for example vector-borne diseases and wildfires). These topics were selected due to the severity and magnitude of their effects on worker populations. It is acknowledged that other climate change or environmental impacts do exist, such as different communicable diseases and chemical hazards, however it was not possible to cover all topics in this report. Mental health is touched on in a dedicated box towards the end of the report. The report also highlights the additional OSH risks that may result from certain “greening” practices, which bring with them the need for enhanced risk assessment for workers.

For each climate change-related risk, the report aims to provide the most recent and pertinent evidence regarding worker exposures and the main safety and health effects that result. Each chapter also details existing responses to the risk. At the national level these responses may include policies and strategies, laws, collective agreements, technical guidelines, training programmes, advisory initiatives and awareness-raising campaigns. At the workplace level, ILO guidance and effective actions identified in the research will be outlined. It is hoped that the findings here will stimulate upcoming discussions and provide a sound evidence base for future work in the field.

Climate change and worker safety and health

Strong evidence demonstrates that climate change and environmental degradation can lead to a deterioration of working conditions and an increased risk of occupational injury, disease and death (Kiefer et al. 2016). Aside from human-induced environmental degradation, consideration must also be given to the connections between different climate change impacts. For example, primary impacts such as increased temperatures can lead to secondary effects such as wildfires and droughts, which are themselves also interdependent.

Numerous health conditions in workers have been linked to climate change, including cancer, cardiovascular disease, respiratory illnesses and mental health conditions, among many others (ILO 2023). In general, pregnant women, children, older adults and persons with disabilities are more vulnerable to health stressors such as extreme heat, air pollution and other climate-related events (NIH 2022a).

Different sectors are affected in different ways and to varying degrees. Those at greatest risk include outdoor workers, who often work in physically demanding sectors, such as agriculture, construction and transportation. Also at risk are those working in hot indoor environments or poorly ventilated enclosed spaces that lack adequate air conditions (Gamble et al. 2016). Some working environments may become dangerous especially quickly, for example those which already generate heat, such as bakeries, foundries and laundries. Furthermore, there will be increased pressure on emergency services, the healthcare sector and other public services, with emergency response workers such as firefighters facing increasingly hazardous working conditions.

The effects are unevenly distributed across regions, with certain workers and employers bearing a disproportionate burden of adverse outcomes. The greatest impacts will be felt by the working poor, those working in the informal economy, seasonal workers, and workers in micro and small enterprises (ILO n.d.).

Climate change threatens ecosystems and therefore the 1.2 billion jobs that depend on them, such as farming, forestry and fishing (ILO 2018b). Whole regions may be rendered unproductive and many work environments will be too hot for work. In other areas natural disasters will destroy critical workplace infrastructure and take lives. This will lead to an increase in climate-induced migration, an upsurge in informal work, and rising unemployment (ILO 2018b). For example, if the global temperature increases by 2 degrees Celsius by the end of the century, asylum applications to the European Union (EU) are expected to double (Missirian and Schlenker 2017).

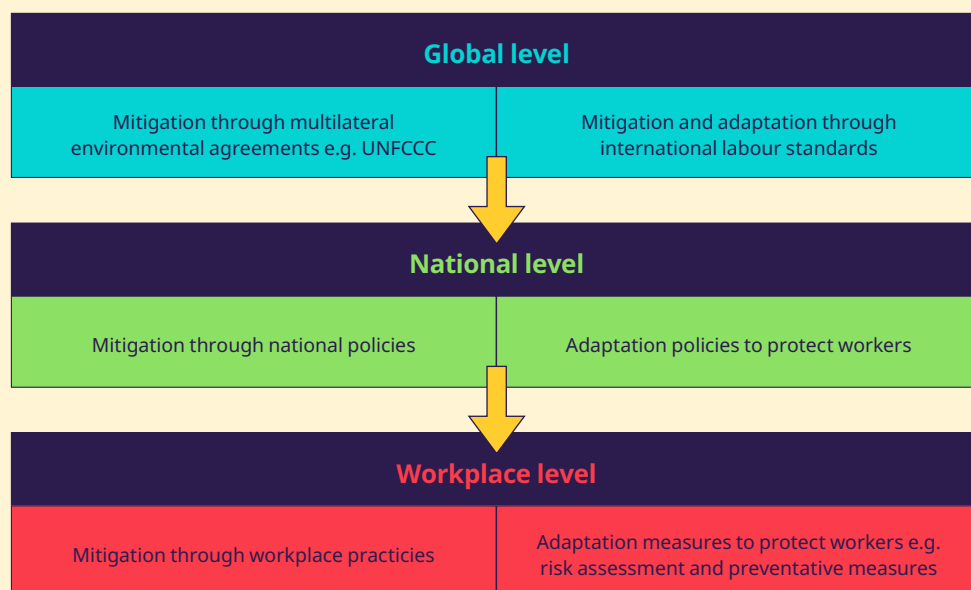
Aside from the climate change impacts explored in this report, other factors will also adversely influence the physical and mental well-being of workers, as well as their ability to work safely. As extreme droughts and water scarcity continue to occur more frequently, access to clean water and sanitation may become limited, leaving workers susceptible to disease (Gulland 2020). The negative impacts of climate change on employment can include job losses, damage to business assets and business interruptions, decreased labour productivity and forced migration (ILO n.d.).

The huge economic costs associated with workplace accidents and diseases are a drain on resources at the workplace, national and global levels. Employers will be impacted by a potential reduction in labour productivity or labour supply (Schulte et al. 2023). Consideration should also be given to financial losses due to increased costs of production, accidents and injuries, and absenteeism (Habibi et al. 2021). Even if global warming is limited to 1.5°C above pre-industrial levels by the end of the century, the accumulated financial loss due to heat-related illnesses alone is expected to reach US\$2.4 trillion by 2030 (ILO 2019a). In the United States of America, the health costs of air pollution and climate change already far exceed US\$800 billion per year and this number is only expected to grow (De Alwis and Limaye 2021).



A global multisectoral response is needed to tackle the impacts of climate change using mitigation and adaptation strategies. Multilateral climate agreements, for example the UNFCCC, are key mitigation strategies in the area of climate change. These go hand in hand with mitigation policies at the national and workplace levels. Climate adaptation efforts are preventive measures to protect workers, economies and communities from the impacts of climate change. Given that climate change mitigation measures are unlikely to take effect for years to come, effective and targeted adaptation policies are critical to ensure safe and healthy working environments (figure 1).

► Figure 1: Mitigation and adaptation at the global, national and workplace levels



► Cross-cutting factors affecting climate change-related OSH risks

Whilst workers all over the world may be adversely impacted by climate change, some face unique exposure situations which place them at higher risk:

- **Women workers** may be at increased risk due to their job roles, such as in subsistence agriculture, and during different life stages; pregnancy-related complications include hypertension, miscarriages and stillbirths (Desai and Zhang 2021; UNICEF 2023).
 - **Men workers** are most likely to carry out heavy manual labour, for example in construction and agriculture, often in hot conditions, and are therefore at high risk of many climate change impacts (Fatima et al. 2021).
 - **Young workers** are often exposed to excessive heat in sectors such as agriculture, construction and waste management and tend to be more likely to have a serious accident at work than older adults, as they may lack maturity, skills, training and experience (EU-OSHA n.d.).
 - **Older adult workers** are particularly susceptible to climate-related hazards, as they are less able to tolerate stress due to slower metabolisms, weaker immune systems and an increased disease burden (Carnes et al. 2014).
 - **Workers with a disability** experience disproportionately higher rates of social risk factors, such as poverty and lower educational attainment, that contribute to poorer health outcomes during extreme weather events or climate-related emergencies (Gamble et al. 2016).
 - **Workers with pre-existing health conditions** may be particularly impacted by climate change risks, as these may exacerbate pre-existing health conditions, including chronic illnesses such as diabetes and heart, kidney and respiratory diseases (Carnes et al. 2014).
 - **Migrant workers** are frequently employed in high-risk, physically demanding occupations, for example as harvest workers, and may be unable to understand OSH procedures and training materials due to language barriers (Schulte et al. 2023).
 - **Workers in the informal economy** are among the workers most at risk of climate change hazards, as they are frequently lacking OSH protections, key services and infrastructure (Dodman et al. 2023). Due to financial concerns, **informal workers**, as well as many **own-account workers**, may also be unable to stop work, even when their health is at risk from extreme climate events.
-



The ILO and climate change

The ILO has recognized the urgent need to address the increasing impacts of climate change on workers' safety and health. With the inclusion of a safe and healthy working environment in the ILO's framework of fundamental principles and rights at work, Member States are required to respect, promote and realize this fundamental right, including by protecting workers from workplace hazards and risks associated with climate change.

The recently adopted ILO Global Strategy on Occupational Safety and Health 2024-30² highlights that OSH concerns related to climate change should be positioned high on global and national policy agendas, with key partnerships secured at national and international levels.

The ILO is strongly committed to the promotion of a Just Transition, recognizing that "greening" the economy should be done in a way that is as fair and inclusive as possible to everyone concerned, creating decent work opportunities and leaving no one behind. In June 2023, the International Labour Conference's General Discussion Committee held a meeting on a Just Transition. The conclusions urged governments, employers' organizations and workers' organizations to "urgently implement OSH measures for all workers impacted by climate-related risks and extreme weather events, addressing the consequences on mental and physical health and promoting safe and healthy working environments." Furthermore, on the basis of the conclusions, the ILO was asked to consider convening a tripartite meeting on OSH in extreme weather events and changing weather patterns, which is now planned as part of the ILO Global Strategy on Occupational Safety and Health Strategy 2024-30 and the plan of action for its implementation.

² ILO Global Strategy on Occupational Safety and Health 2024-30.

International labour standards

International labour standards can strengthen adaptation frameworks by providing the legal foundation for addressing risks related to climate change (ILO 2018b).

The Occupational Safety and Health Convention, 1981 (No. 155) covers workers in all branches of activity and defines the basic principles of a coherent national OSH policy. The key provisions require Member States, in consultation with the most representative employers' and workers' organizations, to formulate, implement and periodically review a coherent national policy on OSH and the working environment, the aim being the prevention of occupational accidents and injuries by eliminating or minimizing the causes of hazards. It also outlines action at the workplace level, defining the responsibilities of employers and the roles of workers and their representatives, emphasizing the importance of cooperation between management and workers and/or their representatives. Furthermore, the Convention provides for protection from undue consequences (in accordance with national conditions and practices) for workers who remove themselves from a work situation which presents an imminent and serious danger to their life or health (Art. 13 and Art. 19(f)). This may also include serious risks related to climate change, as may be the case during and after extreme weather events. The accompanying Occupational Safety and Health Recommendation, 1981 (No. 164) specifies that a national OSH policy should include measures dealing with "temperature, humidity and movement of air in the workplace". Furthermore, the Promotional Framework for Occupational Safety and Health Convention, 2006 (No. 187) states that "[e]ach Member which ratifies this Convention shall promote continuous improvement of occupational safety and health to prevent occupational injuries, diseases and deaths, by the development, in consultation with the most representative organizations of employers and workers, of a national policy, national system and national programme".

Other risk-specific and sector-specific Conventions address particular climate change risks. These include the Prevention of Major Industrial Accidents Convention, 1993 (No. 174) and Recommendation, 1993 (No. 181), which provide for preventive measures to avoid or minimize the consequences of industrial disasters due to chemicals and other hazardous substances, and the Working Environment (Air Pollution, Noise and Vibration) Convention, 1977 (No. 148) and Recommendation, 1977 (No. 156), which contain provisions to protect workers from air pollution.

Also, the List of Occupational Diseases Recommendation, 2002 (No. 194) states that, "[a] national list of occupational diseases for the purpose of prevention, recording, notification and, if applicable, compensation should be established by the competent authority". The list takes into consideration several diseases that can be caused by hazards related to climate change, for example, those caused by physical agents, optical (for example UV) radiation, or exposure to extreme temperatures.

Existing international labour standards and codes of practice related to climate change and OSH

General

climate-related

OSH hazards

- Occupational Safety and Health Convention, 1981 (No. 155)
- Occupational Safety and Health Recommendation, 1981 (No. 164)
- Promotional Framework for Occupational Safety and Health Convention, 2006 (No. 187)
- Promotional Framework for Occupational Safety and Health Recommendation, 2006 (No. 192)
- Occupational Health Services Convention, 1985 (No. 161)
- List of Occupational Diseases Recommendation, 2002 (No. 194)
- Safety and Health in Agriculture Recommendation, 2001 (No. 192)
- Hygiene (Commerce and Office) Recommendation, 1964 (No. 120)
- Workers' Housing Recommendation, 1961 (No. 115)
- Reduction of Hours of Work Recommendation, 1962 (No. 116)
- Protection of Workers' Health Recommendation, 1953 (No. 97)
- Safety and health in construction (revised 2022), Code of Practice
- Safety and health in shipbuilding and ship repair (revised 2019), Code of Practice
- Safety and health in ports (revised 2016), Code of Practice
- Safety and health in forestry (1998), Code of Practice
- Safety and health in opencast mines (1991), Code of Practice



Excessive heat

- Plantations Convention, 1958 (No. 110)
- Ambient factors in the workplace (2001), Code of practice

Ultraviolet (UV)

radiation

- Ambient factors in the workplace (2001), Code of practice

Vector-borne

diseases

- Workers' Housing Recommendation, 1961 (No. 115)
- Technical guidelines on biological hazards in the working environment (2022)



Agrochemicals

- Chemicals Convention, 1990 (No. 170)
- Chemicals Recommendation, 1990 (No. 177)
- Safety and Health in Agriculture Convention, 2001 (No. 184)
- Safety and health in agriculture (2010), Code of practice
- Safety in the use of chemicals at work (1993), Code of practice



Air

pollution

- Working Environment (Air Pollution, Noise and Vibration) Convention, 1977 (No. 148)
- Working Environment (Air Pollution, Noise and Vibration) Recommendation, 1977 (No. 156)



Extreme

weather events

- Prevention of Major Industrial Accidents Convention, 1993 (No. 174)
- Prevention of Major Industrial Accidents Recommendation, 1993 (No. 181)
- Employment and Decent Work for Peace and Resilience Recommendation, 2017 (No. 205)



Guidelines for a Just Transition

The Guidelines for a Just Transition towards Environmentally Sustainable Economies and Societies for All (ILO 2015), developed through tripartite discussion, can be used to ensure that no workers are left behind during the transition to a green economy. Overall, a Just Transition can help to promote a safe and healthy working environment by supporting workers and employers throughout the transition to a low-carbon economy and ensuring that new jobs in the green economy are safe and healthy.

Taking OSH into consideration is critical to a Just Transition, as risks may arise not only due to environmental changes, but also in new work processes or hazardous practices and materials used in the transition. While work processes that promote greener practices may reduce OSH risks by reducing workers' exposure to hazardous substances, other processes and materials may increase risks.

OSH is identified in the guidelines as one of the key policy areas to address the environmental, economic and social sustainability of the transition. Recommendations related to OSH for governments, in consultation with social partners, include:

- Conducting risk assessments of increased or new OSH risks resulting from climate change.
- Improving, adapting or developing awareness of OSH standards for technologies, work processes and new materials related to the transition.
- Adopting and implementing applicable OSH standards and monitoring compliance through labour inspectorates.
- Working towards greater OSH policy coherence and cooperation among occupational health and environmental agencies with regard to regulation and enforcement.
- Promoting the use of appropriate prevention, protection and safety processes.
- Incentivizing companies and supporting research to better understand OSH risks and new technologies.
- Establishing bilateral OSH committees at the workplace level.
- Regulating and incentivizing companies to reduce, minimize, and where possible, eliminate hazardous materials across the supply chain of products and production processes.
- Assessing and defining legislation to ensure that companies take appropriate steps to mitigate adverse impacts on health and safety throughout the life cycle of products and processes.

In addition, actions for governments and social partners include:

- Promoting adequate OSH training in green jobs for workers, employers, OSH committees and labour inspectors.
- Addressing the OSH impacts of informality, and facilitating the transition towards a formal economy, in activities related to the greening of the economy.

ILO activities at the sub-regional level

The ILO is involved with a number of initiatives at the sub-regional level which are linked to climate change and Just Transition. The Vision Zero Fund, a G-7 initiative that aims to reduce accidents, injuries and diseases in supply chains, is implementing a range of activities to address the impact of climate change on the safety and health of workers. In Mexico, the Fund, in collaboration with the University of Colorado and the Mexican Institute of Social Security, is implementing a methodology to measure heat exposure and heat stress among workers in the tomato and chilli pepper sectors, and the perceived and direct impacts on the health and productivity of workers. The methodology includes both qualitative and quantitative components. The former include assessments of the selected companies' and worksites' workplace guidelines, standard operating procedures, worksite characteristics, and workers' characteristics, behaviours and practices. For the quantitative research, data is collected on environmental conditions, measures of activity level and workload, hydration status, potential heat-associated symptoms and illnesses, heart rate, body mass index and skin and core body temperatures. Findings will be used to inform the design, implementation and monitoring of workplace adaptation measures to reduce or mitigate workers' exposure to heat that can potentially result in heat-related illnesses. Proposals regarding possible regulatory and legal improvements to prevent occupational heat stress at the national level will also be developed. In addition, the Fund is conducting research on the impact of climate change on the health of cotton farmers in Madagascar and agricultural subsistence farmers in Viet Nam that will inform future project activities. The research protocol for the first baseline heat exposure measurement has been finalized.

► Gender and Climate Change Training with Labour Inspection Departments in Egypt, Morocco and Tunisia

Together with the Decent Work for Women project, capacity-building sessions were organized by the ILO and relevant Ministries of Labour for 80 labour inspectors on the theme of "climate change, its impact on the world of work, OSH and gender" in Tunisia, Morocco and Egypt in 2023. The workshops aimed to raise awareness among the labour inspection body of the importance of their role in monitoring, advising and supporting companies on climate change issues, including those related to OSH.

The workshops explored the direct and indirect effects of climate change on women's health at work, discussing topics such as heat stress for women working in agriculture or other outdoor settings, vector-borne diseases, air quality, extreme weather events, water scarcity, shifts in occupational patterns impacting tasks that women are engaged in, as well as psychosocial stress brought on by concerns about their families, homes and communities related to climate change. Discussions emphasized the importance of implementing OSH measures, offering training on climate-related health risks, and promoting gender-responsive policies.

As a result of the workshops, the first group of regional labour inspectors were trained on climate change concepts and then authorized to carry out local awareness-raising activities.



1. Excessive heat

Examples of workers at high-risk

Workers in agriculture, environmental goods and services (natural resource management), construction, refuse collection, emergency repair work, transport, tourism and sports.

Primary health impacts

Heat stress, heatstroke, heat exhaustion, rhabdomyolysis, heat syncope, heat cramps, heat rash, cardiovascular disease, acute kidney injury, chronic kidney disease, physical injury.

Global burden of occupational exposures

Every year, at least

2.41 billion
workers

exposed to excessive heat.

Work-related health impact

Every year

22.85 million
occupational injuries

18,970

work-related deaths

2.09 million
DALYs attributable to
excessive heat.

► InFocus

Increase in medical care consultations and additional deaths during the hottest days in Chile

According to a 2023 study carried out in the Santiago Metropolitan Region of Chile, days with temperatures of 35°C were associated with a 23 per cent increase in medical care compared to days of 25°C. During the hotter days, consultations for conditions such as hypertension or arrhythmias increased by up to 52 per cent. When the maximum temperature rose to 38°C, medical consultations doubled. High temperatures particularly affected people between the ages of 41 and 66, with 72 per cent of those impacted being women (Bupa Chile 2023).

Another study from 2024 found that during the heatwaves of 2017 and 2019, a total of 584 and 245 additional deaths were attributable to high temperatures, with those over 65 years of age being the most affected (Silva et al. 2024).

► InFocus

Chronic kidney disease of unknown aetiology (CKDu) in tropical countries

Epidemics of chronic kidney disease of unknown aetiology (CKDu) are affecting large numbers of workers conducting heavy manual labour in hot temperatures. CKDu has emerged in hot, rural regions of the Americas, Africa, the Middle East and India, where abnormally high numbers of agricultural workers have begun dying from irreversible kidney failure. It has been estimated that over 20,000 have died of this disease within a decade in Central America alone, with many more sick or injured and unable to work (Ramirez-Rubio et al. 2013).

The record-breaking trend of rising temperatures seen for much of 2023 has continued in 2024, with January being the hottest January on record, and the eighth month in a row to be the warmest on record for the respective month of the year (WMO 2024). Rising global temperatures due to climate change will result in more frequent and severe heatwaves, causing increased mortality, reduced productivity and damage to infrastructure (Mora et al. 2017). By the end of this century, it is likely that all regions of the world will see increased health risks associated with extreme heat, with the poorest regions affected more than others.

According to new ILO estimates, every year at least 2.41 billion workers are exposed to excessive heat (i.e., over 70 per cent of all workers). Comparing exposure estimates for 2020 with those for 2000, there was a 34.7% increase in the number of workers exposed to excessive heat.³ This increase can be attributed to both rising temperatures and a growing labour force.

In general, the countries most affected by heat-related risks have higher rates of working poverty, informal employment and subsistence agriculture (ILO 2019a). Disadvantaged and vulnerable population groups and communities, such as indigenous peoples who are dependent on agricultural or coastal livelihoods, are at particular risk (ILO 2019a).

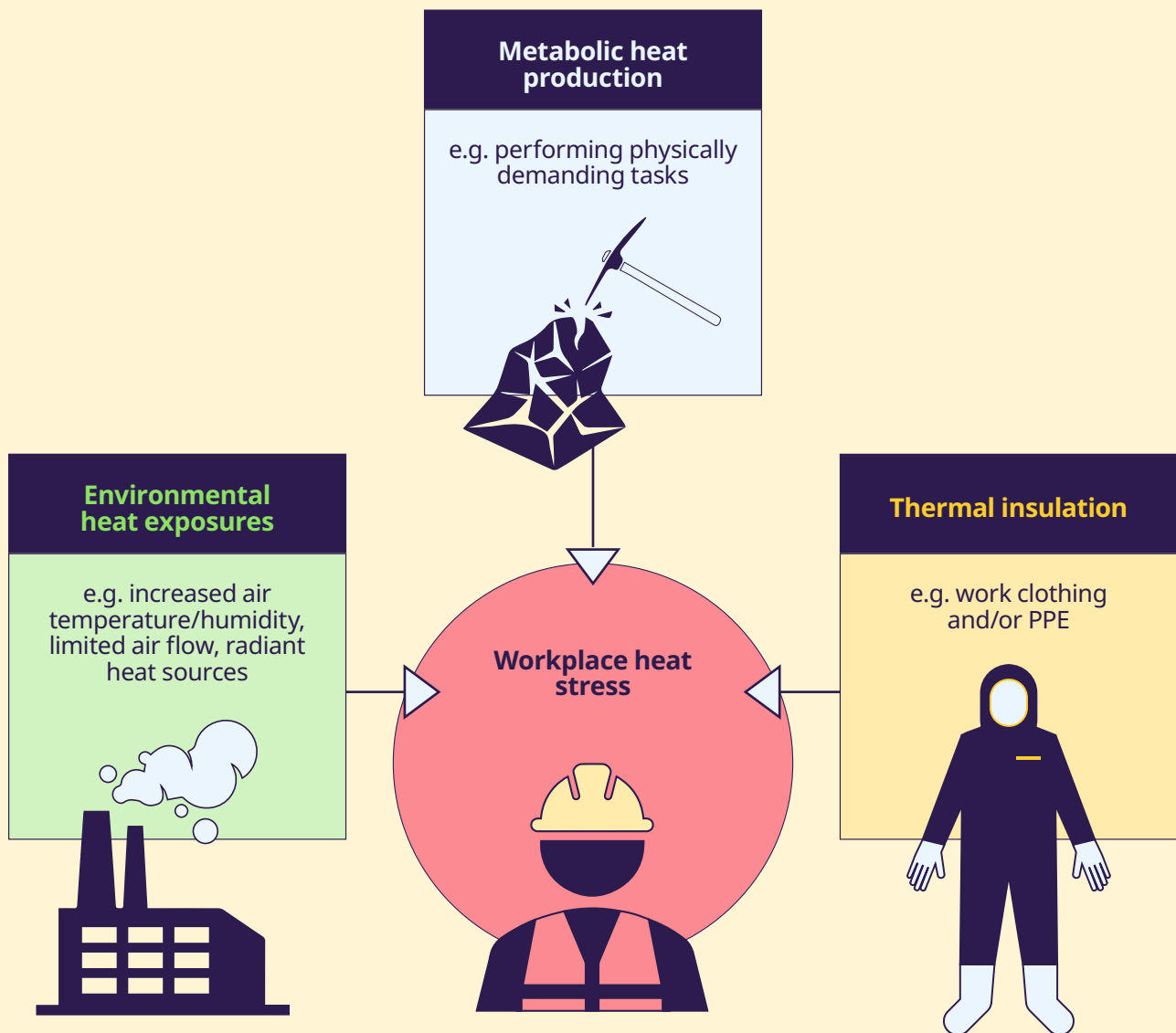
Impact on worker safety and health

Maintaining a core body temperature of around 37°C is essential for continued normal body function. If the body temperature rises above 38°C, physical and cognitive functions are impaired; if it rises above 40.6°C the risk of organ damage, loss of consciousness and, ultimately, death increases sharply (IPCC 2014).

Workplace heat stress refers to the excess heat load a worker can be exposed to due to different contributing factors, acting alone or in combination (figure 2). These include environmental conditions, such as air temperature and humidity, and heat sources from industrial settings, for example heat-emitting sources and machinery. The duration and intensity of physical exertion will also contribute, as well as workplace OSH requirements, such as personal protective equipment (PPE). Even at moderate ambient temperatures, a high level of clothing insulation, especially through PPE, can lead to disruption of the body's heat balance.

³ This ILO global data takes into account climate models, population data, labour force data from ILOSTAT, and occupational health information from ILO Global Estimates. The estimates were calculated by examining global temperature changes using climate models, which divide the world into small approximately 55 km x 55 km grid cells. Daily maximum temperatures at a height of 2 meters were collected from 10 different climate models. Attributable fractions were calculated based on a recent systematic review and meta-analysis (Fatima et al., 2021) of 22 epidemiological studies representing almost 22 million occupational injuries which found that the overall risk of occupational injuries increased by 1% for 1 °C increase in temperature above 20.9°C reference value and 17.4% (RR 1.174, 95% CI: 1.057–1.291) during heatwaves.

► Figure 2: Factors which increase heat-stress risks



Different adverse health impacts have been associated with workplace heat stress. Acute effects range from mild to severe and include heatstroke, heat exhaustion, rhabdomyolysis, heat syncope, heat cramps, heat rash and even death (NIOSH 2022). Longer-term impacts of chronic exposure to heat include cardiovascular disease, acute kidney injury and chronic kidney disease, all of which are associated with hot working environments (Flouris et al. 2018; De Blois et al. 2015; Moyce et al. 2018). Furthermore, a recent scoping review found that a variety of mental health issues including depression, anxiety or irritability and suicide have been reported in workers who were experiencing heat stress (Amodu et al. 2023).

Exposure to excessive heat can also increase the risk of workplace accidents and injuries, caused by issues such as sweaty palms, fogged up safety glasses, dizziness and reduced brain function (EU-OSHA 2023b). Prolonged exposures may increase accident risk due to disorientation, impaired judgement, loss of concentration, reduced vigilance and fatigue (EU-OSHA 2023b).

► InFocus

Workplace injuries in California, United States

A study (Park et al. 2021) found that even a modest increase in workplace temperatures led to 20,000 additional injuries per year in California, with a social cost of US\$1 billion. By comparing records from 2001 to 2018 for more than 11 million California workers' compensation claims to high-frequency local weather data, the authors isolated the impact of hotter days on the number of injury claims. The study shows that on days with high temperatures above 90°F (around 32°C), workers have a 6 to 9 per cent higher risk of injuries than they do on days with temperatures in the 50s or 60s. When the thermometer tops 100°F (around 38°C), the risk of injuries increases by 10 to 15 per cent.

► InFocus

Rising temperatures and chemical accidents

Rising temperatures due to climate change can increase the volatility of temperature-sensitive chemicals, which could lead to accidents (Truchon et al. 2014). Temperatures inside non-insulated, single skin chemical storage containers can reach as high as 50°C when the ambient temperature is around 30°C. "Thermal runaway" - exponentially increased heat from a thermal reaction - can cause violent boiling and rapid gas generation, leading to over-pressurization and explosions. This may result in the plant failing catastrophically, resulting in blast or missile damage, and a release of flammable materials could result in a fire or explosion (HSE 2014).

More intense heatwaves can also destabilize the components of munitions, particularly where explosives are not properly stored. Most munitions are designed to withstand severe heat, but only in the relatively short term. If exposed to extreme temperatures and humidity for long enough, munitions can become unstable. For every 5°C increase above its ideal storage temperature, the chemical stabilizer used to prevent self-ignition depletes by a factor of 1.7 (Schwartzstein 2019).

New ILO estimates have revealed that each year, 22.85 million occupational injuries, 18,970 fatalities, and 2.09 million disability-adjusted life years (DALYs) are directly linked to exposure to excessive heat at work.⁴ Furthermore, in 2020, there were an estimated 26.2 million persons living with chronic kidney disease attributable to exposure to excessive heat at work.⁵

A meta-analysis of 30 countries, including more than 447 million workers from over 40 different occupations demonstrated that 35 per cent of workers who are typically or frequently exposed to excessive heat at work (a minimum of 6 hours per day, 5 days per week, for 2 months of the year) experience physiological strain, while 30 per cent of them also report productivity losses (Flouris et al. 2018).

Workers of all ages are susceptible to the ill effects of excessive heat, even younger populations (Ansah et al. 2021). Older adults are especially affected however, due to reduced heat tolerance and poorer aerobic capacity (Lundgren et al. 2013).

The impact of excessive heat varies across sectors, but those most at risk include outdoor workers in physically demanding jobs and indoor workers in poorly ventilated workplaces where the temperature is not regulated (ILO 2019a). Such jobs are typically found in agriculture, environmental goods and services (natural resource management), construction, manufacturing, refuse collection, emergency repair work, transport, tourism and sports (ILO 2019a). A recent EU Climate Risk Assessment report (European Environment Agency, 2024) highlighted the impact of climate change on workers, noting that extreme temperatures and frequent heatwaves in southern Europe in 2020 and 2023 resulted in increased incidences of heat stroke and fatalities among outdoor workers, especially those in the agriculture, construction, street maintenance, and waste collection sectors.

Agricultural work is particularly hazardous, with one study finding that farmworkers are 35 times more likely to succumb to a heat-related death than workers in other occupations (Gubernot et al. 2015). Workers in heavy clothes or PPE, such as pesticide sprayers and firefighters, also suffer. For example, exposure to extreme heat and physical exertion during

⁴ To assess the impact of excessive heat on occupational injuries, the methodology used integrates climate models, population data, labour force data from ILOSTAT, and occupational health information from ILO Global Estimates. This was done by analysing examining global temperature changes using climate models, which divide the world into small approximately 55 km x 55 km grid cells. Daily maximum temperatures at a height of 2 meters were collected from 10 different climate models. Attributable fractions were calculated based on a recent systematic review and meta-analysis (Fatima et al., 2021) of 22 epidemiological studies representing almost 22 million occupational injuries which found that the overall risk of occupational injuries increased by 1% for 1 °C increase in temperature above 20.9°C reference value and 17.4% (RR 1.174, 95% CI: 1.057-1.291) during heatwaves.

⁵ Calculations similar to the injury estimates were performed based on a recent meta-analytic data analysis (Flouris et al., 2018) encompassing data from nearly 22 thousand workers. The study showed that 15 per cent of the 174.66 million workers who are typically or frequently working in excessive heat develop chronic kidney disease. The 26.2 million persons living with chronic kidney disease attributable to exposure to excessive heat at work constitutes the 3 per cent of the total number of people living with chronic kidney disease.

firefighting may trigger the formation of blood clots and impair blood vessel function, changes associated with increased risk of heart attack (Hunter et al. 2017).

Deaths caused by extreme temperatures are on the rise in the construction industry. According to the US Department of Labor's Occupational Safety and Health Administration (OSHA), US fatalities due to extreme temperature exposure increased by 18.6 per cent in 2022 (Construction Briefing 2024). A 2019 study by the US Center for Construction Research and Training found that construction workers accounted for 36 per cent of all occupational heat-related deaths from 1992 to 2016, despite only representing 6 per cent of the country's overall workforce (Dong et al. 2019).

Office workers may also suffer heat-related risks when workplaces are not adequately equipped to cope with extreme temperatures. For example, increased temperatures in offices have been linked to negative physiological responses, including eye conditions and changes in respiratory patterns, which may consequently affect health conditions and performance (Lan et al. 2012).

The combined impact of excessive heat and workplace chemical exposures could increase the likelihood of ill-health. Specifically, chemical agents can affect thermoregulatory mechanisms, which could reduce workers' capacity to adapt to thermal stress (Truchon et al. 2014). One study (Bourbonnais et al. 2013) identified 136 occupations with high potential of simultaneous exposure to heat and chemicals, with workers in metal manufacturing and roofing and firefighters at most risk.

- **Work productivity** is reduced at high temperatures because it is either too hot to work or workers have to work at a slower pace. The report *Working on a Warmer Planet* (ILO 2019a) looked at the impact of excessive heat on labour productivity and decent work. It projected that by 2030, 2.2 per cent of total working hours worldwide will be lost to high temperatures – a productivity loss equivalent to 80 million full-time jobs. Alarming, heat stress is projected to reduce global gross domestic product (GDP) by US\$2,400 billion in 2030 (ILO 2019a). The report found that the impact of heat stress is unevenly distributed geographically, with the expected reduction in working hours in 2030 amounting to around 5 per cent in both Southern Asia and Western Africa, and 0.1 per cent in the European subregions. Workers in subregions in tropical and subtropical latitudes are at higher risk of heat stress, due to the combined effect of extreme heat and the high share of agriculture in total employment. These areas are characterized by high rates of informality, with workers particularly susceptible to rising temperatures due to a lack of OSH protections and prevention measures.

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Examples of responses to the risk

Policies, laws and other initiatives at the national level

Some countries are including heat-related risks as a key priority in **national OSH policies and strategies**, recognizing the urgency of protecting workers and workplaces generally against this growing risk, and defining actions and initiatives to be implemented in the coming years.

- Chile's new National OSH Policy 2024-28 includes the implementation of policies aimed at preventing "occupational risks derived from exposure to extreme temperatures".
- In Japan, the prevention of heatstroke is one of the targeted outcomes of the 14th National Occupational Accident Prevention Plan 2023-27, with two specific indicators: 1) increased number of establishments addressing heat stress based on the wet bulb globe temperature (WBGT) value⁶ and 2) reduction of increase rate of heatstroke death.
- The Belgian National Plan of Action to Improve the Well-being of Workers 2022-27 acknowledges that climate change will directly and indirectly affect the well-being of workers. It specifically refers to major weather fluctuations, for example due to periods of extreme heat, stating that working in very high temperatures requires adjustments to be made to technical preventive measures (particularly ventilation and heating), the organization of work, and the PPE made available to workers.
- In France, the National Plan for the Prevention of Serious and Fatal Injuries at Work 2022-25 identifies that the monitoring of mortality and serious injuries from heat stress is a key measure to improve knowledge and gain a better understanding of the circumstances in which serious and fatal heat-related injuries occur, in order to define the most appropriate preventive actions.
- One of the objectives of the Spanish Strategy for Safety and Health at Work 2023-27 is to manage the changes resulting from new forms of work organization, demographic changes and climate change with a preventive approach. It lays out actions for the improvement and control of working conditions in activities most affected by environmental changes, for example, exposure to extreme temperatures, especially where there are workers with specific vulnerabilities or sensitivities.

OSH legislations historically addressed the protection of workers against extreme temperatures. However, the intensification of heat due to climate change may necessitate a re-evaluation of existing provisions. Some countries have already created or adapted regulations and guidelines to reflect the developing nature of this climate change hazard.

National legislation often provides a range of acceptable temperatures for specific workplace circumstances. Some examples of these are shown in figure 3.

⁶ The WBGT index takes into consideration ambient temperature, humidity, solar UV radiation and wind speed.

► Figure 3: Examples of legislation regarding temperatures in the workplace

Country	Legislation regarding maximum work temperatures
Armenia	Special breaks should be granted where the work is performed at temperatures above 40°C (Labour Code of 9 November 2004. Art. 153(3)).
Austria	Air temperature in work premises should be between 19 and 25°C for work involving low physical stress and between 18 and 24°C for work involving normal physical effort (Workplaces Regulation [AStV]. Art. 28).
Belgium	Maximum air temperatures, using the WBGT index, are set at 29°C for light physical work, 26°C for moderate to heavy work, 22°C for heavy work, and 18°C for very heavy work (Royal Decree of 4 June 2012 on thermal environmental factors. Section 2.1.).
Brazil	Work must be stopped in cases where the WBGT rises above 29.4°C for low intensity work, 27.3°C for moderate intensity work, 26.0°C for high intensity work, and 24.7°C for very high intensity work (Regulatory Standard No. 15 (Annex 3)).
China	Outdoor work must cease when air temperature exceeds 40°C (Administrative Measures on Heatstroke Prevention (AMPH2012)).
Cyprus	Complete work interruption for acclimatized workers when the WBGT rises above 32.2°C for low intensity work, 31.1°C for moderate intensity work or 30.0°C for high intensity work. For non-acclimatized workers, these values are reduced by 2.5°C (Minimum Requirements for Safety and Health at the Workplace Regulations 2002).
Hungary	Thresholds for indoor work are set at 31°C for light work, 29°C for moderate work and 27°C for heavy work. When ambient air temperature is equal to or within 1 °C of the upper limits, workers may only work a full shift after a one-week period of gradual acclimatization (Joint decree on the minimum level of occupational health and safety requirements for workplaces [SzCsM-EüM] 3/2002 (II. 8.), Section 7).
India	The WBGT should not exceed 30°C in factory workrooms (Factories Act No. 63, 1948).
Latvia	The indoor work temperature limit is set at 28°C, however exceptions exist for some industries or sectors (Cabinet of Ministers Regulation No. 35923 of 28 April 2009 on "Occupational protection requirements in the workplace" (Appendix 1) [Ministru kabineta noteikumi Nr.359, Darba aizsardzības prasības darba vietās]).
Mozambique	Mining operations should be halted if temperatures exceed 33°C (Legislative decree No. 48/73 of July 5; General Safety Rules at Work in Industrial Units 1973-07-05 (Art. 135)).
Portugal	The temperature of commercial, office and service establishments should, as far as possible, be between 18°C and 22°C, except in certain climatic conditions, when it may be as high as 25°C (Decree-Law 243/86. Art. 11).
Qatar	Work must stop if the WBGT rises above 32.1°C (Ministerial Decision No.17).
Singapore	The temperature in any working chamber, man-lock or medical lock in a worksite shall not exceed 29°C (Workplace Safety and Health (Construction) Regulations 2007).
Slovenia	Has an air temperature threshold of 28°C for working rooms, with exceptions for some types of workplaces (Regulation on requirements to ensure the safety and health of workers at work. Art. 25).
South Africa	Employers must take steps to mitigate heat stress if the average hourly WBGT exceeds 30°C (Environmental Regulations for Workplaces 1987. Art 2).
Spain	In enclosed workspaces the temperature must be between 17 and 27°C for sedentary work and 14 and 25°C for light work (Annex III of Royal Decree 486/1997).
Thailand	Work must be stopped when the WBGT rises above 34.0°C for low intensity work, 32.0°C for moderate intensity work, and 30.0°C for very high intensity work (Occupational Standard 2016).
Viet Nam	Indoor workplace temperatures should not exceed 34°C, 32°C and 30°C for light, medium and heavy work respectively (Decision No. 3733/2002/QĐ-BYT).

The table shows that many countries requiring the implementation of control measures by employers refer to enclosed premises/indoor work. This recognizes the fact that it is far easier for employers to control the temperature in indoor spaces, for example using air conditioning or fans, than outside spaces, which are mainly beyond their control.

Whilst figure 3 does provide some cases of national workplace temperature thresholds, its limitations must also be considered. Firstly, the list provided here is not exhaustive and there are many other examples not mentioned. Secondly, many of the figures in the table are not absolute limits, with most regulations offering a progressive approach, and employers required to adopt specific measures as temperatures increase, even above thresholds. For example, in Belgium, artificial ventilation devices should be installed within 48 hours if temperature limits continue to be exceeded, and rest breaks should be provided if high temperatures last beyond this. Also, legislation often includes exemptions or modified provisions for specific work types, locations or even sectors. This is the case for Latvia, where temperature limits do not apply to certain workplaces, such as motor, river, sea, air and rail vehicles, the mining industry, fishing vessels or agricultural and forestry undertakings.

Furthermore, the use of occupational heat thresholds can in itself be problematic, as weather stations do not always directly measure some climate factors, including solar radiation, and workplace environmental conditions such as local heat sources, metabolic heat production from the human body and clothing properties are not taken into consideration.

In certain countries, specific maximum temperatures are not provided, however it is the duty of the employer to maintain a comfortable workplace temperature or to protect workers from excessive heat. This is the case, for example, in Brunei Darussalam⁷, Egypt⁸, Gabon⁹, Senegal¹⁰, Mauritius¹¹, Indonesia¹², Japan¹³, Antigua and Barbuda¹⁴, Barbados¹⁵, Costa Rica¹⁶, Lao People's Democratic Republic¹⁷, Republic of Korea¹⁸, Slovenia¹⁹, Switzerland²⁰, Kazakhstan²¹, Denmark²², Italy²³ and India²⁴. In the EU²⁵, the temperature in working areas, sanitary facilities, canteens and first aid rooms must be appropriate to the particular purpose of such areas.

Some countries that regularly experience exceptionally high temperatures have adopted regulations prohibiting outdoor work during the hottest parts of the day.

7 Workplace Safety and Health (General Provisions) Regulations, 2014 (No. S. 34).

8 Labour Code (No. 12 of 2003). Art. 208.

9 Décret n° 01494/PR/MTEPS du 29 décembre 2011 déterminant les règles générales d'hygiène et de sécurité sur les lieux de travail. Art. 40.

10 Décret n° 2006-1252 du 15 novembre 2006 fixant les prescriptions minimales de prévention des certains facteurs physiques d'ambiance. Art. 10.

11 Occupational Safety and Health Act 2005 (Act No. 28 of 2005). 37.

12 Law No. 1 of 1970 on Occupational Safety.

13 Industrial Safety and Health Law (Law No. 57 of 8 June 1972) as amended.

14 Antigua and Barbuda Labour Code (No. 14 of 1975) (Chapter 27).

15 Safety and Health at Work Act 2005.

16 Decreto 1 por el que se promulga el reglamento general de seguridad e higiene de trabajo.

17 Law on Hygiene, Disease Prevention and Health Promotion.

18 Occupational Safety and Health Act, 1990 (No. 4420).

19 Regulation on requirements to ensure the safety and health of workers at work. Article 25.

20 Ordonnance no 3 du 18 août 1993 relative à la loi sur le travail (Hygiène, OLT 3).

21 Act of the Republic of Kazakhstan on the Safety of Chemical Products, No. 302-III ZRK of July 21, 2007.

22 Executive Order No. 599 of 2004 on the Performance of Work.

23 Decree No. 81/2008 Testo Unico sulla Salute e Sicurezza sul Lavoro.

24 Factories Act 1948 (No. 63 of 1948).

25 Council Directive 89/654/EEC. Annex 1. 7.2

- In Bahrain, the Ministry of Labour has established protocols to protect workers from the hazards of excessive heat during the summer months. According to Order No. 3 for 2013 regulating working hours outdoors, workers are not allowed to work outdoors between 12 p.m. and 4 p.m. from 1 July to 31 August each year²⁶. Similar laws are found in Kuwait²⁷, Oman²⁸, Saudi Arabia²⁹ and the United Arab Emirates (UAE)^{30,31}.
- In Qatar, in May 2021, a Ministerial Decision introduced an expansion of summertime working hours during which outdoor work is prohibited. Under these rules, workers cannot work outside between 10 a.m. and 3 p.m. from 1 June to 15 September³². In addition, regardless of the time, all work must stop if the WBGT rises above 32.1°C in a particular workplace. The new measures also introduced yearly health checks for workers, as well as obligatory risk assessments for enterprises to mitigate heat stress, carried out in collaboration with workers. Moreover, employers must provide training on heat stress before the hot season starts, and workers should be given free and cool drinking water and access to shaded rest areas (ILO 2021b).

OSH legislation in some countries focuses on specific protective measures, such as acclimatization programmes (for example, Singapore³³ and South Africa³⁴), hydration (for example, Austria³⁵, Benin³⁶, Cameroon³⁷, Chile³⁸, Pakistan³⁹, India⁴⁰, Samoa⁴¹ and Saudi Arabia⁴²), ventilation (for example, Argentina⁴³, Barbados⁴⁴, India⁴⁵, Morocco⁴⁶ and Senegal⁴⁷), rest breaks in the shade or air conditioning (for example, Cameroon⁴⁸, Saudi Arabia⁴⁹), training (for example, Bahrain⁵⁰, Oman⁵¹ and South Africa⁵²) and the supply of PPE and other safety equipment (for example, Bahrain⁵³, Plurinational State of Bolivia⁵⁴, Eswatini⁵⁵, Fiji⁵⁶ and Italy⁵⁷).

Other countries have adopted more detailed provisions, defining a set of actions to be taken in the workplace, including risk assessment procedures and adequate prevention and mitigation measures.

26 Ministerial Order No. (3) of 2013.

27 Ministerial Decision No. 535 of 2015.

28 Ministerial Decision No. (286) of 2008, as amended by the Ministerial Resolution (322) of 2011.

29 Ministerial Resolution No. (3337) of 2014.

30 Ministerial Decree No. 401 of 2015 Concerning the Determination of Midday Working Hours.

31 In some cases, for example Bahrain and Kuwait, oil and gas sector workers are not covered by the legislation, leaving a significant proportion of the workforce unprotected.

32 Ministerial Decision No. 17.

33 Enhanced measures to reduce heat stress for outdoor workers. 2023. Article 2.

34 Environmental Regulations for Workplaces, 1987. Art. 2(4)(b)(ii).

35 Employee Protection Act No. 450/1994. Art. 27(9).

36 Arrêté n° 22/MFPTRA/DC/SGM/DT/SST du 19 avril 1999 portant mesures générales d'hygiène et de sécurité au travail. Art. 24.

37 Arrêté n° 39/MTPS/IMT du 26 novembre 1984 fixant les mesures générales d'hygiène et de sécurité sur les lieux de travail. Art. 45(2).

38 Decreto núm. 594 por el que se aprueba el Reglamento de Condiciones Sanitarias y Ambientales básicas en los Lugares de Trabajo. Article 96.

39 Factories Act, 1934. Art. 20(3).

40 Factories Act 1948 (No. 63 of 1948). Art. 18.

41 Occupational Safety and Health Act 2002 (2002, No. 5). Art. 24(e).

42 Procedural Guidelines for Occupational Safety and Health for preventing the Effects of Exposure to the Direct Sun and Heat Stress 1442-2021. Art. 4.1.5.

43 Ley 19587 de higiene y seguridad en el trabajo. Art. 6(b).

44 Safety and Health at Work Act 2005. Section 52.

45 Factories Act 1948 (No. 63 of 1948). Art. 13.

46 Arrêté du ministre de l'emploi et de la formation professionnelle n° 93-08 du 12 mai 2008 fixant les mesures d'application générales et particulières relatives aux principes énoncés aux articles 281 à 291 du Code du travail. Chapter 3.

47 Décret n° 2006-1261 du 15 novembre 2006 fixant les mesures générales d'hygiène et de sécurité dans les établissements de toute nature. Art. 5.

48 Arrêté n° 39/MTPS/IMT du 26 novembre 1984 fixant les mesures générales d'hygiène et de sécurité sur les lieux de travail. Art. 37.

49 Procedural Guidelines for Occupational Safety and Health for preventing the Effects of Exposure to the Direct Sun and Heat Stress 1442-2021. Art. 4.1.10.

50 Ministerial Order No. 8 of 2013 with respect to regulating occupational safety and health in establishments.

51 Occupational Safety Regulations governing by the Labour Code (Ministerial Decision 286/2008).

52 Environmental Regulations for Workplaces 1987. Section IV. Art. 2(4)(b)(iv).

53 Ministerial Order No. 8 of 2013 with respect to regulating occupational safety and health in establishments.

54 Decreto ley núm. 16998 de 2 de agosto de 1979, ley general de higiene, seguridad ocupacional y bienestar. Art. 80.

55 Occupational Safety and Health Act, 2001 (No. 9 of 2001). Art. 9(4).

56 Health and Safety at Work Act, 1996 (No. 4 of 1996). Art. 53(3).

57 D.Lgs. 81/2008 Testo Unico sulla Salute e Sicurezza sul Lavoro. Art. 1.9.2.5.

- In Spain, Royal Decree-Law 4/2023⁵⁸, enacted in May 2023, introduced urgent measures to address issues caused by weather conditions and to prevent labour risks during high temperatures. It requires protective measures for outdoor workers, based on occupational risk assessments, job characteristics, and workers' personal or health conditions. Measures include restricting certain tasks during extreme weather and altering work conditions if hot weather warnings are issued, ensuring that salary is not reduced if work is interrupted.
- China's Administrative Measures on Heatstroke Prevention, issued in 2012, require employers to provide protective measures for outdoor and indoor workers. These include carrying out health checks on employees working in high temperatures and adapting the work of workers suffering from heart, lung and cerebrovascular diseases, tuberculosis, diseases of the central nervous system and other physical conditions unsuited to a hot working environment. Article 8 lays down more specific provisions for the summer season: "during the period of high temperatures, the employer shall [...] adopt reasonable arrangements for working hours, rotation of operations, appropriate increases in rest periods for workers in high-temperature working environments and reductions in work intensity". Furthermore, for outdoor work, employers must comply with the following: (1) If the temperature reaches 40°C, outdoor activities must be stopped for the day; (2) If the temperature is between 37°C and 40°C, the employer must ensure that employees do not work outdoors in the open air for more than 6 hours in total in a day and during the 3 hours of the highest temperature period of the day; (3) If the temperature is between 35°C and 37°C, the employer must adopt measures such as rotating shifts to shorten workers' continuous working time. Furthermore, employers are required to conduct training on heat-related illnesses and provide cooling measures such as rest areas, free cool drinks, and air conditioning in indoor workplaces. Workers who suffer from heatstroke and other heat-related complications must be given workers' compensation and, in workplaces that cannot reduce temperatures below certain thresholds, employers must pay high-temperature subsidies to their workers.
- In Germany⁵⁹, if the air temperature in the room exceeds 26°C protection measures such as ventilation systems, flextime regulations to shift working hours, relaxation of clothing regulations and fans should be implemented. In specific circumstances, further measures must be applied on the basis of an adaptive risk assessment. These include when heavy physical work has to be carried out, when protective clothing that severely impedes the release of heat must be worn, if the employee has health problems, or the worker is young, old, pregnant or breastfeeding. Also, working rooms must have suitable insulation against heat.
- Legislation in Cyprus⁶⁰ states that employers can lower temperatures using technical and organizational measures. Technical measures include interventions on the structural elements of buildings, in parts of the production process or on the workplace microclimate. Organizational measures include providing training for employees, organizing working hours so that heavy work is carried out in the coolest hours of the day and providing workers with fresh drinking water and appropriate clothing.
- In 2015, the Costa Rican Ministry of Labour and Social Security, together with the Ministry of Health, adopted a regulation⁶¹ specifically aimed at protecting outdoor workers from heat stress. It requires employers to implement several protective measures, including educating their workers on the health effects of heat stress, supplying PPE, allowing time for workers to acclimatize to high temperatures, providing rehydrating drinks, and ensuring shaded areas for rest. Additionally, workers are required to be part of a health surveillance programme, which focuses on monitoring kidney health and function.

Legislation in a number of countries, for example South Africa⁶², Japan⁶³, Belgium⁶⁴, Bahrain⁶⁵ and Saudi Arabia⁶⁶, recommends that high risk workers undergo medical assessments in certain situations, for example, to assess if the worker is fit to work in hot conditions.

⁵⁸ Real Decreto-Ley 4/2023, de 11 de Mayo.

⁵⁹ Technische Regeln für Arbeitsstätten: Raumtemperatur ASR 3.5. Article 4.4..

⁶⁰ Factories Law 1956. Article 18(1).

⁶¹ Executive Decree N°MTSS-017-2015 of the President of the Republic by the Minister of Health and the Minister of Labour and Social Security (Decreto Ejecutivo N°MTSS-017-2015 del Presidente de la República por el Ministro de Salud y el Ministro de Trabajo y Seguridad Social).

⁶² Occupational Health and Safety Act No. 85 of 1993.

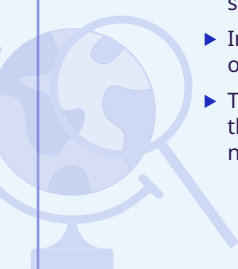
⁶³ Industrial Safety and Health Law (Law No. 57 of 8 June 1972) as amended.

⁶⁴ Book V ("Environmental factors and physical agents"), Title 1 ("Thermal atmospheres").


⁶⁵ Law No. (36), Part 16: Labour inspection and judicial powers. Art. 171.

⁶⁶ Procedural Guidelines for Occupational Safety and Health for preventing the Effects of Exposure to the Direct Sun and Heat Stress 1442-2021. Art 4.1.12.

In line with the ILO List of Occupational Diseases Recommendation, 2002 (No. 194), which includes in its Annex at 1.2.6. Diseases caused by exposure to extreme temperatures, certain countries recognize heat-related illnesses as occupational diseases.

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- For instance, in Mauritius⁶⁷, notifiable occupational diseases include “1.2.7 Diseases caused by extreme temperature (for example sunstroke, frostbite)”, in Malaysia⁶⁸ they include “Conditions resulting from severe heat exposure, such as heat cramps or heatstroke”, and in Namibia⁶⁹ “Diseases caused by hot or cold work environments, and all work involving exposure to the risk concerned”.
 - In Tunisia⁷⁰, several maladies caused by work in temperatures greater than 28°C, such as muscle cramps with profuse sweating and oliguria, are included in table 83 of the list of occupational diseases.
 - In France⁷¹, table 58 lists occupational diseases caused by working at high temperatures, including muscle cramps, oliguria and urinary chloride equal to or less than 5 g/litre.
 - The list of occupational diseases provided in Decree 14229 (art. 4.2.1) in Lebanon includes occupational diseases that result from exposure to extreme heat or any work that exposes the worker to extreme heat that exceeds the national averages.

In certain countries there are legal provisions dedicated to specific vulnerable groups of workers, such as pregnant women.

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- Article 7 of EU Council Directive 94/33/EC of 22 June 1994 on the protection of young people at work prohibits the employment of young people in work in which there is a risk to health from extreme heat.
 - Mexico's Federal Regulation of Occupational Safety and Hygiene and the Working Environment explicitly forbids the assignment of pregnant workers to tasks in environments with unsuitable thermal conditions or extreme outdoor conditions that pose significant health hazards.
 - In Cyprus⁷², employers should avoid exposing vulnerable groups to heat (for example those aged over 65, people with chronic respiratory and cardiovascular diseases, chronic renal failure, diabetes mellitus, reduced immune systems or other serious illnesses, pregnant or breast-feeding women, among others).

⁶⁷ Occupational Safety and Health Act 2005 (Act No. 28 of 2005). List of Notifiable Diseases point 1.2.7.

⁶⁸ Factories and Machinery Act 1967. No. 12.

⁶⁹ Regulations relating to the health and safety of employees at work (Government Notice No. 156 of 1997). Notifiable Occupational Diseases, page 92.

⁷⁰ Joint Ministerial Decree of the Ministers of Health and Social Affairs on 10 January 1995 defining the list of occupational diseases.

⁷¹ Tableaux des maladies professionnelles, Tableau n°58 du régime général : Affections professionnelles provoquées par le travail à haute température.

⁷² Code of Practice for Thermal Stress of Employees.

► InFocus

BESIX International Framework Agreement (BWI 2023b)

Building and Wood Workers' International (BWI) concluded an International Framework Agreement (IFA) with Belgian construction company BESIX, which protects the safety and health of construction workers in the Middle East from extreme temperatures. The IFA states that sites must contain basic welfare elements, which include an adequate supply of wholesome drinking water, washing facilities and sufficient shelter for climate conditions. Furthermore, regular information should be given to workers on how to avoid climate-related diseases, i.e. heatstroke and sunburn. In line with provisions on OSH in the IFA, BWI and affiliates were able to support improvements in working practices and OSH, including the provision of cool and shaded rest areas, water stations with cool water and rehydration salts, and mandatory water bottles and cooling gear for each worker. They also discussed how to adjust working time and shift patterns so that work happens outside peak hours and supported efforts to adapt safety helmets to the heat and encourage workers to wear them.

Collective agreements can be highly relevant tools for the definition of additional measures at sectoral or enterprise level. They can be negotiated for different workplace issues, from specific matters arising on a daily basis affecting workers in an individual company or a particular sector, to extensive negotiations on terms and conditions of employment impacting the workforce as a whole. In the case of heat-related risks in the workplace, collective bargaining has resulted in improved OSH protection measures for workers in different types of industries.

- In Spain, the general collective agreement for the construction sector⁷³ provides (in art. 166 "Atmospheric factors") that "when temperatures are extreme, particularly during heatwaves which have serious consequences for health, union representatives may propose different working hours in order to avoid the hours of greatest sunshine. Protective creams against severe weather conditions such as solar radiation, must also be available on construction sites". This general agreement may be supplemented by local agreements, depending on the autonomous community or province. For example, regions such as Andalusia and Extremadura have restrictions on working hours in the summer.
- In Greece, the national collective agreement for the construction sector and related industries⁷⁴ provides that when temperatures exceed 38°C in the shade, work must be interrupted without any reduction in daily pay. The collective agreement for workers in the shipbuilding and repair sector states that when temperatures are between 36°C and 37°C work should be suspended from 2 p.m. to 6 p.m., and when temperatures reach 38°C, from 1 p.m. to 7 p.m.

- In 2023, the Teamsters, one of the largest unions in the United States, negotiated a new five-year deal with the shipping company UPS to add air conditioning, exhaust heat shields, fans and improved ventilation to UPS trucks (Roscoe 2023). Concerns had previously been raised regarding the dangers UPS drivers face from heat, which can reach nearly 50°C inside trucks. The UPS Teamsters National Master Agreement 2023-2028 is an example of how successful negotiations between employers' organizations and workers' groups can lead to significant improvements in OSH conditions for workers in a specific sector.

73 Resolución de 21 de septiembre de 2017, de la Dirección General de Empleo, por la que se registra y publica el Convenio colectivo general del sector de la construcción.

74 Σ.Σ.Ε. των Εργατοτεχνιτών Οικοδόμων και των Συναφών Κλάδων όλης της Χώρας.

A number of international and national OSH bodies and authorities have developed **technical guidelines** specifying the measures to be adopted in the workplace for protecting workers from heat stress.

- The Indian National Disaster Management Authority, in collaboration with the Ministry of Home Affairs, published the National Guidelines for Preparation of Action Plan - Prevention and Management of Heat Wave to protect the Indian workforce in the face of heat extremes. These guidelines are aimed at public officials who want to prepare heatwave action plans for the general public in cities and towns. They emphasize the importance of: (1) educating workers; (2) ensuring proper hydration; (3) regulating work schedules; and (4) providing necessary medical facilities. The same guidelines highlight the importance of acclimatizing workers to high temperatures to reduce risks to their health while they work under workplace heat stress. They also highlight the need for employers to provide access to cool drinking water during work, as well as encouraging workers to consume traditional beverages that will help them to stay hydrated throughout their shifts. It is recommended that physically demanding jobs should be rescheduled to cooler times of day, and the frequency and duration of work breaks increased during periods of extreme temperatures. Special attention should be given to pregnant workers and workers with underlying medical conditions. Lastly, it is advised that workers wear breathable, light-coloured clothing and hats, or use umbrellas.
- The US National Institute for Occupational Safety and Health (NIOSH) Criteria for a Recommended Standard: Occupational Exposure to Heat and Hot Environments, published in 2016, contains a full list of recommendations to protect workers from heat stress. This includes guidance on workplace surveillance, medical monitoring, PPE, and worker information and training. Workplace control measures are also included.
- The EU has issued guidance on employers' responsibilities to people working in high temperatures. The guidelines⁷⁵, drawn up by European Agency for Safety and Health at Work, provide recommendations for employers, including: carrying out a workplace risk assessment and protecting vulnerable workers; consulting workers and their representatives about how to manage heat risks; adapting working hours and allowing workers to decide when to take breaks; ensuring workers have a supply of drinking water, access to a shaded area and protective clothing; and providing training on how to manage heat stress for at-risk workers.
- In the United Kingdom of Great Britain and Northern Ireland, the Health and Safety Executive (HSE)⁷⁶ gives recommendations for employers on how to protect workers in workplaces where heat stress is an issue all year, such as bakeries and foundries, and also in very hot weather where there is increased risk. Information is provided on methods to assess the risk of heat stress occurring and ways to identify workers more susceptible to heat stress. Methods to reduce the risk of heat stress are also outlined, including temperature controls, limiting work rate and length of exposure, preventing dehydration, PPE, training and acclimatization.
- In Italy, the National Institute for Insurance against Accidents at Work (INAIL), in collaboration with the National Research Council's Institute of BioEconomy, published a guide for workers, employers and company OSH managers, containing guidelines for preventing illnesses caused by heat stress. The document contains a catalogue of conditions linked to heat stress and provides guidance to identify risks and implement effective protection measures, for example training, emergency planning and acclimatization.
- In New Zealand, WorkSafe has a number of online tools for work in hot environments⁷⁷. Working Safely in Extreme Temperatures, concerned with any outdoor work during summer, provides advice on risk assessment in the event of extreme temperatures, as well as preventive measures, for example health checks. Two further sources of practical information are Working in Extreme Heat - a Guide for Businesses and Working in Extreme Heat - a Guide for Workers.

In some countries, public authorities and other bodies have developed **training programmes and advisory initiatives** to educate and assist employers and workers in addressing hazards related to heat and preventing the risks of heat stress at work.

⁷⁵ Heat at work – Guidance for workplaces.

⁷⁶ Temperature in the workplace.

⁷⁷ Working safely in extreme temperatures.

- The United Arab Emirates Government has launched the “Safety in the Heat” programme in collaboration with the Abu Dhabi Public Health Centre (ADPHC 2023). This programme focuses on educating approximately 800,000 workers and employers on effective strategies for managing excessive heat in the workplace, such as hydration, salt intake, rest breaks, gradual adjustment to heat, reduced work demands, and monitoring of at-risk individuals. It also includes training on handling heat-related illnesses.
- The Social Security Superintendence Authority (SUSESO) of Chile instructed occupational accidents and diseases insurance organizations to adopt preventive measures against exposure to high temperatures in the workplace. Technical assistance from these organizations must include: 1) training for employing entities on the definitions, scope and effects on human health of the different types of heat events due to high temperatures and extreme high temperatures that may occur within the framework of meteorological alerts; 2) technical assistance to employers for the preparation and implementation of emergency and contingency plans which include risk assessments for each task and/or job; 3) identification of the main disorders and diseases associated with heat events (heatstroke, heat exhaustion, heat cramps, heat fainting or syncope, heat oedema, heat rash, among others); 4) identification of risk groups or especially sensitive people and preventive measures to be implemented for their protection; 5) preparation and dissemination of information outlining prevention measures. In 2020, the Institute of Public Health reviewed the Protocol for Heat Stress Measurement and established a standardized methodology for the use of heat stress monitoring equipment in occupational heat exposure assessment.

Awareness-raising campaigns are important for spreading information and knowledge and stimulating action on OSH issues. Such initiatives can be organized by public authorities, OSH bodies, trade unions and employers and business membership organizations. Awareness campaigns can address groups of workers in a region affected by a particular climate threat, workers in specific sectors, employers or the public in general.

- The OSH committee of the Bahrain Free Labour Unions Federation conducted a health and safety awareness campaign aimed at outdoor workers who are required to work in direct sunlight in the middle of the day (BFLUFBH 2018). The campaign provided information on the risks of sun exposure and how to prevent heatstroke during working hours. The Federation also conducted checks on construction sites and gave on-site advice to workers about staying hydrated and wearing light clothing. Furthermore, the Federation asked the Government of Bahrain to extend the midday work ban to other months of the year, to account for rising temperatures and more frequent heatwaves.
- In Japan, the Ministry of Health, Labour and Welfare, in collaboration with other ministries and OSH institutes and associations, organized a national awareness-raising campaign on heatstroke prevention, with targeted initiatives in high-risk sectors (construction, transport, ports, forestry).
- In Belgium, the International Trade Union Confederation (ITUC) has been working with the care sector to raise awareness of how climate change concerns can impact workers in the sector and how workers in care homes can advocate for safe and healthy working environments. Coping with Climate Change in the Care Sector is a guide for workers produced by ITUC, which outlines the role workers can play in creating policies to adapt the care sector to climate change. These include awareness-raising campaigns, social dialogue between employers and workers, and advocacy by unions at local, regional and national levels. For example, in Flanders, unions are working with the environmental movement and other social organizations via Reset Vlaanderen on Just Transition. The Warme Dagen [Hot Days] campaign makes many tips and campaign materials available for organizations to work on climate adaptation locally.
- In Australia, the Victorian Chamber of Commerce and Industry's Health, Safety and Wellbeing team have published guidance for employers to raise awareness of the dangers of excessive heat in the workplace. The guidance explains how heat load may impact workers and the types of workplace controls that can be implemented to protect them. Businesses can also seek advice from the team on how to prepare, review and improve procedures and practices for working in hot conditions and methods of skilling staff in these complex safety management needs.
- In Spain, the Confederation of Employers of Cuenca, in collaboration with the Social Dialogue Council of Castilla La Mancha, organized an awareness-raising initiative on work organization in extreme temperatures, focusing on preventive measures and adaptation (EnciendeCuenca 2023). The one-day conference aimed to educate those attending about the recently adopted Royal Decree 4/2023, which established protection measures for workers exposed to extreme temperatures.
- In France, the employer organization Mouvement des Entreprises de France provides guidance to employers on how to protect workers during heatwaves. This includes advice on their legal obligations, as well as practical ways to avoid heat-related accidents (MEDEF 2023).

In some instances, **dedicated committees** have been set up between government ministries and other agencies to promote the development of policies, programmes and initiatives in a comprehensive and systematic manner.

- In Japan, the Committee for the Promotion of Heatstroke Control was established in 2021. The Committee, which succeeds the Coordination Committee on Heatstroke established in 2007, meets 3-4 times a year to discuss the reporting of heatstroke cases, the weather forecast and estimated risks, and joint initiatives on the prevention of heatstroke such as National Plans, updating the legal framework, targeted campaign activities, and awareness materials. Chaired by the Minister of Environment, the Committee involves the Cabinet, the Children and Families Agency, the Fire and Disaster Management Agency, the Ministry of Education, Culture, Sports, Science and Technology, the Ministry of Health, Labour and Welfare, the Ministry of Agriculture, Forestry and Fisheries, the Ministry of Economy, Trade and Industry, the Ministry of Land, Infrastructure, Transport and Tourism, the Japan Tourism Agency and the Japan Meteorological Agency.



► InFocus

BWI campaign for healthy and safe workplaces in the time of a climate emergency (BWI 2023a)

In 2023, BWI launched a new campaign dubbed “Heat-up Workers’ Rights, Not the Planet!” It sought to recognize the importance of health and safety under extreme heat and extreme weather events, and to demand better jobs and conditions for workers in the time of a climate emergency. Actions organized by the campaign included putting posters in support of workers’ rights to health and safety in workplaces, sharing messages on social media to raise awareness and writing to relevant government ministries.



Management of heat-related risks at the workplace level

There are a number of evidence-based practices that can be implemented in the workplace to manage risks from excessive heat. These include hazard identification and risk assessment, and the adoption of preventive and adaptive measures, implemented according to the hierarchy of controls. There are five categories in the hierarchy: elimination, substitution, engineering controls, administrative controls and PPE, with control methods at the top of the hierarchy (elimination) being more effective than those at the bottom (PPE).

With respect to excessive heat, protection measures focusing on eliminating the hazard are often impractical for many businesses. However, engineering controls are an effective way to prevent heat stress, particularly in indoor workplaces. These may include air conditioning to reduce temperature, ventilation, fans to dilute warm air and shade structures to block solar radiation (Cheveldayoff et al. 2023). At the next level of the hierarchy, administrative controls are changes to tasks or schedules to reduce heat stress, such as scheduling work to avoid the hottest times of the day. In most cases, heat stress should be reduced by engineering and administrative controls, but in some limited situations, special cooling devices can protect workers in hot environments (OSHA, n.d.).



Evidence has shown that simple and effective interventions to prevent heat stress include self-pacing, hydration, mechanization and clothing (Ioannou et al. 2022). The following practices are advocated by organizations such as OSHA, NIOSH and the American Conference of Governmental Industrial Hygienists and can be immediately implemented by employers (Watson et al. 2023):

- ▶ **Breaks** - Can be used to reduce the risk of hyperthermia despite hot working conditions. Regular breaks, in shaded or cooled areas where possible, slow down the build-up of heat in the body from prolonged work activity. They have been shown to be effective in some industries, for example agriculture and tourism.
- ▶ **Hydration** - The single most important and feasible strategy. 750ml of water every hour of work in the heat has been found to reduce occupational health strain without impacting labour productivity.
- ▶ **Mechanization** - Can enhance labour productivity without increasing heat strain.
- ▶ **Clothing** - Loose, light-coloured, breathable work coveralls have been shown to reduce occupational heat strain in agricultural workers by 0.4°C. Ventilated garments, such as short-sleeved shirts with integrated electric fans, reduce heat strain in agricultural workers, but have limited practicality. Using a bandana soaked in cool water has been shown to be a very effective option to reduce heat-related illness.

Acclimatization programmes can reduce the risk of heat illness in hot environments by improving the ability to withstand the strain placed on the body by heat (Kenny et al. 2018). However, whilst these programmes have been recognized as useful in countries with hotter climates, for example Singapore, they provide little protection for workers during heatwaves (Schulte et al. 2023). Agricultural workers have been found to benefit from taking regular breaks and having shifts adjusted to the coolest part of the day. However, shift adjustments should be balanced with controls for sleep schedule modification and disruption (Schulte et al. 2023).

Education programmes are key to ensuring employers and workers are aware of excessive heat in the workplace and its associated risks. Training may include recognition of the signs and symptoms of heat-related illness, steps to reduce the risk of ill-health and the proper care of heat-protective equipment (NIOSH 2018).

► ILO Guidance on heat stress

ILO Code of Practice on Ambient Factors in the Workplace: Chapter 8 Heat and Cold (Excerpt)

The scope of this chapter covers conditions in which temperatures and/or humidity are unusually high, workers are exposed to high radiant heat or high temperature and/or humidity occur in combination with protective clothing or high work rate. The chapter outlines assessment, prevention and control, health surveillance and training and information.

8.3.1. Where assessment shows that the workers may be at risk from heat stress, employers should, if practicable, eliminate the need for work in hot conditions or, if elimination is not practicable, take measures to reduce the thermal load from the environment.

8.3.4. Where the assessment shows that health or discomfort conditions arise from increased air temperature, the employer should implement means to reduce air temperature, such as a ventilation system. The design should take into account seasonal and sudden temperature changes in make-up air brought from outside. If the air temperature is below about 36°C, increasing air movement (for example by fans) will cool the workers; above that temperature it will heat them further.

8.3.6. The air may be cooled by evaporation, for example by water sprays, in addition to or instead of ventilation. The design of such a system should first be checked by a technically competent person to ensure that, in the circumstances of use, the increase in humidity does not counteract the effect of the temperature decrease on the working environment.

8.3.8. Where part of the risk arises from the metabolic heat produced during work, and other methods of eliminating the risk are impracticable, employers should arrange a work-rest cycle for exposed workers, either in the workplace or in a cooler restroom. The rest periods should be as prescribed by the competent authority and/or sufficient to

allow the worker to recover (see paragraph 8.2 of the annex). Employers should ensure that appropriate mechanical aids are available to reduce workloads and that tasks performed in hot environments are well designed ergonomically to minimize physical stress.

8.3.9. Where other methods of controlling thermal risk, including a work-rest regime, are not practicable, employers should provide protective clothing. In the selection of such clothing, consideration may be given to the following:

- (a) reflective clothing where heat gain is mostly by radiation;
- (b) insulated clothing with reflective surfaces during simultaneous exposure to high radiant heat and hot air (allowing freedom of movement to perform tasks);
- (c) air-, water- or ice-cooled clothing in other instances and as a possible complement to (a) and (b) above.

8.3.11. For hydration maintenance, employers should make water at low salt concentration or dilute flavoured drinks readily available to workers, and should encourage them to drink at least hourly, by providing a close source or arranging for drinks to be brought to the workers. Drinks at 15 to 20 °C are preferable to iced drinks. Alcohol, caffeine, carbonated drinks or drinks with a high salt or sugar content are unsuitable, as are drinking fountains because they are too difficult to drink from in sufficient volume.

8.3.12. Where a residual risk of heat stress remains even after all the control measures have been taken, workers should be adequately supervised so that they can be withdrawn from the hot conditions if symptoms occur. Employers should ensure that first-aid facilities and staff trained in the use of such facilities are available.



2. Ultraviolet (UV) radiation

Examples of workers at high-risk

Outdoor workers, including in construction and agriculture, lifeguards, power utility workers, gardeners, postal workers and dock workers.

Primary health impacts

Sunburn, skin blistering, acute eye damage, weakened immune systems, pterygium, cataracts, skin cancers.

Global burden of occupational exposures

1.6 billion workers
exposed annually to solar UV radiations (Pega et al. 2023).

Work-related health impact

Every year, over

18,960
work-related deaths.

due to non-melanoma skin cancer alone (Pega et al. 2023).

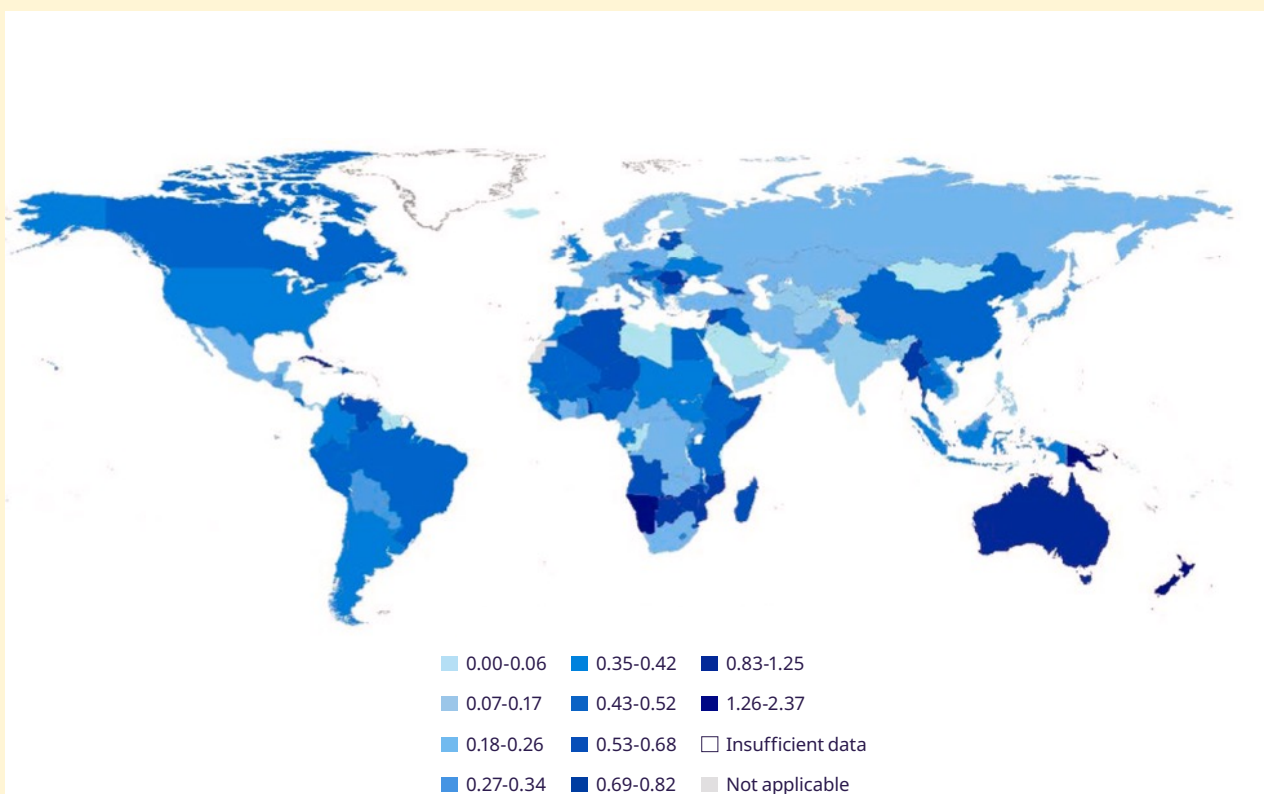
Solar UV radiation is a form of non-ionizing radiation. The quantity of solar UV radiation reaching earth is reduced by ozone molecules in the upper atmosphere. The gradual thinning of the ozone layer, caused by the release of ozone-depleting substances from industry and other human activities, is therefore a major cause for concern.

According to WHO-ILO joint estimates, 1.6 billion workers are occupationally exposed to solar UV radiation every year (Pega et al. 2023). The regional proportion of the population exposed to solar UV radiation was largest for the Africa region (33.0 per cent) and the South-East Asia region (32.3 per cent), and lowest for the Europe region (18.5 per cent) (Pega et al. 2023).

Impact on worker safety and health

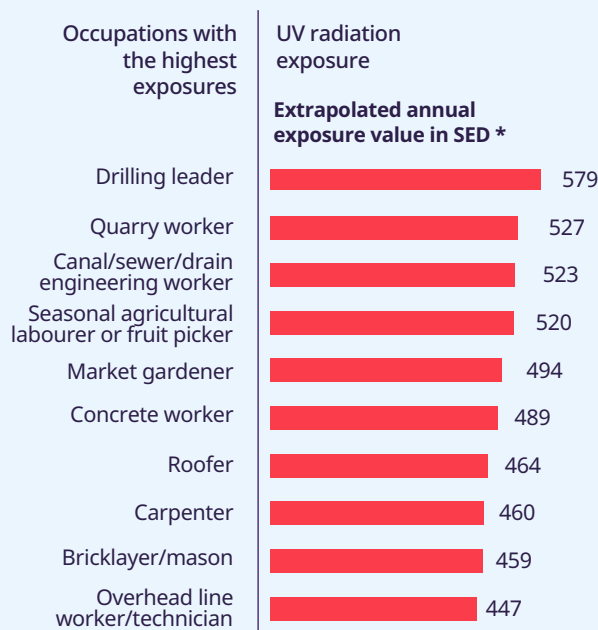
Short-term injuries from UV exposure, such as sunburn, skin blistering and eye damage, are normally temporary, however long-term effects can be serious. These include cataracts, macular degeneration, pterygium, weakened immune systems and skin cancers, such as melanoma, basal cell carcinoma (BCC) and squamous cell carcinoma (SCC) (Wright and Norval 2021). Solar radiation, and some individual components of solar radiation, specifically UVA, UVB and UVC, have all been classified by the International Agency for Research on Cancer (IARC) as carcinogenic to humans (Group 1). Joint WHO/ILO estimates of the burden of non-melanoma skin cancer (both BCC and SCC) attributable to occupational exposure to solar UV radiation for 183 countries found that between 2000 and 2019, annual work-related deaths due to skin cancer almost doubled, increasing from 10,088 deaths in 2000 to 18,960 deaths in 2019 (Pega et al. 2023). This cancer burden was higher among people in the Africa region, the Americas and the Western Pacific region (figure 4), and among men and people of middle to older working age. Worryingly, a rise of 2°C in global temperatures is predicted to increase skin cancer incidence by 11 per cent globally by 2050 (van der Leun and de Gruijl 2002). It is therefore likely that even workers in traditionally cooler climates will be at higher risk than before.

► Figure 4: Rate of deaths (per 100,000 of population) from non-melanoma skin cancer attributable to occupational exposure to solar UV radiation: WHO-ILO joint estimates on burden of work-related injuries and diseases



Solar UV radiation is a particular problem for outdoor workers, who are exposed to UV radiation doses at least two to three times higher than indoor workers and often to daily doses five times above internationally recommended limits (John et al. 2021). For unprotected outdoor workers, occupational exposure limits for UV radiation are typically exceeded within 10 minutes in the summer months (ARPANSA n.d.). There is no other occupational carcinogen (IARC/WHO group 1) to which workers are routinely exposed to levels that surpass recommended daily thresholds (John et al. 2021). Workers in countries with higher levels of ozone depletion are at greater risk of higher intensities of UV radiation, for example Argentina, Chile, South Africa, New Zealand and Australia (Ozone depletion 2018). Other environmental factors affecting a worker's solar UV exposure include time of year or day, latitude, altitude and reflection off the ground and work surfaces (WHO 2016).

Workers in construction and agriculture have been found to be at particularly high risk, as many of their job tasks are performed outside. For instance, the Australian Workplace Exposure Study identified that 99 per cent of agricultural workers and 86 per cent of construction workers were exposed to solar UV radiation (ARPANSA n.d.). Outdoor construction workers specifically can accumulate sufficient solar UV exposure over 30-40 years of work to more than double their risk of non-melanoma skin cancer (Cherrie et al. 2021). Other high-risk occupations include lifeguards, power utility workers, gardeners, postal workers and dock workers (John et al. 2021). Additionally, workers in some outdoor workplaces may experience 'phototoxicity', where skin sensitivity to UV radiation is enhanced by handling certain chemicals, such as some plants, sunscreens and disinfectants (e.g. epoxy resins, bitumen, hydrazine and also some drugs) (ICNIRP 2007).



* Standard erythema dose: 1 SED is sufficient to cause sunburn on skin type (pale skin, reddish hair)

Source: www.dguv.de

The GENESIS-UV project in Germany measured the exposure of outdoor workers to solar radiation. Since 2014, nearly 1,000 workers from almost 100 different occupations/subgroups have taken part in the study and have provided well over 80,000 days of measurement (DGUV 2019). Of the ten occupations with the highest radiation exposure, many are found in the construction sector, but also in raw materials extraction and agriculture. Exposures were found to vary considerably, even within the same profession.



UV radiation can be especially hazardous for workers as they may be unaware that they are being exposed to dangerously high levels. For example, a systematic review of outdoor workers' sun-related knowledge, attitudes and protective behaviours found that many workers stated that they never or only rarely wore a long-sleeved shirt (50-80 per cent), sun-protective headgear (30-80 per cent) and sunscreen (30-100 per cent) while working in the sun (Reinau et al. 2013). This may be because protections were perceived as unsafe or uncomfortable, or due to workplace culture (Reeder et al. 2013).

- The **economic impact** of work-related UV radiation-induced skin cancer is hard to measure but likely to be considerable. In Canada, for example, the direct and indirect costs of occupational non-melanoma skin cancer cases are estimated at 28.9 million Canadian dollars, with total costs on a per case basis at CA\$5,670 for BCC and CA\$10,555 for SCC (Mofidi et al. 2018).

Examples of responses to the risk

Policies, laws and other initiatives at the national level

OSH legislation sometimes covers exposure to all types of radiation, which therefore includes types of non-ionizing radiation, such as solar UV radiation. However, generally when laws and regulations are more specific, they mostly focus on ionizing radiation, for example in the ILO Radiation Protection Convention, 1960 (No. 115), or artificial radiation, such as in EU Directive 2006/25/EC, thus excluding solar UV radiation.

Some countries expressly refer to the protection of workers against risks from solar UV radiation in their legislation, defining some protection measures, in particular the provision of adequate PPE.

- Employers in Cyprus⁷⁸ are obliged to implement appropriate measures to avoid excessive exposure to UV radiation.
- In Senegal, workstations must be protected from direct solar radiation⁷⁹.
- Legislation in Chile⁸⁰ mandates that workers who perform work subjected to direct solar radiation between 1 September and 31 March between 10 a.m. and 5 p.m. and those who perform regular functions under direct solar UV radiation with a UV index equal to or greater than 6 at any time of the year, are considered exposed to UV radiation (art. 109a). Employers of exposed workers must carry out management of the UV radiation risk by taking adequate control measures (art. 109b), which include: (a) informing workers of solar UV exposure risks; (b) publishing the estimated UV index daily; (c) identifying exposed workers and those requiring extra protective measures; (d) applying control measures, for example engineering and administrative controls, and PPE; (e) maintaining a practical and theoretical instruction programme for workers on the risk and health consequences of exposure to solar UV radiation and preventive measures to be considered, among others. Public and private care establishments shall notify the Regional Health Authority of data in cases of erythema and sunburn sustained in relation to or during work (art. 109c).
- In Germany, employers are required to conduct UV radiation exposure risk assessments, provide PPE and offer UV radiation-exposed employees a consultation with an occupational physician every three years⁸¹.
- Belgium's Well-being at Work Code⁸² has a number of provisions related to solar UV radiation. For example, PPE should be given to protect the skin of those exposed, including dermatological products, hats, glasses and gloves. Table 2.1 of the Code presents the risks associated with different types of radiation, including solar UV radiation.
- In Peru⁸³, employers must provide workers who are exposed to prolonged periods of solar radiation with PPE and sunscreen, as well as training on how to use equipment correctly.
- Employers in Costa Rica are obliged to provide workers with glasses and special protections against light or heat radiation, whatever the origin⁸⁴.
- Finland's Government Decree (427/2021)⁸⁵ on the Selection and Use of Personal Protective Equipment at Work includes provisions on the use of PPE to protect against UV radiation.
- In the Philippines, the Occupational Safety and Health Standards (art 1076.05 (2)) contain provisions to protect workers against radiation in general. More specifically, the Labour Advisory No. 03 (2016) states that PPE for the head, body and extremities must be provided, including hats, goggles or UV protective eyewear and comfortable, light long-sleeve t-shirts, to mitigate the effects of extreme heat at work.

⁷⁸ Code of Practice for Thermal Stress of Employees.

⁷⁹ Décret n° 2006-1252 du 15 novembre 2006 fixant les prescriptions minimales de prévention des certains facteurs physiques d'ambiance, Art. 4.

⁸⁰ Decreto núm. 594 por el que se aprueba el Reglamento de Condiciones Sanitarias y Ambientales básicas en los Lugares de Trabajo.

⁸¹ Ordinance on Preventive Occupational Health Care.

⁸² Code du bien être au travail du 28 avril 2017 (dans sa teneur modifiée au 27 mai 2020).


⁸³ Law no. 31110. Aprueba el Reglamento de negociación colectiva y condiciones mínimas de trabajo de la Ley N° 31110, Ley del régimen laboral agrario y de incentivos para el sector agrario y riego, agroexportador y agroindustrial. Art. 22.

⁸⁴ Decreto 1 por el que se promulga el reglamento general de seguridad e higiene de trabajo. Art. 81.

⁸⁵ Government Decree (427/2021) on the Selection and Use of Personal Protective Equipment at Work.

Although international guidance exists containing recommendations on OELs for UV radiation, for example, the Australian Radiation Protection and Nuclear Safety Agency (ARPANSA) Radiation Protection Standard for Occupational Exposure to Ultraviolet Radiation of 2006, a study by Cherrie and Cherrie (2022) found that there are no specific legal OELs on solar UV exposure in any country in the world.

In some countries, OSH legislation provides for regular medical assessments to protect workers against the risks associated with exposure to solar UV radiation.

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- In Malawi, workers who continuously work under non-ionizing radiation, including solar UV radiation, should be under medical surveillance to detect potentially pre-cancerous lesions of the skin⁸⁶.

In line with the List of Occupational Diseases Recommendation, 2002 (No. 194) which includes in its Annex “1.2.5. Diseases caused by optical (ultraviolet, visible light, infrared) radiations including laser”, some countries are including diseases caused by solar UV radiation in their list of occupational diseases.

► InFocus

Work-related skin cancer as an occupational disease

Few countries officially recognize work-related skin cancer as an occupational disease and even in those countries that do, the number of reported cases is often limited. For example, in Denmark, only 36 cases of skin cancer have been recognized since its inclusion in the list of occupational diseases in 2000 and in Italy, on average, only 34 cases were reported annually between 2002 and 2017 (John et al. 2021). However, in Germany, when some forms of work-related skin cancer were officially included in the list of occupational diseases in 2015, within the first 12 months of official recognition, more than 7700 cases were notified. By 2018, this figure had risen to 9905 cases.

- In Switzerland, the “list of harmful substances” in article 14 of the Accident Insurance Ordinance (Annex 1) explicitly mentions solar UV radiation. This legally-binding directive includes the recognition of skin changes – resulting from photoexposure – as being of an occupational nature if they are due exclusively or at least partly to this activity (> 50 per cent).
- In Lebanon, Section 7.2.1 of the occupational disease list⁸⁷ includes occupational diseases that result from exposure to UV radiation or any work that exposes workers to UV radiation exceeding national averages.
- The list of occupational diseases in Albania⁸⁸ includes conjunctival diseases resulting from exposure to UV radiation.
- Finland’s Government Decree on the List of Occupational Diseases (769/2015)⁸⁹ includes those caused by UV radiation, such as inflammation of the conjunctiva and cornea and skin changes (photodermatitis).
- In Italy, the list of occupational diseases in industry and agriculture⁹⁰ contains actinic keratosis, which is caused by solar UV damage to the skin, and cutaneous epithelioma of photoexposed sites.

⁸⁶ Occupational Safety, Health and Welfare Act Part VI, Section 62.

⁸⁷ Decree 14229. Section 7.2.1.

⁸⁸ Decree No. 594 dated 01.07.2015 On the approval of the list of occupational diseases. Position 5.

⁸⁹ Government Decree on the List of Occupational Diseases (769/2015). No. 7.

⁹⁰ Decreto 10 ottobre 2023 Revisione delle tabelle delle malattie professionali nell'industria e nell'agricoltura. No. 80.

National OSH bodies and other authorities have developed comprehensive **technical guidance** on sun safety for workers and employers.

- The UK Institution of Occupational Safety and Health recommends eight simple steps for employers to reduce sun exposure for outdoor workers, which include completing an organizational solar risk assessment, communicating the risks, implementing suitable control measures focused on eliminating or reducing solar exposure, and providing workers with information and training on solar exposure (IOSH n.d.).
- The UK HSE⁹¹ offers safety advice to workers, including information on who is at risk, the harmful effects of sun exposure and protection measures, such as keeping clothes on, wearing a hat, working in the shade whenever possible, wearing high factor sunscreen and drinking plenty of water. It also recommends checking skin regularly for any unusual moles or spots.
- The US Centers for Disease Control and Prevention⁹² provide guidance in English and Spanish on how individuals can protect their skin from the sun:
 - Shade - Stay in the shade under a tree, umbrella or other shelter.
 - Clothing - Wear long-sleeved shirts, pants and skirts, made from tightly woven fabric.
 - Hat - Wear a hat that has a brim all the way around to protect your face, ears and the back of your neck.
 - Sunglasses - Wrap-around sunglasses that block both UVA and UVB protection work best.
 - Sunscreen - Use a broad-spectrum sunscreen with a high protection factor that filters both UVA and UVB rays. Reapply it regularly and check the expiration date.
- The guidance also includes sun safety tips for employers, for example incorporating safety measures into workplace policies, and training and guidance for employees:
 - Encourage sun safety among your employees and provide sun protection when possible.
 - Use tents, shelters, and cooling stations to provide shade at worksites.
 - Schedule breaks in the shade and allow workers to reapply sunscreen throughout their shifts.
 - Create work schedules that minimize sun exposure. For example, schedule outdoor tasks such as mowing for early morning instead of noon, and rotate workers to reduce their UV exposure.
- WorkSafe New Zealand⁹³ has produced guidance targeting both the person conducting a business or undertaking (PCBU) and workers. The quick guide Protecting Workers from Solar UV Radiation (for PCBUs) describes how to identify and assess the health hazards and risk related to solar UV radiation, and how to effectively control and monitor this risk. The guide Keeping Safe in the Sun (for workers) provides information on keeping safe from the sun's harmful rays.
- In Spain, within the framework of a Project on Photoprotection Policies and Prevention of Occupational Skin Cancer, financed by the Andalusian Institute of Occupational Risk Prevention, the Andalusian Health Service published a manual of good practice⁹⁴. The manual is intended as a tool to promote organizational and structural changes to prevent risks related to exposure to the sun at work and thus protect the health of outdoor workers.

91 HSE Skin at work: Outdoor workers and sun exposure.

92 CDC Sun Safety Tips for Employers.

93 Protecting workers from solar UV radiation.

94 Guía de trabajo saludable (hcs.es).

Initiatives to raise awareness among, inform and train workers and employers on the increasing risks associated with solar UV radiation have been developed in many countries. Such initiatives, often focusing on outdoor workers, have been carried out by different authorities and bodies, as well social partners.

- Sun Safety at Work⁹⁵ is a Canadian initiative to raise awareness of the importance of sun safety and to help workplaces implement sun safety programmes within their occupational health and safety management systems. Aside from providing general information about sun safety and the risks of solar UV exposure, it also gives detailed instructions for employers on how to build a sun safety programme. This programme has a number of stages including planning, implementing control measures, first aid and incident notification, and monitoring, for example through incident investigation, workplace inspections, auditing and evaluation. The website provides numerous online resources about a variety of topics, for example acclimatization, daily solar UV procedures and risk assessment.
- In Italy, INAIL and the University of Modena and Reggio Emilia carried out a joint project entitled “Prevention of occupational risk from solar radiation: a training intervention for workers and students in the agricultural and construction sectors” (Gobba and Modenese 2018). Over 200 OSH representatives from the two sectors participated in a workshop, which provided instruction on measures to protect workers against solar UV radiation. A total of 15 targeted 8-hour training sessions were also organized for workers in construction and agriculture, as well as for agriculture and surveying students in higher education establishments.
- In Spain, the National Institute for Safety and Health at Work launched a campaign in 2023 entitled, «With the sun it's time for prevention»⁹⁶. This national awareness-raising initiative focused on two messages: «at work, don't let the sun hit you» and «at work, don't let the sun burn you». Different materials were developed, including sector-specific posters, leaflets and videos, with the aim of drawing attention to the issue and preventing serious health problems, such as heatstroke or skin cancer.
- In 2023, the Swiss trade union Travail.Suisse widely disseminated a practical guide on preventive and adaptive measures, including recommendations on climate change impacts in the workplace⁹⁷. These include how to protect workstations from solar radiation.
- We Build the Future, a UK construction charity, launched a campaign in 2023 to promote sun safety in the construction sector⁹⁸. The initiative aims to mitigate the risk and occurrence of skin cancer among workers who are exposed to the sun on a regular basis as part of their job. Despite comprising only 8 per cent of the UK workforce, construction workers account for 44 per cent of occupational skin cancer diagnoses and 42 per cent of related deaths annually. The campaign's objective is to lower the likelihood and occurrence of skin cancer by promoting sun safety measures at all construction sites. The campaign promotes awareness of solar UV radiation risk among built environment industry workers and employers; provides access to simple advice on how to reduce UV risk; advocates for sites and offices to adopt safe practices to reduce UV risks; and promotes access to information and advice for people with concerns about skin cancer. Additional support has come from Melanoma UK and Rainbow Signs, who have teamed up with the charity to offer employers and main contractors sun safety boards for their construction sites.

⁹⁵ Enhancing Sun Safety in Canadian Workplaces.

⁹⁶ Con sol es tiempo de prevención”, nueva campaña del INSST.

⁹⁷ Guide pratique avec des mesures d de prévention, d'adaptation et des recommandations.

⁹⁸ Stay Sunsafe.

► InFocus

Effect of an occupational skin cancer prevention programme on worker sun safety practices in Colorado, United States

The Sun Safe Workplaces (SSW) programme was developed and tested in a randomized controlled trial by Walkosz et al. (2018). The study, carried out in Colorado, enrolled local government organizations with outdoor workers in public works, public safety and/or parks and recreation. SSW advocated that senior managers adopt formal sun safety policies and provide training and printed/electronic messages for outdoor workers. Initial follow-up showed that SSW increased policy adoption at intervention worksites and improved senior managers' implementation of actions to support employee sun safety. A two-year follow-up assessment of SSW involving 1724 outdoor workers also found that sun protection behaviours improved significantly in the intervention group receiving the SSW programme, compared to the control group.

Many countries are developing **skin cancer prevention programmes** with health surveillance and skin cancer screening to detect adverse changes in the skin at an early stage. These programmes often include outdoor workers as a priority target group.

- In Germany, a 12-month population-based skin cancer screening project called SCREEN led to cost savings of over €575 million per year (Kornek and Augustin 2013). Yet few countries have developed comprehensive programmes for occupational skin cancer prevention, screening of high-risk workers and aftercare (Ulrich et al. 2016). Indeed, studies have found that outdoor workers are less likely to have received a skin examination than the average (indoor) worker (John et al. 2021).
- In Australia, different initiatives exist to reduce skin cancer incidence, morbidity and mortality through targeted prevention and early detection programmes. For instance, Cancer Council Australia⁹⁹ recommends that all workplaces which require employees to work outdoors for some or all of the day have a comprehensive sun protection programme in place that includes periodic assessment of the UV radiation exposure risk for workers, the introduction of sun protective measures, and education and training for all outdoor personnel. Control measures should be documented in a written policy created by both employers and workers. Another example is the SunSmart initiative in the state of Victoria¹⁰⁰, which offers advice and UV safety training to workers from different industries, including construction, agriculture, fisheries and transportation. The SunSmart Global UV app from Cancer Council Victoria and

ARPANSA¹⁰¹, which provides users with forecasts of both the weather and UV index, was jointly launched by the World Health Organization (WHO), ILO, World Meteorological Organization and the United Nations Environment Programme (UNEP). The app is available free worldwide and gives users information about the UV index, which is a scale from 1 (low) to 11 and higher (extreme), indicating the potential for damage from the sun.

- In Ireland, the National Cancer Strategy 2017-2026 Recommendation 3 states, "The Department of Health will develop a national skin cancer prevention plan and oversee its implementation as a priority. The plan will prioritize children, outdoor workers, sunbed users and those who pursue outdoor leisure activities". Furthermore, the National Skin Cancer Prevention Plan 2023-2026 outlines the further action required to tackle elevated rates of skin cancer in high-risk groups, such as outdoor workers. The strategy outlines four action areas targeted at outdoor workers specifically: 1) Continue to identify and pursue opportunities to raise awareness of UV risk and skin cancer prevention among outdoor workers through the development of training and education; 2) Promote resources to support employers to adopt policies for UV risk and skin cancer prevention for outdoor workers; 3) Incorporate skin cancer prevention messaging and behaviours into healthy workplaces initiatives; and 4) Continue to partner with relevant stakeholders to develop skin cancer prevention best practice in the workplace.

⁹⁹ Sun (UV) protection in the workplace.

¹⁰⁰ UV Training and Education.

¹⁰¹ Free SunSmart Global UV app.

Management of solar UV radiations at the workplace level

Large-scale, quality research projects have provided evidence of effective strategies to decrease harmful exposure to UV radiation in outdoor workers, particularly to prevent skin cancer. However fewer studies have measured the effects of individual intervention components (Horsham et al. 2014). In addition, study comparison to identify trends can be difficult, as exposure of outdoor workers to solar UV radiation is highly variable (Cherrie and Cherrie 2022).

There are specific measures employers and outdoor workers can take to mitigate exposures following the hierarchy of controls, for example using engineering controls, such as the provision of shaded work areas, and administrative controls to avoid work being carried out in direct sunlight during the hottest part of the day. Effective interventions also include the use of sunscreens and sun-protective clothing, however certain recommendations for sun-protective clothing may be at odds with choosing appropriate clothing for working in the heat (Schulte et al. 2023).

The prevention of skin cancer in outdoor workers is thought to depend heavily on initiatives that include health education, which can help employees better comprehend and perceive the occupational UV radiation risk (Symanzik and John 2022). Providing information and guidance for workers on sun protection and skin examination using digital interventions, such as websites and mobile apps, may also be more effective than conventional interventions (Houdmont et al. 2016).

Public health interventions may be effective at increasing preventive behaviours in occupational settings. These interventions are defined as having at least two distinctive components (such as strategies directed toward individuals, mass media campaigns or environmental and policy changes) implemented in multiple settings or for the entire community in a defined geographic area (Tripp et al. 2016).

Low-cost methods for monitoring exposure levels to UV radiation in the workplace can be effective at measuring levels and managing risks (Cherrie and Cherrie 2022). Technical guidance from the International Commission on Non-Ionizing Radiation Protection, the ILO and the WHO, entitled Protecting Workers from Ultraviolet Radiation, provides recommendations on protecting workers from UV radiation exposure (ICNIRP 2007). These include information regarding exposure assessment and suggestions for protective measures for outdoor workers.



► ILO Guidance on UV radiation

ILO Code of Practice on Ambient Factors in the Workplace: Chapter 8 Optical radiation (Excerpt)

The scope of this guidance applies to all workplaces where there is hazardous exposure to optical radiation, including UV and visible light, as a result of work activities.

7.2 Assessment

7.2.1. Employers should assess equipment and activities likely to give rise to hazardous exposure to optical radiation. The assessment should include outdoor work which exposes workers to the sun.

7.2.3. Employers should assess the hazard and risk:

- (a) by characterizing the level of hazard and risk including by comparing the real exposure levels with exposure limits following measurements by a technically competent person using appropriate and properly calibrated equipment, designed to assess hazard to health of UV, IR radiation or visible light, as applicable [...]

7.3 Prevention and Control

7.3.7. Employers should:

- (d) where practicable, in the case of outdoor work:
 - (i) minimize exposure of workers to the sun by organizing the work so that it can be carried out in the shade;
 - (ii) protect workers by appropriate clothing and personal protection, such as sunscreen ointment or lotions and eye protection, when necessary.

7.5. Training and Information

7.5.1. Employers should inform workers likely to be exposed to significant levels of optical radiation and/or involved in work with lasers:

- (a) about the hazards to health of optical radiation and the sources and activities that may pose a risk of exposure, especially about the need for protection against the effects of the sun;
- (b) of the importance in outdoor work of using any available shade and personal protection, where indicated, including protective clothing and sunscreen ointments and lotions;
- (f) that some perfumes and medicines can cause sensitization on exposure to UV radiation and that they may need to consult their physician.



3. Extreme weather events

Examples of workers at high-risk

Medical personnel, firefighters, other emergency workers, construction workers involved in clean-up, agricultural and fishing workers.

Global burden of occupational exposures

Limited data.

Primary health impacts

Various.

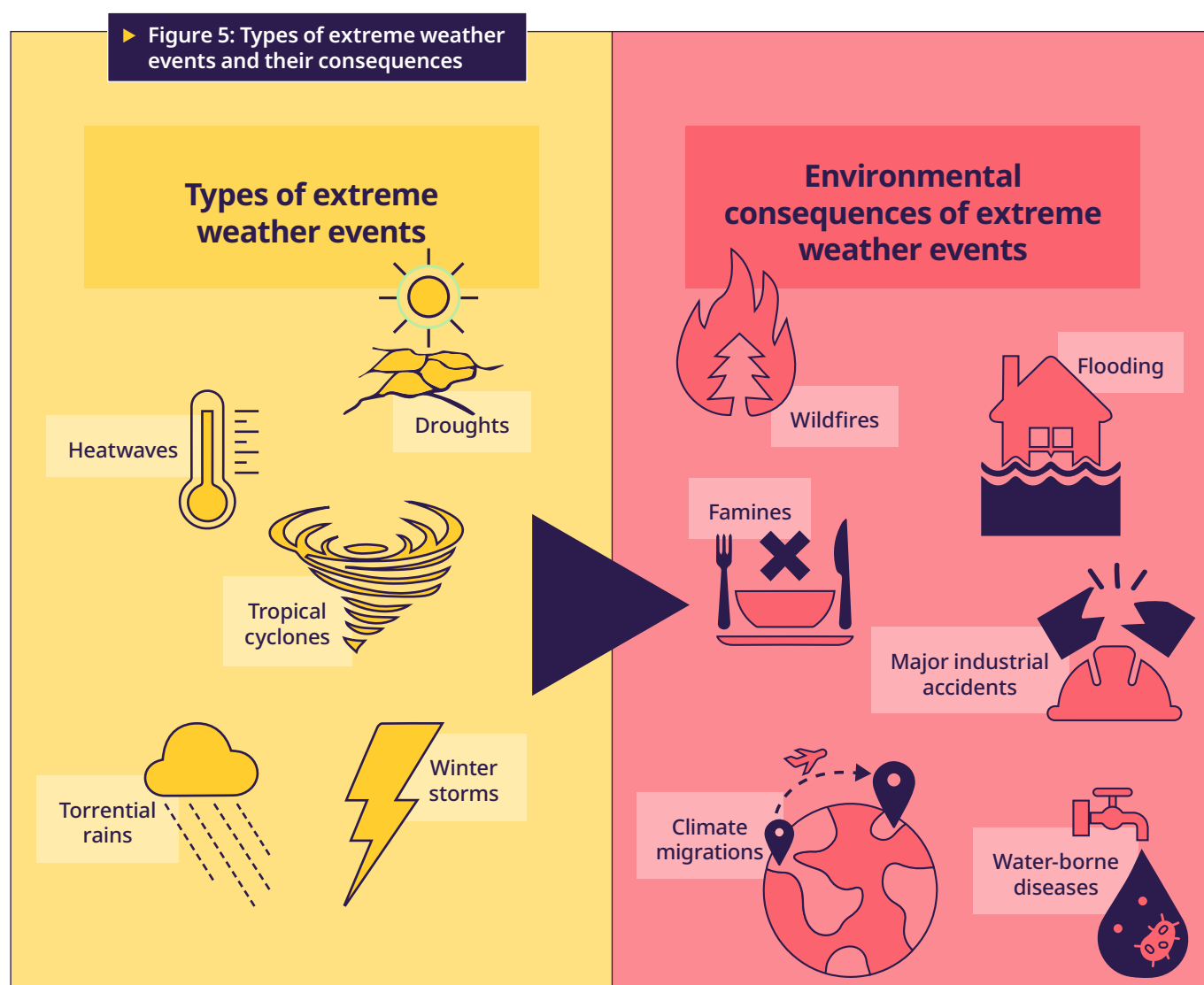
Work-related health impact

2.06
million deaths

due to weather, climate and water hazards (not just occupational exposures) from 1970 to 2019 (WMO 2021).

Thousands of people are killed and injured every year in extreme weather events and natural disasters, such as floods, droughts, wildfires and hurricanes. According to International Disaster Database (EM-DAT) records from 1970 to 2019, weather, climate and water hazards accounted for 50 per cent of all disasters, 45 per cent of all reported deaths (2.06 million deaths) and 74 per cent of all reported economic losses (US\$3.6 trillion) (WMO 2021). In 2018 alone, 831 climate-related extreme events resulted in US\$166 billion in economic losses (Lancet 2021).

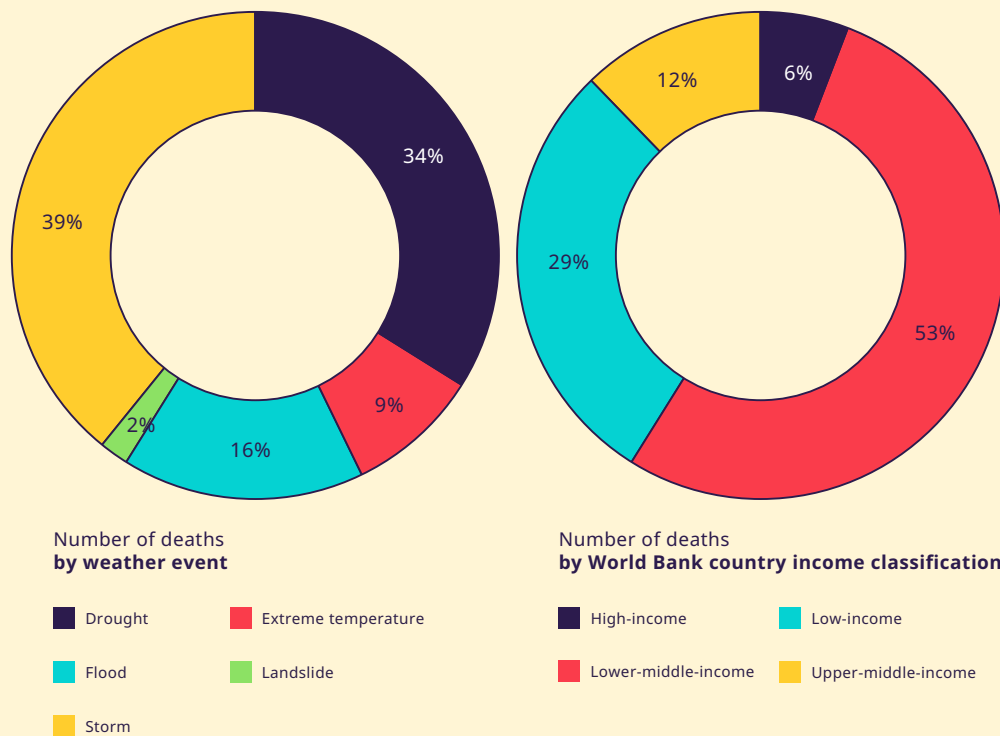
Alarming, climate projections point towards an increase in the frequency, duration and intensity of these events, which will continue to have devastating human and economic consequences. Moreover, the interconnectedness of these events must also be considered, for example, a drought may accelerate a heatwave (Sutanto et al. 2020), heatwaves may lead to a higher risk of cyclones (Choi et al. 2024) and cyclones induce heavy rainfalls (Messmer and Simmonds 2021).



Adapted from: IBERDROLA n.d.

The main types of extreme weather events and possible consequences are shown in figure 5. The increased frequency of natural disasters will affect all regions, but certain regions are more exposed to certain types of natural hazards than others. Of all the deaths from weather, climate and water hazards, 82 per cent of deaths occurred in low- and lower-middle-income countries (WMO 2021) (figure 6). Indeed, natural disaster losses disproportionately affect poorer people and force some 26 million people into poverty each year.

► **Figure 6: Number of reported deaths globally between 1970 and 2019 by weather event type and World Bank Country Classification (Total = 2,064,929) (WMO 2021)**



Selected extreme weather events from 2023

- **Record-breaking heat across Asia** – Many parts of Bangladesh, India, Thailand and Lao People's Democratic Republic saw record-high temperatures in April. Temperatures were as high as 45.4°C in Tak, Thailand. Viet Nam recorded its highest temperature ever at 44.1°C in Thanh Hoa province, south of Hanoi, on 6 May. China's summer saw scorching temperatures, reaching a national record high of 52.2°C in Sanbao. China's capital, Beijing, suffered through 27 consecutive days of temperatures above 35°C, leading to a temporary ban on outdoor work.
- **Libya's destructive floods** – Storm Daniel, which landed on 10 September, brought torrents of rain that resulted in catastrophic floods, breaking dams near the eastern city of Derna and wiping out entire neighbourhoods in the country. The floods killed more than 4,300 people and damaged critical infrastructure.
- **A strong cyclone in Southeast Africa** – Cyclone Freddy stayed for a month in the Southeast African countries of Madagascar, Malawi, Mozambique and Zimbabwe. It killed over 1,000 people and displaced over 500,000 residents. The storm is also a factor in Malawi's worst cholera outbreak.
- **Wildfires in Chile** – Record heat in Chile caused deadly wildfires. Chile's temperatures soared above 40°C in February, triggering wildfires that claimed 24 people and scorched 270,000 hectares of land.
- **A severe sandstorm in Beijing, China** – The sandstorm engulfed the capital with particles with a particulate matter density of PM10, so tiny that they could travel to the lungs. The particles reached a peak concentration of 1,667 µg/m³, which far exceeds the daily average guideline of 45 µg/m³ set by the WHO. People were urged to stay indoors, and the city's parks operations were suspended.

► InFocus

Firefighters and wildfires in the United States

The size and frequency of wildfires are increasing due to extreme weather conditions caused by climate change, such as extremely dry conditions and very high winds. Wildfires cause widespread devastation, with land and resources destroyed and thousands of people left homeless. Wildfire smoke degrades air quality by releasing large quantities of carbon dioxide, carbon monoxide and fine particulate matter into the atmosphere. Firefighters are particularly at risk of this hazardous air pollution, as their work involves suppressing wildfires or conducting prescribed burns work under arduous conditions, often for long hours (Navarro 2020). Firefighters may also be subjected to elevated levels of particulate matter at base camps from vehicle emissions, dust and generator use (McNamara et al. 2012). Occupational exposure to wildfires has significant health implications, including short-term effects on lung function and long-term risks such as cardiovascular diseases, ophthalmic conditions and post-traumatic stress symptoms (Groot et al. 2019; Finlay et al. 2012).

Firefighters will also be increasingly exposed to hazardous chemicals, such as per- and polyfluoroalkyl substances (PFAS), contained in firefighting foams, as well as some treated protective gear. PFAS have been linked to a variety of cancers, with perfluorooctanoic acid (PFOA) classified as possibly carcinogenic to humans (Group 2B) by the IARC. They are also known to interfere with immune function, endocrine function and breast development. Several studies have shown that firefighters have higher blood levels of PFAS compared to the public. For example, a recent study of an all-female cohort of firefighters showed that all the 86 female firefighters had at least four PFAS detected in their serum samples (perfluorohexanesulfonic acid, PFOA, perfluorooctanesulfonic acid, and perfluorononanoic acid) (Trowbridge et al. 2019).

Many extreme weather events have also led to major damage to hazardous installations, such as factories or extraction sites, triggering the release of hazardous substances, fires and explosions. In some cases, the damage is so severe that a major industrial accident (MIA) is caused, resulting in loss of life, adverse health effects, environmental pollution, and economic losses. It is likely that the risk and impact of MIAs from weather events is increasing, due to a combination of increasing industrialization and urbanization, combined with a projected rise in hydro-meteorological hazards caused by climate change (WHO 2018a).

Impact on worker safety and health


During extreme weather events, and in the immediate aftermath, there are drastic surges in demand on workers in the emergency services. Floods, storms, droughts, and wildfires often require complex emergency response, recovery, and rescue operations. Emergency workers are expected to work harder, for extended periods, in difficult and often hazardous circumstances, and with limited resources (Bennett and McMichael 2010). Health impacts may be both physical and mental. For example, damage to infrastructure and buildings can put response workers at increased risk of traumatic injury and death (Dogden et al. 2016). They may suffer respiratory tract injury from inhalation of irritant gases, combustion products, heavy dust and fibres. Workers may also be exposed to biological hazards during flooding, for example bacteria, mould, faecal matter and vector-related risks (for example cholera and Weil's disease), causing allergic, infectious and toxic effects. In times of drought and wildfires, firefighters and other rescue workers may be exposed to elevated levels of particulate matter and face risks from chemicals in firefighting foams (Mazumder et al. 2023). The increased intensity and duration of the wildfire season due to drought can also result in more exposure of firefighters to smoke and reduced firefighter recovery time between fire seasons (Schulte et al. 2016). "Zombie fires", which are fires that ignite in one fire season, smoulder through the winter months beneath the snow, and resurface in early spring, are also getting worse and are becoming a year-round problem in certain places (BBC 2024).

Emergency workers and others may also be subjected to contaminated environments during clean-up operations in the weeks following the event. Chemical industry workers may be exposed to hazardous substances if chemical storage facilities are damaged and construction workers may encounter numerous hazardous substances, such as lead, asbestos, and solvents. For example, the 2019 Tropical Cyclone Idai caused catastrophic damage and a humanitarian crisis in Mozambique, Zimbabwe, and Malawi, leaving more than 1,300 people dead and many more missing. The cyclone left a high degree of hazardous waste, primarily asbestos from Lusalite sheets, which construction workers were exposed to when clearing older buildings (ILO 2019b). Moreover, environmental deterioration after a natural disaster can result in an increase in vector breeding sites and rodent populations, leading to the extensive use of insecticides and rodenticides, posing further chemical risks to workers.

The predicted increase in both the frequency and severity of weather events poses a threat to the long-term well-being of these workers. The repeated trauma and stress of multiple emergency events and the ongoing management of the injured, ill, and displaced may leave these workers physically and emotionally fatigued and unable to contribute as strongly during later events (Bennett and McMichael 2010). The mental health effects of climate change in the general population can include anxiety, depression and post-traumatic stress disorder (EEA 2019). Studies have shown that mental disorders are more frequently reported among emergency services personnel due to the stressful nature of the job, combined with high exposure to traumatic events, including injury to others, proximity to death and perceived survivors' guilt (Stevellink et al. 2020). Extreme weather events may also force workers to work extended hours, resulting in mental fatigue that increases the risk of accidents (Schulte et al. 2016).

MIAs due to natural events can affect workers in several ways, either due to the toxic effects of chemicals, the effects of fire or the effects of explosion. Acute exposure to toxic chemicals can cause local injury, for example, skin burns due to a corrosive agent, or systemic damage to the whole physiological system, such as from mercury poisoning. If large quantities of hazardous chemicals are released, they have the potential to kill or injure people who are far away from the plant. Chlorine and ammonia are toxic chemicals commonly used in major hazard quantities and both have a history of major accidents. Workers may also suffer skin burns and be exposed to toxic fumes from fires. Explosions may cause workers to be blown over, buried under collapsed buildings or injured by flying glass and other debris.

Extreme weather will also have consequences for other workers, for example those who depend on stable weather conditions for their livelihoods. For example, agricultural workers would be directly impacted by the destruction of their land, resulting in a variety of acute and chronic adverse health outcomes such as traumatic injuries, fatigue and mental stress (Schulte et al. 2023). In commercial shipping, extreme weather events may result in vessels sinking (Lucas et al. 2018).

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- The **financial implications** of extreme weather events should also be considered. These include damage to infrastructure and buildings, reduced labour productivity, lower consumption and investment and disruption to global trade flows (Gagliardi et al. 2022). Two recent reports by Cornell University School of Industrial and Labor Relations Global Labor Institute and Schroders found that extreme heat and flooding are threatening key apparel production hubs, with four countries vital for fashion production at risk of losing US\$65 billion in export earnings and 1 million potential jobs by 2030 (Judd et al. 2023; Bauer et al. 2023). Aside from the financial implications, the reports highlight that even the most established clothing brands are failing to comprehend how these extreme weather events will jeopardize the safety and health of workers.

► Working in extreme cold

Despite overall warming trends globally, shifts in extreme temperatures are leading to an increase in damaging winter storms, even in areas historically seeing few such events (CISA n.d.). Experts have predicted that blizzards will get more severe due to climate change as a warming planet causes numerous alterations to the climate, including disruption to the polar vortex (Marsh 2022). The damaging effects of such storms include ice, freezing rain, heavy snow, ice storms and freezing fog, all of which can be amplified by climate change (CISA n.d.). What constitutes extreme cold varies between regions, as some areas are less used to extreme weather events (CDC n.d.). It can be defined as “temperatures that are lower than historical averages to the point that it creates a dangerous environment for people, animals and critical infrastructure” (CISA n.d.).

As mentioned above, the internal temperature (core body temperature) of the human body needs to be maintained at $37^{\circ}\text{C} \pm 2^{\circ}\text{C}$ (ILO 2022a). A core temperature below 35°C represents the threshold for hypothermia. As the core temperature falls, cognitive and neurological functioning decreases. Signs and symptoms of hypothermia include numbness, stiffness, or pain (especially in the neck, arms, and legs), poor coordination, slurred speech, slow breathing and pulse, low blood pressure, severe shivering, confusion and collapse. As hypothermia progresses, serious health effects may occur, including atrial fibrillation and cardiac arrest (ILO 2022a). Exposure to cold may also cause local soft tissue injuries, such as frostbite, frostnip, chilblains and cold urticaria. Several other diseases are either caused or triggered by cold exposure, for example Raynaud’s phenomenon, ischaemic heart disease, and cardiac arrhythmias.

Furthermore, the combined cognitive (namely lowered alertness), psychomotor and musculoskeletal effects of exposure to cold temperatures may also affect the worker’s performance and increase the risk of accident. These deficits can be heightened by hazardous environmental conditions, such as snow accumulation, ice, high winds and melting snow. The safety and health of workers may be put at risk due to poor driving conditions from a lack of visibility and snow-covered or icy roads and an increased risk of slips, trips and falls, both on the ground and off outdoor elevated areas (for example roofs) (CCOHS n.d.). There may also be an increased risk of flooding due to melted snow (CCOHS n.d.).

The main factors influencing the effects of cold environments on workers are air temperature, wind speed, and humidity. In particular, workers feel colder if wind speed increases, and humid air conducts heat out of the body faster than dry air.



Anyone working in a cold environment may be at risk of cold stress, however those most at risk are workers who are required to work outdoors for extended periods. This includes those working in snow clean-up crews, sanitation, construction and ground activities, reindeer herding, forestry activities, sawmills, underwater diving, farming, the tourist industry, trapping, and emergency response and recovery personnel, for example police officers, firefighters, search and rescue teams, and emergency medical technicians. High exposures to cold temperatures may also occur in activities performed in cold indoor environments such as food freezing, processing, and storage in chilled environments.

Appropriate interventions to protect workers in situations of extreme cold include sheltering workers in climate-controlled enclosures, supplying insulated clothes, boots and equipment, and managing work schedules in order to alternate tasks and allow for proper recovery periods (ILO 2022a). Exposed workers should be supplied with adequate food that is easily digestible and able to provide the necessary caloric intake.

Examples of responses to the risk

Policies, laws and other initiatives at the national level


OSH legislation often contains provisions aimed at protecting workers and workplaces in cases of emergencies. Some OSH laws specifically include measures to deal with extreme weather events and natural disasters.

- The EU has a number of directives which contain provisions related to protecting workers in extreme weather events. For example, Directive 2009/104/EC on the use of work equipment states that temporary work at a height may be carried out only when the weather conditions do not jeopardise the safety and health of workers, and that safety measures should be implemented in the event of changing weather conditions which could adversely affect the safety of the scaffolding concerned. Directive 89/656/EEC on the use of PPE states that weather-proof clothing should be worn for work in the open air, in rain and in cold weather, and Directive 89/654/EEC on workplace requirements provides that when workers are employed at workstations outdoors, such workstations must as far as possible be arranged so that workers are protected against inclement weather conditions and if necessary against falling objects.
- In Costa Rica¹⁰², workers should be protected against inclement weather in general, and should be provided with appropriate equipment.
- Article 215 of the Egyptian Labour Code (No.12 of 2003) states that employers should carry out an analysis of the risk of natural disasters and prepare an emergency plan for the protection of workplaces and workers in the event of such a disaster. Workers should receive training on the plan and practical drills should be conducted to ascertain its efficacy.
- In Jordan¹⁰³, regulations state that employers must take the necessary precautions to preserve the safety and health of workers in exceptional weather conditions if the situation requires workers to continue working. Moreover, in exceptional weather conditions, the hours during which work is prohibited may be determined by a ministerial decision.
- The Philippines' Occupational Safety and Health Standards (as amended, 1989) specify that roofs shall be of sufficient strength to withstand normal load, typhoons and strong winds (art. 1061). In addition, the Standards state that "no work shall be started or continued in timbered areas during periods of high winds, extremely heavy fogs and other hazardous weather conditions" (art. 1423).
- Article 5.1 of Germany's Workplace Ordinance [ArbStättV] states that workstations must be protected against inclement weather conditions or that workers must be provided with suitable PPE for such conditions.


¹⁰² Decreto 1 por el que se promulga el reglamento general de seguridad e higiene de trabajo. Art 23.

¹⁰³ Regulation No. 31 of 2023 on the occupational safety and health system and prevention of occupational hazards in institutions. Art 9-A.

In some instances, new regulations have been adopted as a specific response to climate change and the increase of extreme weather events.

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- In Uruguay, Decree 38/022 on work in adverse weather conditions in rural areas acknowledges the need for greater protection of workers' health due to diverse natural events, such as winds, thunderstorms and heatwaves. It obliges employers in rural sectors to suspend work when there are risks to safety and health from rain, wind, electrical storms and other extreme weather events. It affords workers the right to remove themselves from dangerous situations, in line with Article 13 of Convention No. 155. In addition, the Decree includes a general protocol with the minimum measures to be adopted in workplaces, on the basis of the type of extreme weather event, the characteristics and location of the workplace, and any previous experiences of extreme weather events. The protocol contains various recommendations, such as on how to behave in the event of an electrical storm, for example avoiding work near trees or antennas and power lines.

Collective agreements have been adopted by social partners negotiating provisions to protect the safety and health of workers from extreme weather conditions.

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- In 2016, BWI affiliate Unia agreed a collective agreement with the regional government and employers' association in the Vaud Canton of Switzerland to protect construction workers from the impact of extreme weather (BWI 2023b). The agreement ensures that when construction stops due to extreme weather such as snow, heavy rain or extreme cold, workers will receive financial compensation for the lost hours of work. A similar agreement, the Bad Weather Compensation Act for Construction Workers, was made in Austria between the Union of Construction and Woodworkers (GBH) and the construction employer association.
 - In Spain, social dialogue carried out between the Trade Union Confederation of Workers' Commissions (CCOO), the General Union of Workers (UGT), the Spanish National Research Council (CSIC) and the Andalusia Environment and Water Agency (AMAYA) resulted in an agreement recognizing wildland firefighters' exposure to carcinogens during the course of their work (ETUI 2023). This followed a study carried out by the labour inspectorate which identified 11 substances classed as carcinogens, mutagens and/or reprotoxins in smoke. It is hoped that the agreement will result in updated risk assessments accounting for the carcinogenic nature of smoke, as well as new health protection measures, such as enhanced PPE and health surveillance protocols.

In some countries, OSH bodies and other authorities have developed **technical guidelines** to plan and respond to extreme weather events in the workplace.

- In Chile, a state of emergency was declared in some areas due to forest fires. As a response, SUSESO instructed occupational accidents and diseases insurance organizations to implement prevention measures aimed at protecting workers in emergency situations from forest fires. Measures included: i) providing technical assistance in disaster risk management; ii) providing training to workers on fire risk prevention, protection measures and first aid measures in emergencies; iii) operating healthcare centres in areas affected by forest fires and notifying employers of the location of these centres; and iv) making available informational materials on prevention measures to protect workers from accidents, diseases and health conditions resulting from exposure to fire. In addition, within the framework of the Labour Board of the National Platform for Disaster Risk Reduction of Chile, two guides were created: the Guide for the Implementation of the Plan for the Reduction of Disaster Risk in Workplaces of Micro-, Small- and Medium-sized Enterprises and its Manual of Implementation and the Guide for the Implementation of Disaster Risk Reduction Plans in Workplaces.
- The Canadian Centre for Occupational Health and Safety (CCOHS) has highlighted the need for workplaces to include extreme weather events in their emergency planning¹⁰⁴. This is done through:
 - Hazard identification - A vulnerability assessment can identify which extreme weather events could occur and the associated hazards and risks to workers and the organization which may arise as a result.
 - Risk assessment - This considers the likelihood of harm or damage, as well as the severity of that harm or damage. The assessment will help with prioritization and resource allocation during emergency planning, and the development of proper emergency response procedures.
 - Emergency response plans - These are the actions required to protect workers, property and the environment. Also included, among other things, are the required resources to execute emergency plans safely, detailed lists of emergency response personnel, designated safe areas for seeking shelter, and procedures on how to safely monitor, shut down or continue to operate critical processes, equipment and other devices that may cause injuries or damage in the event of a power failure or malfunction.


In some instances, social partners provide **information and advice** to their members on disaster management, especially in areas prone to extreme weather events or natural disasters, for example in preparedness planning, as well as ways to respond in the event of a crisis situation.

- In the Philippines, disasters pose a major threat to enterprise survival. The Employers' Confederation of the Philippines, with the support of the ILO's Bureau for Employers' Activities, has worked to develop strategies and practical tools that can be deployed to enterprises in the country following disaster situations. The aim is to facilitate the rapid resumption of normal operations, and to be able to provide more jobs to people in affected areas.
- In Australia, the United Workers Union organizes OSH training on "Extreme weather at work"¹⁰⁵. The training educates workers about their OSH rights in extreme weather events, the impacts of extreme weather and climate change on workers and workplaces, what kinds of actions they can take, and the responsibilities of employers.

¹⁰⁴ Climate Change: Extreme Weather - Preparing for Climate Related Emergencies.

¹⁰⁵ Extreme Weather at Work. Workplace Health and Safety Training.

Raising awareness of the effects of extreme weather events on the safety and health of workers will increase the knowledge and understanding of both employers and workers and facilitate lasting behavioural changes.

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- In December 2023, the Chilean Ministry of Labour and Social Provision, jointly with the Association of Mutual Societies, launched an awareness-raising campaign aimed at preventing the risk of extreme heat in workplaces. Through radio and social media, the campaign recommends measures such as assigning rest periods, reducing physical activity, increasing staff and creating shifts, evaluating working time and installing shade and hydration points¹⁰⁶.
 - An initiative for Natural Disaster Prevention and Risk Reduction was conducted by the Arab Institute for Occupational Health and Safety and the Syrian Higher Institute for Environmental Research in Latakia, the Syrian Arab Republic, in 2023. The initiative focused on raising awareness about the risks of natural disasters, improving disaster risk management to better respond to disasters, and investments in strengthening disaster response, reconstruction and rehabilitation.
 - In the United States, during National Preparedness Month in September, OSHA is involved in publicizing how important it is for employers to plan ahead, and prepare for and respond to climate-related risks¹⁰⁷. The message of the campaign focuses on four steps to keep workers safe during an emergency:
 1. Develop a plan specific to your workplace;
 2. Make a list and check it twice;
 3. Educate and properly train your employees; and
 4. Review, practise and refine your plan.

Responding to extreme weather events at the workplace level

The increase in extreme weather events has highlighted the need for workplaces to include these occurrences in their emergency planning. It is important for an organization to create detailed emergency response plans for all type of events that may arise, as each will require a different response plan. This includes having a plan for any MIAs which may occur as a result of extreme weather events. Building a sound OSH management system in the workplace is essential for a timely and effective response during a crisis.

¹⁰⁶ [Ministra Jara Anuncia Medidas Para Proteger La Salud De Las Y Los Trabajadores Ante Las Altas Temperaturas.](#)

¹⁰⁷ National Preparedness Month: Planning Ahead to Protect Workers | U.S. Department of Labor Blog (dol.gov).

► ILO Guidance to protect workers in extreme weather events

The Prevention of Major Industrial Accidents Convention, 1993 (No. 174) and its accompanying Prevention of Major Industrial Accidents Recommendation, 1993 (No. 181) outline precautionary measures to avoid or minimize the consequences of industrial disasters due to chemicals and other hazardous substances. Extreme weather events are included within the scope of MIAs caused by "natural forces".

According to Article 9, in respect of each major hazard installation employers shall establish and maintain a documented system of major hazard control which includes provision for: [...]

- (d) emergency plans and procedures, including:
 - (i) the preparation of effective site emergency plans and procedures, including emergency medical procedures, to be applied in case of major accidents or threat thereof, with periodic testing and evaluation of their effectiveness and revision as necessary;
 - (ii) the provision of information on potential accidents and site emergency plans to authorities and bodies responsible for the preparation of emergency plans and procedures for the protection of the public and the environment outside the site of the installation;
 - (iii) any necessary consultation with such authorities and bodies;
- (e) measures to limit the consequences of a major accident;
- (f) consultation with workers and their representatives;
- (g) improvement of the system, including measures for gathering information and analysing accidents and near misses. The lessons so learnt shall be discussed with the workers and their representatives and shall be recorded in accordance with national law and practice.

According to the Guidelines on Occupational Safety and Health Management Systems (ILO-OSH 2001), emergency prevention, preparedness and response arrangements should be established and maintained as part of the OSH management system. These arrangements should identify the potential for accidents and emergency situations and address the prevention of OSH risks associated with them. The arrangements should be made according to the size and nature of activity of the organization. They should:

- (a) ensure that the necessary information, internal communication and coordination are provided to protect all people in the event of an emergency at the worksite;
- (b) provide information to, and communication with, the relevant competent authorities, and the neighbourhood and emergency response services;
- (c) address first-aid and medical assistance, firefighting and evacuation of all people at the worksite; and
- (d) provide relevant information and training to all members of the organization, at all levels, including regular exercises in emergency prevention, preparedness and response procedures.

Emergency prevention, preparedness and response arrangements should be established in cooperation with external emergency services and other bodies where applicable.

Emergency services workers are at particular risk during and after extreme weather events, and therefore need special protections to ensure their safety and health.

► ILO Guidance to protect public emergency services workers in extreme weather events

► InFocus

The use of technology to reduce OSH risks from extreme weather events (FAO, ILO & United Nations 2023)

Technological developments are increasingly being used to reduce OSH risks for workers exposed to hazardous situations. For example, drones can be used to assess OSH risks, such as the accessibility of areas after storms, or to investigate accidents. They can also be deployed for wildfire monitoring and management, and can assist in the containment of wildfires even in remote locations. A reduction in the size and duration of fires would reduce risks for firefighters and other emergency workers. Furthermore, in some circumstances they allow for a greater distance to be maintained between workers and the fires, reducing some dangerous exposures, such as smoke inhalation. Smart clothing may also be used to reduce the OSH risks from extreme weather events. For example, sensors can be integrated into work clothing and PPE to detect extreme body temperatures, cameras can record and assess incidents, and global positioning systems (GPS) can warn workers if they are entering unsafe areas.

The ILO Guidelines on Decent Work in Public Emergency Services (ILO 2018c) complement the Employment and Decent Work for Peace and Resilience Recommendation, 2017 (No. 205) that covers “all measures on employment and decent work taken in response to crisis situations arising from conflicts and disasters.”

The Guidelines include disasters with causes that are hydro-meteorological (such as wild land fires, floods, landslides, avalanches, droughts, tsunamis, hurricanes, typhoons, cyclones, and tornadoes) and geological (such as earthquakes and volcanic eruptions). Section VII. Occupational safety and health has recommendations related to communicable diseases, radiation and extreme hot and cold temperatures, as well as general considerations. Police, firefighting, emergency medical services, and search and rescue personnel are covered, among others.

Workplaces should be appropriate for the circumstances and types of weather events which may occur. One major type of response to extreme weather events is adaptation, such as modifying physical infrastructure and relocating people and assets (Woetzel et al. 2020). Beyond adaptation, employers and workers need training in preventive practices to significantly improve workers’ ability to respond appropriately in extreme weather situations, reducing accidents and injuries (Utilities One 2023). Regular safety drills that mimic extreme weather conditions prepare teams for real-life scenarios (OH&S 2023). In addition, technological advances, such as surveillance drones, may provide life-saving capabilities and real-time data (OH&S 2023). However, research is needed to characterize the hazards to workers from the direct effects of severe weather events (Kiefer et al. 2016).



4. Workplace air pollution

Examples of workers at high-risk

All workers, particularly outdoor workers, transport workers and firefighters.

Primary health impacts

Cancer (lung), respiratory disease, cardiovascular disease.

Global burden of occupational exposures

Increased risk of exposure to air pollution for the

1.6 billion outdoor workers

Work-related health impact

Every year,

860,000 work-related deaths

due to air pollution (outdoor workers only) (ILO 2021a).

Different air pollutants increase global warming, and global warming in turn leads to the formation of air pollutants (ETUI 2023). In 2019, 99 per cent of the world's population was living in places where the WHO air quality guidelines levels were not met (WHO 2022). Changes in the climate affect air quality via three pathways: outdoor air pollution, airborne allergens (aeroallergens) and indoor air pollution (Fann et al. 2016).

For outdoor air pollution, changing climates have modified weather patterns, which in turn have influenced the levels and location of pollutants, such as ground-level ozone, fine (PM_{2.5}) and coarse (PM₁₀) particulate matter, nitrogen dioxide and sulphur dioxide. Climate change is also projected to increase the intensity and duration of naturally occurring wildfires, which increase emissions of particulate matter and ozone precursors (Fayard 2009). Furthermore, regions experiencing excessive periods of drought and higher temperatures will have more windblown dusts from soils (USGCRP 2018). In the case of aeroallergens, increasing carbon dioxide levels due to climate change promote the growth of plants that release these allergens. Climate change can also alter concentrations of indoor air pollutants, which may come from indoor sources, for example mould and volatile organic compounds, or may be transported into the building with outdoor air (Fann et al. 2016).

Workers across all economic sectors and throughout the supply chain are constantly exposed to air pollution. Globally, over 1.6 billion workers spend most of their working hours outdoors and are continuously exposed to outdoor air pollution.¹⁰⁸ Studies show that the increasing impact of climate change on levels of air pollutants will disproportionately impact outdoor workers with increased exposure to PM_{2.5}, ozone and allergens (Schulte et al. 2023).

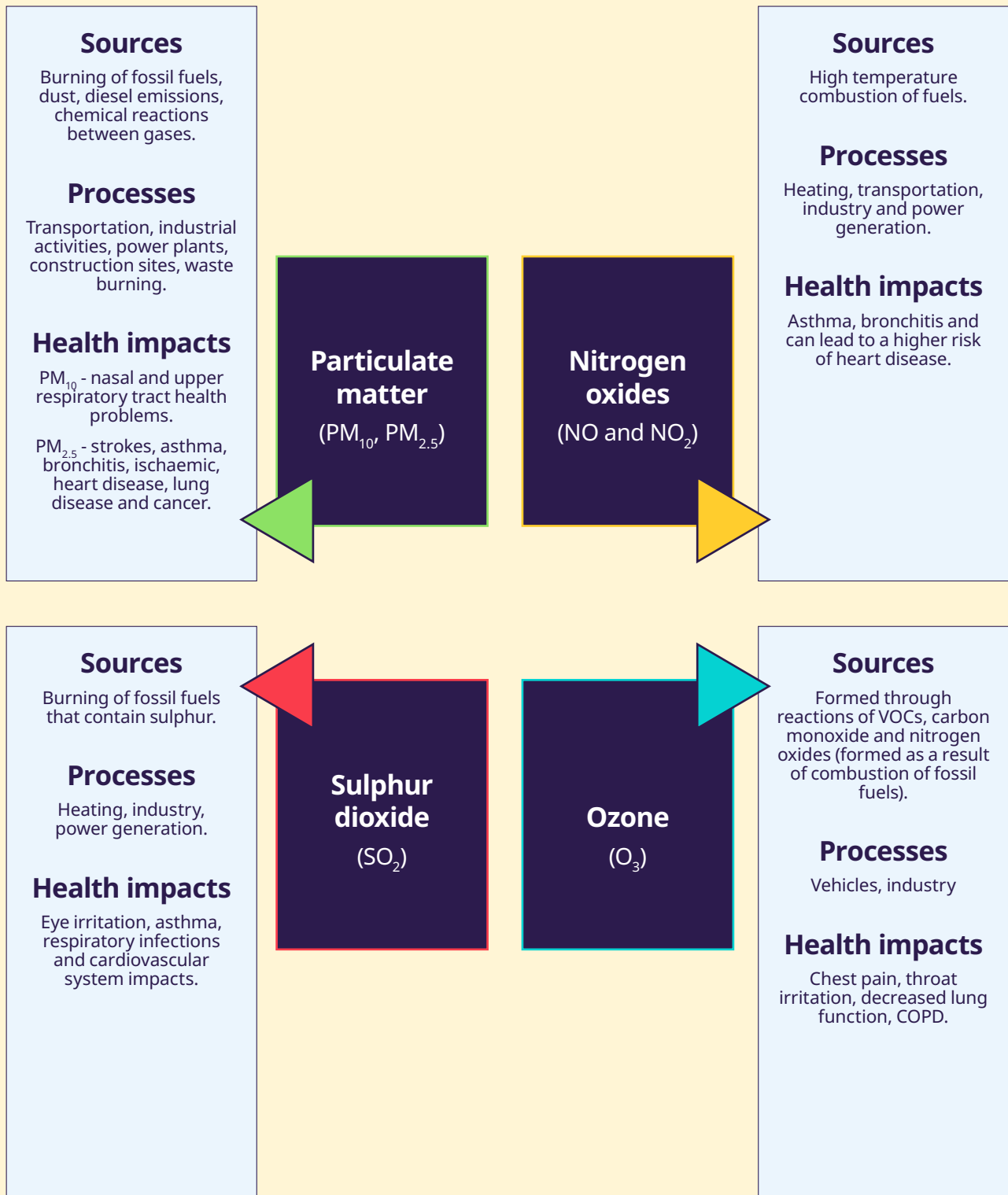
Greater exposures are observed for outdoor workers in areas with high levels of air pollution generated by heavy traffic or industries. For example, a study found that outdoor workers in London were exposed to 15 per cent more pollution than the average Londoner, with levels well above WHO recommended limits (British Safety Council 2020). Levels of exposure are in general higher in low- and middle-income (LMIC) megacities and industrial areas (Chen et al. 2020). In fact, 89 per cent of deaths due to ambient air pollution occur in LMICs (Landrigan et al. 2018).

Impact on worker safety and health

It is estimated that more than 860,000 workers die each year from occupational exposure to air pollutants, however this figure is likely to be much higher when also including indoor workers (ILO 2021a). Pollution of air at the workplace, either indoors in the work premises or during work outdoors, can cause a range of acute and chronic health impacts, including cancer, stroke, respiratory disease, cardiovascular disease and other health issues (ILO 2021a). An overview of the main components of air pollution and their associated health impacts is shown in figure 7.

¹⁰⁸ Calculations based on the ILO harmonized micro-data collection.

► **Figure 7: The main components of ambient air pollution**



► InFocus

Health impact assessment of Delhi's outdoor workers exposed to air pollution

A study by Barthwal et al. (2022) assessed the effects of outdoor air pollution and extreme weather events on the health of outdoor workers in Delhi, including autorickshaw drivers, street vendors and sweepers. 228 people participated in a questionnaire survey, and a pulmonary function test (PFT) was performed on 63 participants. Most of the respondents from different occupational groups complained about headaches/giddiness, nausea, and muscular cramps during extreme heat events, due to the physically demanding nature of their jobs in the outdoor environment. Furthermore, autorickshaw drivers reported the highest prevalence of ophthalmic symptoms, such as eye redness (44 per cent) and eye irritation (36 per cent). In comparison, vendors reported a higher prevalence of headaches (43 per cent) and eye redness, albeit at a lower level (40 per cent), due to increased exposure to vehicular emissions. In addition, a significant proportion of autorickshaw drivers (47 per cent), vendors (47 per cent), and sweepers (48 per cent) considered that air quality had a severe impact on their health. PFT results showed that most respondents had restricted lung function. The study highlighted the need for using PPE and developing guidelines to reduce their exposure level.

Air pollution has been classified by the IARC as carcinogenic to humans (Group 1). For lung cancer alone, air pollution causes 223,000 deaths per year worldwide (IARC 2013). Particulate matter, a major component of outdoor air pollution, and diesel exhaust have also been classified by the IARC as carcinogenic to humans (Group 1). Exposure-response estimates for workers in the trucking industry and miners show that approximately 6 per cent of annual lung cancer deaths in these workers may be due to diesel exhaust exposure (Vermeulen et al. 2013). Epidemiological evidence on outdoor air pollution and other types of cancer is more limited, however PM2.5 has been associated with a higher incidence of brain and breast cancer (White et al. 2024; Weichenthal et al. 2020).

Aside from cancer, PM2.5 exposures have been linked to a wide range of other illnesses, including cardiovascular and pulmonary diseases. For example, a cohort study on 176,309 construction workers showed that occupational exposure to particulate air pollution, especially diesel exhaust, increased the risk of ischaemic heart disease (Torén et al. 2007).

The combined impact of air pollution and excessive heat must also be considered, as there is growing evidence that exposure to both simultaneously presents a greater combined risk to health than the sum of their individual risks (EEA 2023). For example, a study by Rahman et al. (2022) found that the increased mortality risk related to exposure to extreme heat was 6.1 per cent and for elevated PM2.5 was 5.0 per cent, however the mortality risk for combined exposure to both extreme heat and PM2.5 was estimated at 21 per cent.

Changes in climate, specifically rising temperatures, altered precipitation patterns and increasing concentrations of atmospheric carbon dioxide, are expected to contribute to increases in the levels of some airborne allergens and associated increases in asthma episodes and other allergic illnesses (Fann et al. 2016).

- The **financial implications** of outdoor air pollution, which include impacts on labour productivity, health expenditures and agricultural crop yields, are projected to lead to global economic costs that gradually increase to 1 per cent of global GDP by 2060 (OECD 2016). Global air pollution-related healthcare costs are estimated to increase from US\$21 billion in 2015 to US\$176 billion in 2060. By 2060, the annual number of lost working days, which affect labour productivity, are projected to reach 3.7 billion (currently around 1.2 billion) globally (OECD 2016).



Examples of responses to the risk

Occupational exposure to outdoor air pollution is a particular concern, because the exposed population is large, and conventional measures for engineering controls of workplace hazards, such as hazard encapsulation and ventilation, are not always applicable to the outdoor environment. Therefore, employers and workers themselves may have little or no control over the sources of outdoor air pollution.


Policies, laws and other initiatives at the national level

Measures to reduce air pollution are mostly integrated into overall **public health, environmental and climate change policies and strategies**. In some cases, such policies explicitly refer to the protection of the health of workers, among others.


- The principles and standards of Indonesia's Comprehensive Investment Policy Plan 2023 (CIPP), which is part of the Just Energy Transition Partnership Indonesia, include pollution prevention and resource efficiency. Notably, adverse impacts on human health and the environment due to pollution in the land, water, and air must be avoided or minimized in project activities. This is linked to community health, safety and security. Another principle of the CIPP focuses on labour and working conditions and specifically highlights the promotion of safe and healthy working conditions and the overall health of workers in general, including informal, contract and migrant workers.¹⁰⁹

¹⁰⁹ Source: <https://jetp-id.org/cipp>

In a small number of cases, workplace air pollution has been included in **national OSH policies and strategies**.

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- In Guyana, the 2018 National Policy on Occupational Safety and Health defines the roles and responsibilities of the different ministries and authorities, as well as the social partners, in relation to OSH. In particular, recognizing that air pollution can lead to respiratory diseases for workers, the policy assigns to the Ministry of the Presidency and the Ministry of Natural Resources, among other relevant stakeholders, the development of policies in the oil and gas sector. These aim to prevent environmental pollution due to air pollution, and the subsequent damage to productive lands, crops and livestock as well as the health of workers¹¹⁰.

Independent of today's debates on urgent climate action, provisions on air pollution have existed for decades. Some countries include clauses in general **OSH legislation** regarding the prevention or control of workplace air pollution.

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- Samoa's Occupational Safety and Health Act 2002 refers to effective arrangements that shall be "taken to eliminate, isolate or minimise the harmful and potentially harmful effects to employees of any (...) atmospheric pollutants" (art. 24 (l)).
 - In Fiji, employers "shall ensure an adequate supply of clean air [...] and if atmospheric contaminants or impurities are created or occur at any workplace, exposure to those particles or dust is prevented or otherwise controlled"¹¹¹.
 - Laws in Cameroon¹¹² and Australia¹¹³ contain provisions to address the risk of pollution from dust, toxic or caustic fumes, and the appropriate actions to prevent these.

Often laws are concerned with preventing air pollution in indoor environments, for example through the use of suitable ventilation, as is the case in Madagascar¹¹⁴, Benin¹¹⁵, Namibia¹¹⁶ and Singapore¹¹⁷.

¹¹⁰ Guyana National Policy on Occupational Safety and Health 2018

¹¹¹ Health and Safety at Work (General Workplace Conditions) Regulations, 2003 (Legal Notice No. 25). Part 20(59).

¹¹² Arrêté n° 39/MTPS/IMT du 26 novembre 1984 fixant les mesures générales d'hygiène et de sécurité sur les lieux de travail. Art. 30.

¹¹³ Work Health and Safety Regulation 2011 [2011-674]. (Sections 49-53).


¹¹⁴ Loi n° 94-027 du 18 novembre 1994 portant Code d'hygiène, de sécurité et de l'environnement du travail. Chapter 3, Art. 5-6.

¹¹⁵ Arrêté n° 22/MFPTRA/DC/SGM/DT/SST du 19 avril 1999 portant mesures générales d'hygiène et de sécurité au travail. Art. 44.


¹¹⁶ Regulations relating to the health and safety of employees at work (Government Notice No. 156 of 1997). Section 30.

¹¹⁷ Workplace Safety and Health Act (No. 7 of 2006). Art. 41(i) and Art. 65(b).

National regulations sometimes refer to air quality standards and OELs which have been established for many workplace air pollutants by organizations and national committees.

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- The general OEL for respirable dust in the absence of a lower, more specific limit in South Africa is 5mg/m³ (an eight-hour time-weighted average)¹¹⁸.
 - Mexico has established air quality standards for a number of air pollutants, including ozone, carbon monoxide, sulphur dioxide, nitrogen dioxide and some types of particulate matter¹¹⁹. The country has also determined official standards which establish the measurement methods to determine the concentration of the different pollutants in ambient air and the procedures for the calibration of measurement equipment.¹²⁰

Some OSH authorities and bodies have developed **technical guidelines** to address air pollution risks in the workplace, such as the guidelines developed by Safe Work Australia¹²¹, the American Lung Association¹²² and OSHA¹²³.

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- Safe Work Australia offers advice about how to protect workers from air pollution¹²⁴. It recommends applying the hierarchy of controls to manage risks from air pollution. Measures include:
 - **Elimination** - For example, relocate work to areas with good air quality, allowing work from home or alternative sites. If air pollution is limited to outdoors, postpone outdoor work.
 - **Substitution** - Minimise risks by substituting the hazard with a safer alternative, for example work inside where possible.
 - **Engineering controls** - Protect workers from exposure by isolating them from air pollution, for example by using air purifiers or air locks.
 - **Administrative controls** - These measures rely on human assessment and intervention to work effectively, and include methods of work, processes or procedures designed to minimize risk, for example rotating staff, increasing frequency of rest times and reducing the physical intensity of work to reduce how much air pollution is inhaled.
 - **PPE** - PPE must be suitable, maintained properly and workers must be instructed on how to use it properly. For example they should use P2 or N95 masks for respiratory protection. However, it is essential that they are fitted properly.

¹¹⁸ Regulations for Hazardous Chemical Agents, 2021.

¹¹⁹ Official Mexican Standard NOM-020-SSA1-2021; Official Mexican Standard NOM-021-SSA1-2021; Official Mexican Standard NOM-022-SSA1-2019; Official Mexican Standard NOM-023-SSA1-2021; Norma Oficial Mexicana NOM-025-SSA1-2021

¹²⁰ Official Mexican Standard NOM-034-SEMARNAT-1993; Official Mexican Standard NOM-035-SEMARNAT-1993; Official Mexican Standard NOM-036-SEMARNAT-1993; Official Mexican Standard NOM-037-SEMARNAT-1993; Official Mexican Standard NOM-038-SEMARNAT-1993; Official Mexican Standard NOM-156-SEMARNAT-2012


¹²¹ Managing the risks from air pollution: Advice for PCBUS.

¹²² Clean air at work.


¹²³ Indoor Air Quality in Commercial and Institutional Buildings (2011).

¹²⁴ Managing the risks from air pollution: Advice for PCBUS.

Sometimes, such guidelines are focused on specific groups of workers or situations, such as protecting workers exposed to wildfire smoke.


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- In the US, NIOSH have issued specific guidance to protect workers exposed to air pollution from wildfire smoke. This includes the following steps to reduce smoke exposure: frequent monitoring of air quality conditions in the area; relocation or rescheduling of work tasks to smoke-free or less smoky areas or times of the day; reduction of levels of physical activity, especially strenuous and heavy work, where possible; requiring and encouraging workers to take frequent breaks in places that are free from smoke; limiting workers' smoke exposure by making accommodations for workers to perform their duties indoors or in a location that reduces exposure to smoke. To create an indoor environment that reduces exposure to and protects the occupants from wildfire smoke, employers and building managers should install air cleaners, ensure building openings are kept closed and operate heating, ventilation, and air conditioning systems¹²⁵.

Collective agreements can be highly relevant tools for providing concrete solutions at sectoral and/or local level. They make it possible to target improvements to OSH conditions as closely as possible to the needs of the specific sector concerned.


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- In the Philippines, environmental provisions were proposed by the workers' union in Philippine multinational corporation San Miguel Corporation (SMC). SMC specializes in food, beverage, agri-business and packaging. Agreed provisions included making the company's labour management committee responsible for the implementation of protections from air pollution and rehabilitation. The collective agreement between SMC and its union encouraged SMC to contribute actively towards a clean and thriving environment for the well-being of its communities and employees.

¹²⁵ Outdoor Workers Exposed to Wildfire Smoke

OSH bodies may organize **activities to raise awareness** and disseminate information among workplaces on the risks associated with air pollution.


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- The British Safety Council runs the “Time to Breathe” awareness campaign¹²⁶, which calls for employers to protect outdoor workers from air pollution and for enhanced pollution monitoring across the United Kingdom. The campaign produced a White Paper, which explores the evidence and assesses what actions the Government, employers and stakeholders should take to minimize the health impacts of pollution on outdoor workers. The campaign also provides visual materials to encourage people to stop, think and act to reduce air pollution exposure.

Employers’ organizations can carry out awareness campaigns, informing businesses about the dangers of air pollution and the financial benefits gained from improving workplace air pollution.

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- The Confederation of British Industry (CBI) speaks on behalf of 170,000 businesses of all sizes and sectors, across every region in the United Kingdom. This includes over 1,100 corporate members, employing over 2.3 million private sector workers, plus nearly 150 trade associations. The CBI is involved in awareness-raising on the dangers of poor air quality in the workplace (CBI 2023). The organization found that improved workplace air quality could give significant productivity benefits in terms of reduced absenteeism due to ill-health, as well as less presenteeism, where employees are present at work despite being unwell. It estimated that a 95 per cent reduction in indoor pollution could boost London employees’ productivity by up to 15 per cent, which could deliver an additional £38bn of economic activity to the London economy. Similar positive outcomes were seen for Los Angeles, Singapore, Sydney and Barcelona.

¹²⁶ Time to Breathe air pollution campaign | British Safety Council | British Safety Council (britsafe.org)

Trade unions are also engaging in initiatives to provide information and support to workers, and to lobby for better national standards on air quality.

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- In the United Kingdom, the Trade Union Clean Air Network (TUCAN) was established in 2019 by the Hazards Campaign and the Greener Jobs Alliance (TUCAN 2023). It provides a source of information and practical support for unions campaigning for better air quality. In 2023, TUCAN was involved in a number of initiatives, such as workplace and community monitoring (assisting union representatives in carrying out air pollution measurements at a range of workplaces); training and information on monitoring and action on clean air; lobbying for better national and regional standards; and research on the dangers of toxic substances and their impact on health.

Management of air pollution at the workplace level

Although climate change mitigation policies and regulations to decrease air pollution may be the most effective longer-term approach to protect workers, preventive measures must also be taken at the workplace level. These include reducing exposure through administrative control measures, such as rotating work roles, implementing medical surveillance programmes, recording pollution levels and reporting cases of occupational diseases that may be caused by ambient air pollution, as well as providing PPE (ILO 2021a). Further actions include moving to safer technologies, such as electric vehicles, improving maintenance schedules and replacing old equipment.

A study by Laumbach and Cromar (2022) looked at the effectiveness of personal interventions to reduce outdoor air pollution, including for worker populations. It found that staying indoors is the mainstay of advice for extreme air pollution, however acknowledged that this option is often not available for outdoor workers. Air cleaners can reduce indoor concentrations of air pollutants arising from both indoor and outdoor sources, but again this is only an option for indoor workers. For some outdoor workers, face masks may be the only available option to reduce exposure to air pollution, however these require fit-testing and worker training to ensure they function appropriately. Interventions aimed at improving indoor air quality can be effective in improving health, well-being and productivity in indoor office workers (Felgueiras et al. 2022).

► ILO Guidance related to workplace air pollution

Working Environment (Air Pollution, Noise and Vibration) Convention, 1977 (No. 148), Excerpts

The scope of this Convention defines air pollution to cover all air contaminated by substances, whatever their physical state, which are harmful to health or otherwise dangerous.

Article 9

As far as possible, the working environment shall be kept free from any hazard due to air pollution, noise or vibration--

- (a) by technical measures applied to new plant or processes in design or installation, or added to existing plant or processes; or, where this is not possible,
- (b) by supplementary organisational measures.

Article 10

Where the measures taken in pursuance of Article 9 do not bring air pollution, noise, and vibration in the working environment within the limits specified in pursuance of Article 8, the employer shall provide and maintain suitable personal protective equipment. The employer shall not require a worker to work without the personal protective equipment provided in pursuance of this Article.

Article 11

1. There shall be supervision at suitable intervals, on conditions and in circumstances determined by the competent authority, of the health of workers exposed or liable to be exposed to occupational hazards due to air pollution, noise or vibration in the working environment. Such supervision shall include a pre-assignment medical examination and periodical examinations, as determined by the competent authority.

Article 12

The use of processes, substances, machinery and equipment, to be specified by the competent authority, which involve exposure of workers to occupational hazards in the working environment due to air pollution, noise or vibration, shall be notified to the competent authority and the competent authority, as appropriate, may authorise the use on prescribed conditions or prohibit it.

Article 13

All persons concerned shall be adequately and suitably--

- (a) informed of potential occupational hazards in the working environment due to air pollution, noise and vibration; and
- (b) instructed in the measures available for the prevention and control of, and protection against, those hazards.



5. Vector-borne diseases

Examples of workers at high-risk

Outdoor workers including farmers, foresters, landscapers, groundskeepers, gardeners, painters, roofers, pavers, construction workers, firefighters, among others.

Global burden of occupational exposures

Limited data.

Primary health impacts

Diseases such as malaria, Lyme disease, dengue, schistosomiasis, leishmaniasis, Chagas disease and African trypanosomiasis, among others.

Work-related health impact

Every year, over

15,170
work-related deaths

attributable to Parasitic and vector diseases.

Vector-borne diseases are illnesses caused by parasites, viruses and bacteria that are transmitted by vectors. Some examples of vectors and the diseases they cause are shown in figure 8.

► Figure 8: Examples of vectors and the diseases that they can transmit (WHO 2020)

Vector		Disease caused	
Mosquito	Aedes	Chikungunya	Virus
		Dengue	Virus
		Lymphatic filariasis	Parasite
		Rift Valley fever	Virus
		Yellow Fever	Virus
		Zika	Virus
	Anopheles	Lymphatic filariasis	Parasite
		Malaria	Parasite
	Culex	Japanese encephalitis	Virus
		Lymphatic filariasis	Parasite
		West Nile fever	Virus
Aquatic snails		Schistosomiasis (bilharziasis)	Parasite
Blackflies		Onchocerciasis (river blindness)	Parasite
Fleas	Plague (transmitted from rats to humans)		Bacteria
	Tungiasis		Ectoparasite
Lice	Typhus		Bacteria
	Louse-borne relapsing fever		Bacteria
Sandflies	Leishmaniasis		Parasite
	Sandfly fever (phlebotomus fever)		Virus
Ticks	Crimean-Congo haemorrhagic fever		Virus
	Lyme disease		Bacteria
	Relapsing fever (borreliosis)		Bacteria
	Rickettsial diseases (e.g.: spotted fever and Q fever)		Bacteria
	Tick-borne encephalitis		Virus
	Tularaemia		Bacteria
Triatomine bugs		Chagas disease (American trypanosomiasis)	Parasite
Tsetse flies		Sleeping sickness (African trypanosomiasis)	Parasite

A number of studies have linked climate change impacts with an increased risk of vector-borne diseases in workers (Vonesch et al. 2016; Levi et al. 2018; Jones et al. 2018). Climate change is expected to alter the seasonality, distribution, and prevalence of existing vector-borne diseases, through changing weather patterns, such as higher temperatures, humidity, and rainfall patterns. These alterations can impact disease incidence through their effects on vector population sizes, survival rates and reproduction. For example, the transmission season for dengue and malaria is could increase by 1-2 months (eventually by 6 months for malaria) in southern and eastern Europe by 2080 (European Environment Agency, 2024).

Furthermore, climate change has indirect repercussions for vector-borne diseases through its broader influence both on natural ecosystems and on human systems. For instance, droughts may change water-storage, land-use and irrigation practices (Campbell-Lendrum et al. 2015). New vector-borne pathogens may also emerge due to the interactions of climate factors with these other elements, such as changing land-use patterns (C. B. Beard et al. 2016).

► InFocus

Seroprevalence of vector-borne pathogens in outdoor workers from Southern Italy and associated occupational risk factors

Vector-borne diseases represent an emerging global threat to public health due to the geographical expansion of arthropod vectors. A cross-sectional study by Stufano et al. (2022) assessed the seroprevalence of selected vector-borne pathogens in different groups of outdoor workers and the occupational risk factors for exposure to arthropod bites.

The study was conducted on 170 workers recruited in two different regions of Southern Italy, including farmers, forestry workers, veterinarians, geologists, agronomists and administrative employees, who were tested for antibodies against a number of pathogens. The relationship among job characteristics, tick exposure and the prevalence of seropositive subjects for each pathogen was also investigated.

A high seroprevalence for bacteria causing, among other diseases, Q fever (30.0 per cent) and spotted fever (15.3 per cent) was reported, mainly in farmers (67.7 per cent and 54.8 per cent respectively) and forestry workers (29.0 per cent and 16.1 per cent respectively). A positive association was also found between bacteria causing Rickettsial diseases and job, tick bite exposure, working area and contact with animals.

Impact on worker safety and health

New ILO estimates have found that every year over 15,170 workers die due to occupational exposure to parasitic and vector diseases, including malaria, trypanosomiasis, chagas disease, schistosomiasis, leishmaniasis, lymphatic filariasis, onchocerciasis, cysticercosis, echinococcosis, dengue, trachoma, yellow fever, and rabies. This represents about 7.6% of all deaths due to parasitic and vector diseases.¹²⁷ However, it is likely that these numbers are underestimated due to insufficient data, as occupational exposures are not always recognized or notified. Furthermore, it is not always easy to make a distinction between a disease being caused by work, for example in a rice field, or when resting in a nearby area (ILO 2024a).

Outdoor workers are particularly susceptible to vector-borne diseases, as they have the highest exposure to vectors such as mosquitoes, ticks and fleas, that can transmit parasites, viruses, or bacteria (Schulte et al. 2016). They include farmers, foresters, landscapers, groundskeepers, gardeners, painters, roofers, pavers, construction workers and firefighters. Emergency responders and healthcare workers who deal with infected subjects are also in danger of exposure (Vonesch et al. 2016). Workers at risk of emerging viral infections, for example from handling infected tissues or fluids, include farm and agricultural workers, veterinarians, slaughterers, animal handlers, healthcare workers and soldiers (Vonesch et al. 2019).

¹²⁷ This ILO global data are based on the 2023 ILO Global Estimates of occupational injuries and work-related illnesses.

The greatest burden of these diseases is in tropical and subtropical areas, and they disproportionately affect the poorest populations. However, as climate change worsens, models project a substantial expansion of regions with a suitable climate for many vector-borne diseases (Rocklöv and Dubrow 2020). Consequently, outdoor workers may find themselves exposed to serious diseases such as Lyme disease, dengue and Zika, in regions and during periods where transmission was previously unlikely (ILO 2022b). According to a 2022 study in *The Lancet Planetary Health*, an additional 4.7 billion people may be at risk of the vector-borne diseases malaria and dengue by 2070 (Colón-González et al. 2021).

Changes in daily work routines driven by rising temperatures may also impact worker exposures. For example, extended rest periods in the middle of the day and increased activity during dawn and dusk, may align with peak times of insect vector activity, thereby increasing the risk of disease transmission (Bennett and McMichael 2010).

Examples of how climate change has increased the risk of vector-borne diseases for workers (Schulte et al. 2016; Bennett and McMichael 2010)

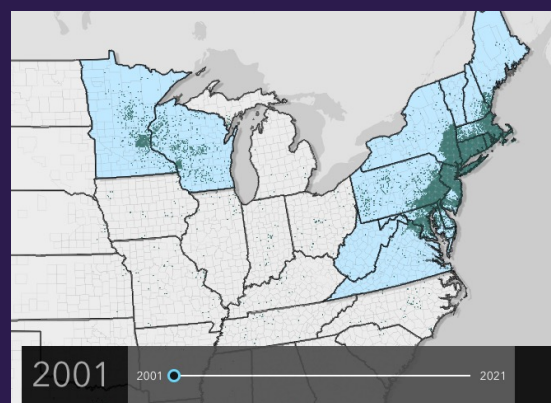
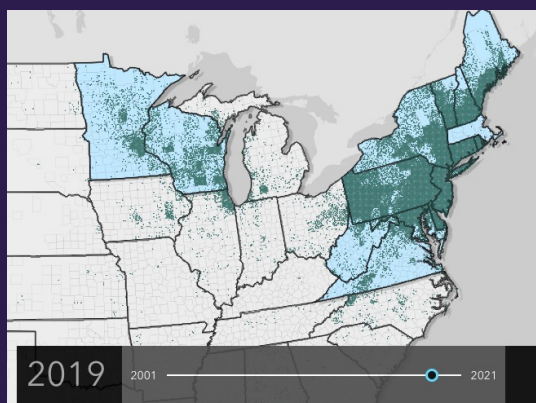
- In China, schistosomiasis, a serious risk for farmworkers, has recently re-emerged in areas where it was previously eradicated, thought to be associated with the spread of suitable habitats for the intermediate host snail *Oncomelania hupensis* in response to regional warming.
- West Nile and Zika viruses, known vector-borne hazards to outdoor workers, may increase because of climate change.
- In Japan, the distribution of *Aedes albopictus* (the mosquito species that transmits dengue fever) has been advancing northwards over recent decades, thought to be associated with higher autumn mean temperatures that promote larval development and warmer annual mean temperatures that encourage expansion of adult mosquitoes during summer.
- The incidence of coccidioidomycosis, a fungal disease endemic in the Southwestern United States, has been associated with several outdoor occupations and has increased substantially from 1998 to 2011.
- Drought-ridden areas may lead to outdoor workers breathing more windborne dusts, which may be toxic or contain harmful organisms.
- Waterborne diarrhoeal disease is sensitive to climate variability, impacting workers in occupations such as fishing.

Aside from the adverse effects of the diseases themselves, increased exposure to biological hazards can also lead to an intensified use of chemicals, which will also impact on worker health. For instance, vector control using insecticides plays a key role in the prevention and control of infectious diseases such as malaria, dengue and filariasis (WHO 2006).

► InFocus

Lyme disease in the United States

Lyme disease is a bacterial illness transmitted by ticks that can cause fever, fatigue, joint pain, and skin rash, as well as more serious joint and nervous system complications. Outdoor workers in Lyme disease-endemic regions are at particular risk of contracting the disease, for example those employed in forestry or farming (Magnavita et al. 2022). The incidence of Lyme disease in the United States has nearly doubled since 1991, from 3.74 reported cases per 100,000 people to 7.21 reported cases per 100,000 people in 2018 (US EPA 2021). Studies show that climate change has contributed to the expanded spread of ticks, increasing the potential risk of Lyme disease, even in areas where ticks were previously unable to survive (C. B. Beard et al. 2016). Warming temperatures are projected to increase the range of suitable tick habitats, whilst shorter winters could extend the period when ticks are active each year, increasing the time that humans could be exposed (US EPA 2021). The maps below show the reported cases of Lyme disease in 2001 and 2019 for the Northeast and Upper Midwest areas of the United States. Both the distribution and the number of cases have increased.



Source: CDC 2024

- Vector-borne diseases are already responsible for considerable losses in **economic productivity** every year, primarily in regions where a disease is endemic, such as malaria in Africa. Endemic vector-borne diseases create less healthy workforces, who are less physically capable of working, which in turn results in an increasing number of workdays lost to ill health (Bennett and McMichael 2010). Moreover, lasting health impacts of vector-borne diseases may reduce the ability of an individual to work in the longer-term.
- **Medical costs** may also be considerable. According to studies from eight countries, an average dengue episode represents 14.8 lost days, including workdays, for ambulatory patients at an average cost of US\$514, and 18.9 days for non-fatal hospitalized patients at an average cost of US\$1,491 (WHO 2014). Endemic vector-borne disease has been associated with substantial negative impacts on long-term economic development in many regions in Africa and Asia and the Pacific. Certain macroeconomic studies have found that in highly endemic countries, malaria may be responsible for reducing economic growth by more than one percentage point a year (Malaney et al. 2004). Over 25 years this can amount to almost half of the per capita GDP in poor countries (Bennett and McMichael 2010).

Examples of responses to the risk

Policies, laws and other initiatives at the national level

Recommendations for protecting workers from the potential impact of climate change on biological hazards have included robust disease and vector surveillance, vector control, training for workers about biological hazards and best preventive practices, and PPE for workers where appropriate (Schulte et al. 2023).

In many countries, **OSH legislation** already requires employers to protect workers against biological hazards, with vector-borne diseases mentioned specifically in certain instances.

- Article 210 of the Egyptian Labour Code (No. 12 of 2003) states that, “The establishment and its branches shall take all protection means for its workers from the danger of infection with bacteria, viruses, fungi, parasites and other biological risks, once the nature of work exposes the workers to the conditions of infection therewith...”
- In Togo it is prohibited to keep or abandon waste in conditions favouring the development of harmful animals, insects and other disease vectors likely to cause damage to people and property¹²⁸. A similar law is found in Fiji, which says that land situated within twenty yards of a workshop or workplace should not contain bush, weeds or long grass which are likely to harbour mosquitoes¹²⁹.
- Legislation in Mozambique states that in workplaces with more than 30 workers, the windows of dining areas should be covered with mosquito netting where necessary¹³⁰.
- In Mexico, Official Standard NOM-032-SSA2-2010 is concerned with epidemiological surveillance, prevention and control of vector-borne diseases. These diseases include dengue fever, malaria, Chagas disease, onchocerciasis, leishmaniasis, West Nile fever, Rickettsiosis and chikungunya fever. Leishmaniasis is considered an occupational disease, as more than 95 per of the cases correspond to localized cutaneous leishmaniasis, which essentially affects the population of jungle, cocoa and coffee areas.
- Section 49 of the Safety and Health at Work Act (2005) of Barbados states that a vector control programme must be in place in workplaces.
- Laws in Costa Rica¹³¹ state that any person who operates any of the establishments mentioned in the previous article (for example hair salons, barber shops, beauty salons and gyms) must maintain the place, facilities, equipment and utensils in hygienic and clean conditions, in order to prevent them from becoming a source of infection or breeding ground for vectors of communicable diseases.
- In Finland, Section 9 of the Government Decree on Protection of Workers from the Dangers of Biological Agents (933/2017) mandates that there should be effective control of vectors such as rodents and insects.


128 Loi n° 2008-005 portant loi-cadre sur l'environnement. Art. 107.

129 Public Health Act (Cap. 111) Article 105.

130 Legislative decree No. 48/73 of July 5; General Safety Rules at Work in Industrial Units 19730705. Art. 148.

131 Ley núm. 5395 General de Salud de 30 de octubre de 1973. Art. 254.

In some instances, the employer may be required to provide health surveillance for specific hazards and/or in specific sectors where these hazards are present.

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- In Thailand, a health check-up is required for workers who are exposed to specific hazards or risk factors related to work including toxic microbes which may be a virus, bacteria, fungus or other biological organism¹³².
 - Article 23 of the Factories Act (1934) of Pakistan mandates that workers "...shall be provided with a 'Hygiene Card' in which during the month of January and July entries shall be recorded after examination by an appointed factory doctor to the effect that the worker is not suffering from any contagious or infectious disease". If workers are found to be suffering from such a disease, they are not required to work until they are free of the disease. Moreover, workers should be vaccinated against such diseases.

In line with the ILO list of occupational diseases, national lists of occupational diseases in some countries include diseases caused by biological hazards, including Albania¹³³, Barbados¹³⁴, Croatia¹³⁵, Finland¹³⁶, Latvia¹³⁷, Thailand¹³⁸, Mauritius¹³⁹, Trinidad and Tobago¹⁴⁰ and Singapore¹⁴¹, although again vector-borne diseases are not always mentioned specifically. Sometimes, for example in Namibia, the diseases are only recognized for specific types of operations, such as work handling animals¹⁴². Other times, only a limited number of diseases caused by biological hazards are recognized as occupational. For example, Barbados¹⁴³ and Thailand¹⁴⁴ include in their lists skin diseases caused by biological agents and infectious or parasitic diseases contracted in an occupation where there is a particular risk of contamination. In Latvia¹⁴⁵, the list of occupational diseases caused by biological hazards explicitly includes certain vector-borne diseases, for example tick-borne encephalitis, Lyme disease and tularaemia.

132 Safety, Occupational Hygiene and Workplace Environment Act B.E. 2554 (2011).

133 Decree No. 594 dated 01.07.2015 on the approval of the list of occupational diseases. Position 4.

134 Accidents and Occupational Diseases (Notification) (Amendment) Act, 1983. (Art. 2).

135 Act concerning a list of occupational diseases (Art. 3).

136 Government Decree on the List of Occupational Diseases (769/2015). Section Biological factors (1).

137 Cabinet of Ministers Regulation No.908 "Procedures for Investigation and Registration of Occupational Diseases" of November 6 2006.

138 Notification of the Ministry of Labour and Social Welfare regarding criteria on decision and assessment of the loss of capability of a patient or the injured due to occupational disease. Workmen's Compensation Act B.E. 2537 of 15 June 1994. (Section 5).

139 Occupational Safety and Health Act 2005 (Act No. 28 of 2005). Art.1.3.1.

140 Occupational Safety and Health Act 2004 (No. 1 of 2004). (Art. 4).

141 Workplace Safety and Health Act (2009 Ed.) (Second Schedule).


142 Regulations relating to the health and safety of employees at work (Government Notice No. 156 of 1997)

143 Accidents and Occupational Diseases (Notification) (Amendment) Act, 1983. (Art. 2).


144 Notification of the Ministry of Labour and Social Welfare regarding criteria on decision and assessment of the loss of capability of a patient or the injured due to occupational disease. Workmen's Compensation Act B.E. 2537 of 15 June 1994. (Section 5).

145 Cabinet of Ministers Regulation No.908 "Procedures for Investigation and Registration of Occupational Diseases" of November 6 2006.

Vector-borne diseases may sometimes be included in **action plans and strategies on climate change** and public health.

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- The Australian Work Health and Safety Strategy 2023-2033 addresses climate-related risks, including the emergence of novel infectious diseases and the increased transmission and spread of other diseases. It states that employers need to consider infectious diseases at work as ongoing hazards and ensure appropriate control measures are in place to manage the risks to workers and others at work. Actions to address the climate change impacts of vector-borne diseases are also included in the 2023 National Health and Climate Strategy produced by the Australian Government.
 - India's Kerala State Action Plan for Climate Change 2023 - 2030 covers a health adaptation plan for vector-borne diseases. Incidence of dengue, malaria, Japanese encephalitis and scrub typhus have all risen in the state, with a link to climate change highlighted in the action plan. Specific roles for the health sector are identified in the plan, for example a mapping of vulnerabilities (such as populations at risk), capacity-building and increasing awareness for individuals, communities and healthcare workers through various media or campaigns and workshops. At individual level, self-protective measures such as protective clothing are recommended. The Department of Health and Family Welfare is acknowledged as an actor for intersectoral involvement.

As for the other climate change hazards, **technical guidelines** to protect workers from vector-borne diseases have been developed by OSH bodies and authorities. These may be specific to the type of vector, the actual disease, or a particular industry. For example, NIOSH has employer recommendations for both mosquito-borne and tick-borne diseases, whilst OSHA has recommendations on Lyme disease and Zika for workers in the construction or outdoor services industries.

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- Vector-borne disease guidance from the Maryland Department of Health, United States, includes a Tick-borne Disease Occupational Toolkit¹⁴⁶. Employers are encouraged to take proactive steps to help protect employees from tick bites. These include informing staff about ticks in the workplace, recommending protective clothing, instructing employees to check for ticks regularly and reminding staff of the importance of timely reporting of tick bites and symptoms of tick-borne diseases. Workers are given information about protective measures to take before starting work (for example applying repellent and treating clothing with 0.5 per cent permethrin), while working (for example checking for ticks), and after returning from work (for example showering and putting clothes in a hot dryer to kill ticks).
 - The International Petroleum Industry Environmental Conservation Association, the global oil and gas industry association for advancing environmental and social performance across the energy transition, produced a guide for managers and supervisors in the oil and gas industry. The guide sets out general principles on the management of vector-borne disease in hot areas to protect workers' health and the industry¹⁴⁷.

¹⁴⁶ TICKBORNE DISEASE OCCUPATIONAL TOOLKIT.

¹⁴⁷ Vector-borne disease management programmes.

Public health programmes and community engagement strategies often involve targeting worker populations that are most at risk, such as in those in agricultural areas. Social dialogue is essential for worker engagement and to ensure that interventions are practical at the workplace level.

- Since its establishment in the 1960s, the Singapore dengue control programme (Sim et al. 2020) succeeded in reducing the dengue force of infection 10-fold by the 1990s and has maintained it at low levels ever since. The programme collaborates closely with government ministries, as well as town councils, communities, the private sector, and academic and research institutions. Besides nationwide general messaging, community engagement strategies also target specific population groups. For example, domestic helpers and construction workers are targeted with behaviour change messaging through outreach and roadshows at dormitories, shopping malls and other meeting places. Since these groups are often migrants and therefore transient populations, behaviour change materials are produced in the relevant languages (for example Bahasa Indonesia, Hindi, , Filipino) and outreach is conducted regularly.
- The UK National Institute for Health and Care Research's Global Health Research Group on Controlling Vector Borne Diseases in Emerging Agricultural Systems in Malawi is a research collaboration between the Liverpool School of Tropical Medicine, Malawi College of Medicine, Malawi-Liverpool-Wellcome Trust Centre, Lilongwe University of Agriculture and Natural Resource and the African Institute for Development Policy (LSTM n.d.). Based in the Chikwawa region of southern Malawi, the group's Shire Valley Vector Control Project (Shire-Vec) focuses its research on the Shire Valley Transformation programme, a new 40,000-hectare irrigation scheme which began construction in 2020. The project will investigate how the new irrigation scheme affects vector-borne diseases like malaria and schistosomiasis, and their influence on smallholder farming practices. Shire-Vec will bring together stakeholders from across public health and agriculture via the Technical Vector Control Advisory Group of the Ministry of Health in Malawi and will establish a Community Advisory Group with local farming communities.
- Irrigated agriculture exposes rural people to vector-borne diseases and many developing countries lack collaboration between the agricultural and health sectors to address this problem. In 2002 in Sri Lanka, an intersectoral community-based health programme used the "farmer field school" method (van den Berg et al. 2007). The farmer field school is a well-established technique for introducing principles and methods for crop management through hands-on learning. Farmers were taught how to manage vector-borne diseases, whilst improving rice yields. Farmers graduating from the programme were able to implement vector control actions and were also given information regarding PPE to prevent disease transmission. By mid-2006, the project had held 67 farmer field schools on integrated pest and vector management (with 20-30 per cent of participants being women).
- Insecticide resistance is a key barrier to long-term malaria control, and it may be exacerbated by poor agricultural pesticide use. Current practices in the United Republic of Tanzania do not link public health and agricultural pesticide use. A project in the United Republic of Tanzania investigated the perspectives of farmers and other stakeholders regarding the integration of agricultural and public health measures to address resistance (Matowo et al. 2022). It included participatory workshops and field training for the farmers, where agroecosystem practices related to pesticide use were taught. Furthermore, farmers learnt how to discriminate between malaria vectors and non-vectors, identify agricultural pests and diseases, choose and use pesticides effectively, and conduct resistance tests. The research highlighted the significance of farmers' awareness of mosquito ecology and merging public health and agricultural pesticide management measures.





Management of vector-borne diseases at the workplace level

The need for protective measures at the workplace level is most acute for dengue fever, chikungunya, leishmaniasis and Chagas disease for which there are no obvious methods of treatment nor effective vaccines (WHO 2014). The ILO Technical Guidelines on Biological Hazards in the Working Environment (ILO 2022b) aim to provide governments, employers, workers and their organizations with key practices for the effective management of biological hazards in the working environment, in line with ILO standards and principles. The Guidelines state that employers should have systems in place to identify biological hazards, make risk assessments, and take reasonable and practicable measures to eliminate or, if this is not possible, control biological risks to safety and health. Preventive and protective measures should be implemented, in consultation with workers and their representatives, and in line with the hierarchy of controls (ILO 2022b).

Different types of control methods can be used to reduce or control the risk of exposure to disease-carrying vectors. These include engineering controls, such as insecticidal nets, administrative controls, including changing work hours to times when vectors are less active, and PPE, for example, using special gloves. Proven, cost-effective vector control tools and interventions include long-lasting insecticidal nets, indoor residual spraying, space sprays, larvicides, molluscicides and environmental management for specific target vectors (WHO n.d.). Whilst studies exist which evaluate the efficacy of different control tools, these are mainly related to public health, and there is extremely limited research regarding preventing occupational exposures. As diseases such as dengue become increasingly prevalent and a greater burden on societies, more sophisticated techniques are needed to protect those at greatest risk. For example, early warning systems using seasonal climate forecast modelling have the potential to predict dengue outbreaks up to seven months in advance (R. Lowe et al. 2017).

► ILO Guidance related to addressing the risk of vector-borne diseases

The Workers' Housing Recommendation, 1961 (No. 115)

II. Housing Standards

7. The housing standards referred to in Paragraph 19 of the General Principles should relate in particular to--
 - (d) appropriate protection against heat, cold, damp, noise, fire, and disease-carrying animals, and, in particular, insects; [...]

The Technical Guidelines on Biological Hazards in the Working Environment (2023) provide governments, employers, workers, and their organizations with a rights-based approach for the effective management of biological hazards in the working environment, the scope of which includes biological vectors or transmitters of disease. The guidelines contain the following chapters:

1. General obligations, responsibilities, duties and rights.
2. Risk management at the workplace level.
3. Workers' health surveillance.
4. Information, instruction and training.
5. Investigation of dangerous occurrences, occupational accidents and diseases.
6. National system for recording and notification of occupational accidents and diseases.
7. Preparedness and response to emergencies.
8. Inspection and compliance with legal provisions.

Chapter 7 specifically refers to the increased transmission and spread of vector-borne diseases due to climate change-related temperature rises, which is putting outdoor workers across numerous sectors at heightened risk. The importance of social dialogue and consultation is emphasized in a number of sections, as well as full cooperation at all levels between the competent authority, employers, workers and their representatives, and other relevant stakeholders. In line with Convention No. 155, workers also have the right to "remove themselves and their co-workers in the vicinity from danger when they have reasonable justification to believe that there is an imminent and serious danger to their safety and health, without any adverse consequences".



6. Agrochemicals

Examples of workers at high-risk

Workers in agriculture, plantations, chemical industries, forestry, pesticide sales, green space, vector control.

Primary health impacts

Poisoning, cancer, neurotoxicity, endocrine disruption, reproductive disorders, cardiovascular disease, COPD, immune suppression.

Global burden of occupational exposures

Increased risk of exposure to agrochemicals for a significant number of the

873 million
workers employed
in agriculture.

Work-related health impact

Over

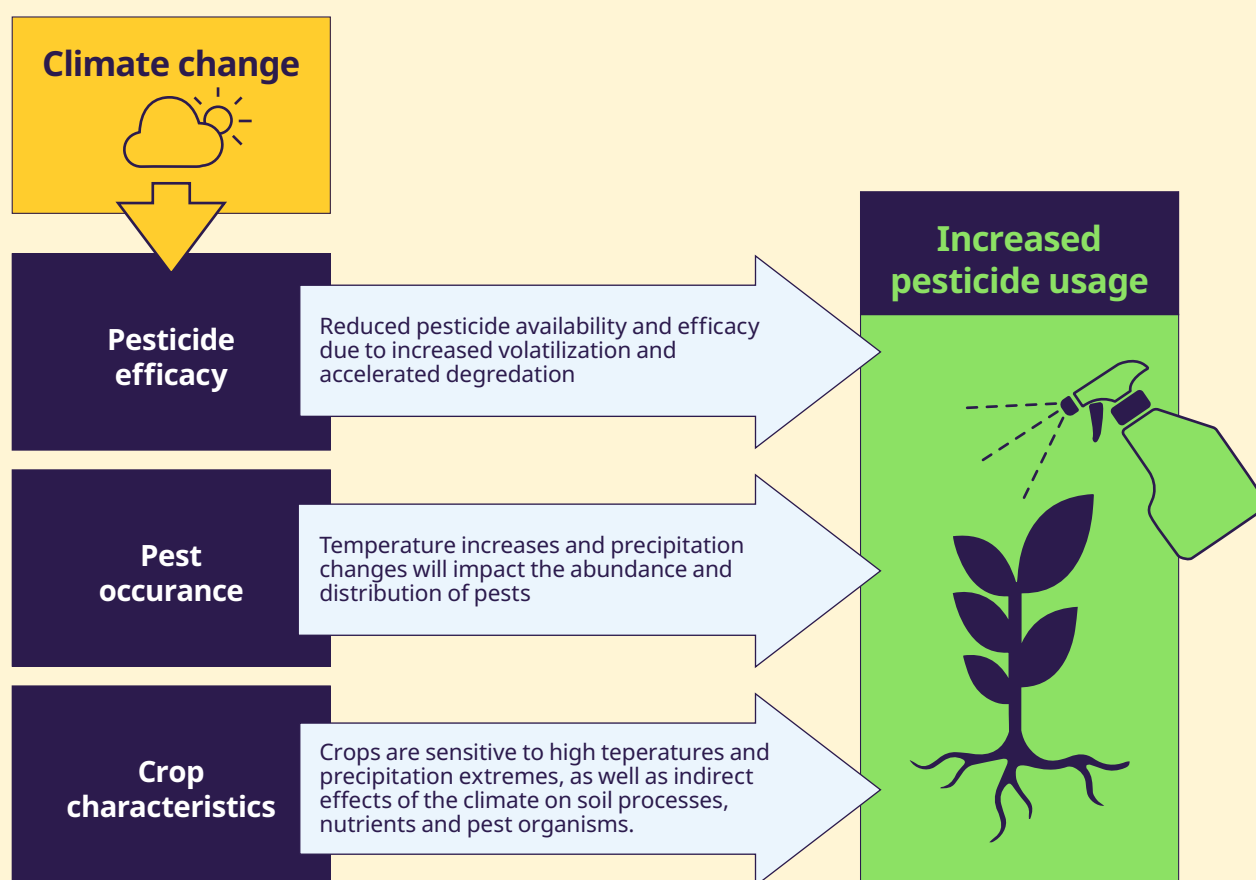
300,000
deaths

annually due to pesticide poisoning (Jørs et al. 2018).

Approximately 873 million workers are employed in agriculture worldwide¹⁴⁸ and are at risk for exposure to pesticides and other agrochemicals, such as fertilizers. Furthermore, changing weather patterns due to climate change are affecting the crops we grow by reducing both yields and quality (Gulland 2020). Meanwhile, between 1990 and 2021, global consumption of agricultural pesticides increased by almost 96 per cent, with worldwide consumption of pesticides at nearly 3.54 million metric tonnes in 2021 (Statistica 2023). This trend reflects the increasing demand for agricultural productivity and food security in the face of population growth, climate change and pest resistance.

An increase in pesticide use has been identified as one important impact of climate change on worker safety and health (US EPA 2023; EU-OSHA 2023a; Levy and Roelofs 2019; Koli et al. 2019). This is not a surprise when considering the sheer number of workers using agrochemicals globally on a daily basis. Pesticide use is directly impacted by pesticide efficacy, crop characteristics and pest occurrence, all of which are influenced by climate change (Delcour et al. 2015) (figure 9). Climate change can reduce pesticide efficacy due to a combination of increased volatilization and accelerated degradation, which are strongly influenced by a high moisture content, elevated temperatures, and direct exposure to sunlight. Climate change promotes the abundance and distribution of pests, for example through temperature increases and precipitation changes, and can also affect the location and availability of host plants for pests. Food crops themselves are sensitive to high temperatures and precipitation extremes, as well as the indirect effects of the climate on soil processes, nutrients, and pest organisms. As a result, people may turn to stronger pesticides and more frequent sprayings to deal with these issues.

► Figure 9: The impact of climate change on pesticide usage



Adapted from Delcour et al. (2015)

¹⁴⁸ Employment by sex and economic activity -- ILO modelled estimates, Nov. 2023.

Fertilizer use can also be impacted by climate change. Increased precipitation due to climate change can cause soil erosion and thus decrease essential soil nutrients such as nitrogen and phosphorus, which are essential for plant growth. Loss of fertile soil can pressure agricultural workers to increase their use of chemical fertilizers and other agrochemicals, impacting safety and health.

► InFocus

Adaptation practices in pesticide use by smallholder cotton farmers in Zimbabwe due to perceived climate change-related increases in pest populations (Zinyemba et al. 2021)

A study of Zimbabwean smallholder cotton farmers in Rushinga District examined adaptive practices adopted in response to perceived climate change impacts. The study found that factors such as perception of shorter growing seasons resulted in adaptive pest management practices, for example, increased pesticide spraying frequencies. In response to shorter seasons, farmers reported that they were illegally retaining residue crop (ratoon cotton) due to delayed seasons influenced by changing weather conditions. Reluctance to destroy cotton stalks, necessary to curb bollworm breeding, was attributed to the altered season timing, resulting in heightened pest infestations. Farmers reported an increased frequency of crop spraying within a season, with some expressing concerns about the diminishing effectiveness of pesticides. Separately, the findings also detected opportunities for decreasing or eliminating pesticide use, as some adaptations to climate change included the reduction of cotton acreage and diversification of crops.

Impact on worker safety and health

Agricultural workers are disproportionately impacted by pesticide exposures, as agriculture accounts for approximately 85 per cent of all pesticide use (Cassou 2018). However, workers in many other sectors, including forestry, chemical industries, pesticide sales, green space (for example parks) and vector control may also face hazardous exposures. Higher temperatures, such as those driven by climate change, can put workers at increased risk of both acute and long-term health impacts from pesticides (Ferguson et al. 2019). The use of highly hazardous pesticides (HHPs) is a major concern, as their widespread use has caused serious health problems and fatalities in many areas of the world (WHO 2019). LMICs account for about 70 per cent of worldwide HHP use and therefore workers are at serious risk in these countries (Public Eye 2020).

Workplace pesticide exposures are of particular concern as they are frequently sustained over years of work and can lead to both acute and chronic health effects. Occupational exposure occurs during handling, dilution, mixing, application, and disposal of pesticides, as well as during cleaning of containers and handling of crops. Workers may also be at risk during re-entry into treated fields, throughout the harvest and when cleaning equipment (Mamane et al. 2015). Additionally, events such as accidental spills, splashes, and consumption by mistake may result in acute poisonings (Damalas and Koutroubas 2016). Emissions to air generated during pesticide manufacturing, formulating and packaging processes include volatile organic compounds, fine particulates, exhaust gases and greenhouse gases (IFC 2007). Droughts caused by climate change can increase the amount of dust in rural areas, increasing the risk of workers inhaling pesticides (Constible et al. 2020). Stocks of obsolete pesticides still represent an exposure hazard in many countries if storage or disposal is inappropriate.

Hazardous pesticide exposures can result in pesticide poisoning, which occurs commonly in developing economies where pesticides are often mislabelled. It is estimated that 385 million cases of unintentional, acute pesticide poisoning (UAPP) occur annually and 44 per cent of farmers are poisoned by pesticides every year (Boedeker et al. 2020). The greatest number of non-fatal UAPP cases is in South Asia, followed by South-East Asia and East Africa (Boedeker et al. 2020). The proportion of pesticide self-poisoning varies considerably between regions, from 0.9 per cent in LMICs in the European region to 48.3 per cent in LMICs in the Western Pacific region (Mew et al. 2017).

► **Figure 10: Pesticides classified as carcinogenic or probably carcinogenic by IARC**

Pesticides classified as carcinogenic to humans (Group 1)	Pesticides classified as probably carcinogenic to humans (Group 2A)
Arsenic and arsenical compounds	Dichlorodiphenyltrichloroethane (DDT)
Pentachlorophenol (PCP)	Organophosphates (malathion, diazinon, glyphosate)
Lindane	Aldrin and dieldrin
Ethylene oxide	Captafol
Formaldehyde	Ethylene dibromide

► InFocus

Occupational exposure to pesticides and associated health effects among greenhouse farmworkers in the United States

The number and production capacities of greenhouse farms have been increased across the globe, driven by an effort to address food security problems related to rapid population growth and the effects of climate change. As a result, there was a large increase in the number of greenhouse farmworkers who are typically involved in chemical preparations and pesticide sprayings, crop harvesting, and greenhouse maintenance activities. A review by Amoatey et al. (2020) looked to characterize pesticide exposure levels and resultant health effects among these workers. Reproductive disorders, respiratory symptoms, neurological symptoms and skin irritations were the most reported health effects, although limited epidemiological and clinical studies were found. Ventilation systems and indoor environmental conditions of greenhouse farms were not designed according to the specifications of the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE). The study suggested that compliance with ASHRAE indoor ventilation and environmental standards will be very important in reducing pesticide exposure and health effects among greenhouse farmworkers.

A range of different pesticides have been classified by the IARC as carcinogenic to humans (Group 1) and probably carcinogenic to humans (Group 2A) (see Figure 10). In the Agricultural Health Study led by the US National Institute of Environmental Health Sciences¹⁴⁹, a prospective cohort study of over 89,000 farmers, cancer excesses were observed for prostate cancer, lip cancer, lymphomas, leukaemia, thyroid cancer, testicular cancer and peritoneal cancer among farmers exposed to pesticides (Lerro et al. 2019). Other health impacts include neurotoxic effects, for example, Parkinson's disease and Alzheimer's disease, reproductive disorders, cardiovascular disease, COPD, endocrine disruption and immune suppression (ILO 2024c). Higher pesticide use has also been linked to cytotoxic and genotoxic damage (Rivera et al. 2022). A systematic review on the high incidence of depression, anxiety and suicide in farmers identified that pesticide exposure is a risk factor for depression and pesticide poisoning is a risk factor for suicidal behaviour (Zanchi et al. 2023).

The combined impact of agrochemical exposures with excessive heat could increase the likelihood of ill-health in workers. As workers sweat more, they are at risk of greater exposure from the high rate of dermal absorption. Also, chemical agents can affect thermoregulatory mechanisms, which could reduce worker's capacity to adapt to thermal stress (Truchon et al. 2014). For example, organophosphorus compounds and carbamates can cause acetylcholinesterase inhibition, which can modify responses associated with maintaining body temperature, such as skin blood flow, heart rate, respiration and sweat secretion (Leon 2008).

Nitrogen-based fertilizers are made from ammonia, which can cause burns, laryngeal oedema, pneumonitis and pulmonary oedema, as well as permanent effects, including visual impairment and chronic pulmonary diseases (ILO 2022a). White phosphorus, used in some artificial fertilizers, is extremely toxic to humans and can damage the kidneys, liver, cardiovascular system and central nervous system (US EPA 2000). Additionally, fertilizers contain varying levels of heavy metals, such as cadmium and lead, which may impact the health of fertilizer industry workers (Ning et al. 2023). These workers may also be exposed to hazardous gas emissions, including gaseous fluorides in the form of hydrofluoric acid, silicon tetrafluoride and sulphur dioxide, which can adversely impact the respiratory system and cause bone deformities (Shaker 2024). Furthermore, the unsafe storage of fertilizers is a risk for MIAs, for example, as occurred in 2020, when around 2,750 tonnes of ammonium nitrate stored in a warehouse at Beirut Port exploded, causing numerous deaths and injuries.

Despite the risks, workers using pesticides frequently display unsafe behaviours during handling and disposal. For example, one study of 147 workers in Mexico found that 78 per cent left containers in the field or incinerated them, 94 per cent did not know the required time lapse before re-entering the sugar cane field after application, and 18 per cent lacked complete PPE (Ramírez-Mora et al. 2019). Inadequate OSH measures subject agricultural workers and others to costly health problems (Centner 2021). For example, the use of organophosphate pesticides in the United States has been estimated to lead to health costs of up to \$US42 billion per year (Attina et al. 2016). The estimated total cost of treating all causes of pesticide poisoning in Sri Lanka was US\$2.5 million or 0.19 per cent of the total government health expenditure in 2015 (Ahrensberg et al. 2019).

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Examples of responses to the risk

Policies, laws and other initiatives at the national level

There are numerous examples of legislation regarding the safe use of agrochemicals, including pesticides. Some countries have provisions on agrochemicals included in general OSH or environmental legislation, whilst others have specific laws dedicated entirely to chemicals or even agrochemicals.

Legislation frequently relates to the safe manufacture, storage, use or disposal of agrochemicals.

- Article 25(1)(b) of the Pesticides Control Act (Act No. 4 of 1996) of Seychelles states that the health of workers should be protected against hazards arising from the manufacture, use, storage, handling and disposal of pesticides.
- In Colombia the law states that the Ministry of Health should establish standards for the protection of health and safety of people from the dangers arising from the manufacture, storage, transport, trade, use or disposal of pesticides¹⁵⁰.
- Laws in Botswana¹⁵¹ and Ghana¹⁵² include precautions to be taken when handling or using agrochemicals.
- Mexico has a number of official standards concerned with different topics related to pesticides: Chemical pollutants in the working environment - recognition, assessment and control (NOM-010-STPS-2014); Handling, transport and storage of hazardous substances (NOM-005-STPS-1998); PPE (NOM-017-STPS-2008); Communication of chemical hazards and risks (NOM-018-STPS-2015); Safety in processes and equipment with chemicals (NOM-028-STPS-2012); and Pesticides and fertilizers (NOM-003-STPS-1999).

In determining the requirements for the safe use of pesticides, national legislation often addresses specific issues, such as the labelling of pesticides (Zimbabwe¹⁵³, Lesotho¹⁵⁴ and Saint Lucia¹⁵⁵), ventilation (Cambodia¹⁵⁶), the registration of pest control operators (Zimbabwe¹⁵⁷), information and training (Mozambique¹⁵⁸, Cambodia¹⁵⁹, the Philippines¹⁶⁰, Chile¹⁶¹, Colombia¹⁶² and Croatia¹⁶³) and PPE (Mozambique¹⁶⁴, Colombia¹⁶⁵ and Chile¹⁶⁶).

¹⁵⁰ Ley núm. 9 del 24 de enero de 1979 por la que se dictan Medidas Sanitarias.

¹⁵¹ Agrochemicals Act. Section 23.

¹⁵² The Environmental Protection Agency Act, 1994. Art. 40.

¹⁵³ Chapter 20:27 Environment Management Act (Hazardous Substances, Pesticides and other toxic Substances) Regulations, 2007. Art. 3.

¹⁵⁴ Labour Code Order 1992 (Order No. 24 of 1992). Art. 17.

¹⁵⁵ Pesticide Control (Labelling of Pesticides) Regulations 1987. S.I. No. 70.

¹⁵⁶ Ministry of Labour and Vocational Training Instruction on Pesticide Spraying Inside and Outside the Compound of Factories, Enterprises, Establishments and Companies (MoLVT Instruction No. 001/16 K.B/SNN).

¹⁵⁷ Pesticides Regulations, 2012 (S.I. No. 144 of 2012).

¹⁵⁸ Decree No. 6/2009 of 31 March; Regulation on Management of Pesticides 20090331. Art. 31.

¹⁵⁹ Ministry of Labour and Vocational Training Instruction on Pesticide Spraying Inside and Outside the Compound of Factories, Enterprises, Establishments and Companies (MoLVT Instruction No. 001/16 K.B/SNN).

¹⁶⁰ Occupational Safety and Health Standards. Art. 1953.01.

¹⁶¹ Código del Trabajo (última actualización 20.09.2014). Art. 95.

¹⁶² Ley núm. 9 del 24 de enero de 1979 por la que se dictan Medidas Sanitarias (Sections 136-144).

¹⁶³ Act of 5 February 2014 on Sustainable use of Pesticides 20140205 (Art 5).

¹⁶⁴ Decree No. 6/2009 of 31 March; Regulation on Management of Pesticides 20090331.

¹⁶⁵ Ley núm. 9 del 24 de enero de 1979 por la que se dictan Medidas Sanitarias (Sections 136-144).

¹⁶⁶ Decreto núm. 594 por el que se aprueba el Reglamento de Condiciones Sanitarias y Ambientales básicas en los Lugares de Trabajo. Art. 129.

- EU Directive 98/24/EC of 7 April 1998 on the protection of the health and safety of workers from the risks related to chemical agents at work sets out minimum health and safety requirements covering the risks arising from exposure of workers to such products, as well as general and specific preventive measures to reduce those risks. In 2022, the European Commission adopted a proposal for a new regulation on the sustainable use of plant protection products¹⁶⁷, including EU-wide targets to reduce by 50 per cent the use and risk of chemical pesticides by 2030. The regulation states that the use, storage and disposal of plant protection products require compliance with minimum health and safety requirements at the workplace, as laid down by Directive 89/391/EEC, Directive 89/656/EEC, Directive 98/24/EC, Directive 2004/37/EC and Directive 2009/104/EC. Chapter V of the proposal sets out requirements for professional users, distributors and advisers to hold a certificate of training in certain circumstances. It also sets out general requirements for the use of pesticides and application equipment. Other relevant EU directives provide indicative OEL values for chemicals found in agricultural settings, for example aniline, trimethylamine, manganese, amitrole, carbon disulphide, chloroethane and phosgene.
- In India, the Plantations Labour (Amendment) Act (No. 17 of 2010) states that employers shall ensure that every worker in a plantation employed to handle, mix, blend and apply insecticides should be given training on these operations¹⁶⁸. Furthermore, the Insecticides Act (Act No. 46 of 1968), outlines that measures should be taken to detect and investigate cases of poisoning, and PPE should be provided to workers using pesticides¹⁶⁹. The Insecticide Rules 1971 contain provisions on PPE, medical examination, first aid and training of workers¹⁷⁰. The Central Insecticides Board & Registration Committee also scrutinizes and periodically reviews all pesticides and their usage, and makes additions as necessary to the List of Banned Pesticides.
- In the Republic of Korea, article 670 of the Ordinance of the Occupational Safety and Health Standards has a number of provisions related to the safe use of pesticides at work. It provides specific measures to be taken in a workplace where a worker scatters, fumigates or injects an agricultural pesticide. It also requires the employer to minimize dust or mist from agricultural pesticide where a worker is mixing it, and to inform workers with regard to measurements and apparatus..
- In Tajikistan, Act No. 1 of 22 April 2003 on production and secure handling of pesticides contains general safety requirements with regard to the development of new pesticides and agrochemicals, labelling and recommendations on the safe use, production, storage, transportation, import and export, application, purchase, sale, decontamination, disposal and destruction of pesticides and agrochemicals.
- The Dangerous Chemicals Control Act 2004 of Mauritius requires employers with ten hectares of land or more where pesticides are used to keep a register of workers, the hours worked, and the specific chemical substances with which the worker has worked¹⁷¹.

In a few cases, legislation addresses the combined risks of agrochemical exposure with excessive heat.

- Decree no. 33507-MTSS in Costa Rica regulates the use of agrochemicals. Article 18 states the application of pesticides should be carried out in the cooler early morning or late afternoon and is prohibited from 10a.m. to 2p.m. Workers should not undertake the application of pesticides for more than four hours continuously.

¹⁶⁷ Regulation of the European Parliament and of the Council on the sustainable use of plant protection products and amending Regulation (EU) 2021/2115.


¹⁶⁸ Chapter IV(a)(4).

¹⁶⁹ Section 36.

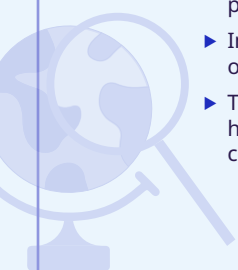
¹⁷⁰ Chapter VIII. Articles 37-42.

¹⁷¹ Dangerous Chemicals Control Act, 2004 (Act No. 16 of 2004). Section 21.

In some countries, there are special provisions for vulnerable groups of workers, such as pregnant women.

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- Legislation in Honduras prohibits pregnant or breastfeeding workers from engaging in agrochemical work¹⁷² and in Uruguay, pregnant and breastfeeding workers are forbidden to apply, handle or prepare pesticides¹⁷³.
 - In Pakistan¹⁷⁴, laws state that precautions should be taken to protect workers from pesticide poisoning, with special precautions taken for those at particular risk of poisoning, for example due to their health status or age.

Some countries have recognized some pesticide-related health impacts via national occupational disease lists, in line with the Recommendation No.194.

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- In Thailand¹⁷⁵ the list of diseases that occur at work or because of the nature or type of work include diseases caused by chemical agents and particularly by pesticides.
 - In Cameroon¹⁷⁶, several occupational diseases are listed which are caused by the manufacturing or handling of pesticides.
 - In Mozambique¹⁷⁷, Brunei Darussalam¹⁷⁸ and Namibia¹⁷⁹, poisoning due to pesticides is listed in the national lists of occupational diseases and in Singapore, organophosphate poisoning is specifically mentioned¹⁸⁰.
 - The Factories and Machinery Act 1967 [Act 139] (Revised 1974) of Malaysia includes, "Intoxication resulting from handling of insecticides, or herbicides or fungicides as organic phosphate compounds, nitrogenous and chlorinated compounds" as a notifiable occupational disease.

172 Acuerdo Ejecutivo núm. STSS-001-02 por el que se aprueba el Reglamento General de medidas Preventivas de Accidentes de Trabajo y Enfermedades Profesionales. Section 430.

173 Decreto núm. 321/009 de 9 de julio de 2009 de reglamentación de ciertas actividades agropecuarias referente al Convenio Internacional de Trabajo núm. 184 (Section 92)

174 Agricultural Pesticides Ordinance, 1971 (II of 1971). Art. 29.

175 [Notification of the Ministry of Labour: Diseases that occur at work or because of the nature or type of work.](#)

176 Arrêté n° 051/MINTSS/S6/DSST du 06 octobre 2009 fixant la liste des tableaux des maladies professionnelles indemnissables au Cameroun.


177 Decree No. 62/2013 of December 4. Art. 20.

178 Workplace Safety and Health Order 2009 (No. S 44). Third Schedule. No. 31.

179 [Regulations relating to the health and safety of employees at work \(Government Notice No. 156 of 1997\).](#)


180 [Workplace Safety and Health Act \(2009 Ed.\) \(Second Schedule\).](#)

For workers exposed to pesticides, medical surveillance is used to check workplace control measures are effective, detect biological effects requiring cessation or reduction of pesticide exposure and collect data to evaluate individual exposures over time.

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- In Malaysia, the Occupational Safety and Health Act, 1994 (No. 514) states that if there is a risk of injury to health from occupational exposure to pesticides, workers should receive medical surveillance and medical examinations¹⁸¹. This is also the case in Thailand, where a health check-up is required for workers exposed to pesticides¹⁸². In the Philippines, specific health surveillance is required when workers are exposed to natural fertilizer¹⁸³.

To date there is no harmonized, internationally agreed list of HHPs. While some pesticides are classified as HHPs and banned in specific countries, in other countries they are approved for use. For example, phorate, which is classified as extremely hazardous (Class 1a) by the WHO has been banned in the EU, Brazil and China, while it remains approved for use in other countries (Donley 2019).

Numerous and comprehensive **technical guidelines** have been created by government departments and OSH bodies regarding the safe storage, use and disposal of pesticides, for example by the CCOHS, HSE, the Victoria Department of Health and the US Environmental Protection Agency. A number of Food and Agriculture Organization of the United Nations (FAO)/WHO guidelines also exist, including the International Code of Conduct on Pesticide Management (FAO/WHO 2014), Guidelines on Highly Hazardous Pesticides (FAO/WHO 2016) and the International Code of Conduct on Pesticide Management for personal protection when handling and applying pesticides (FAO/WHO 2020).

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- The Victoria Department of Health, Australia, has issued information on managing pesticide spills (Victoria DoH 2021). This includes the following guidance:
 - **Caution** - Assess the dangers of spills, ensure the area is well ventilated and follow emergency instructions on the label and safety data sheet.
 - **Control** - Control the source of the spill, for example decant liquid from a leaking container.
 - **Contain** - Contain the spill using sand or another absorbent material and block any drains in the area.
 - **Clean up** - Develop and practise spill procedures so that everyone always knows what to do. These may include leaving absorbent materials on the spill for at least an hour, supervising the spill location and sending contaminated materials to a suitable disposal facility.

181 Art. 28(1)(d) and Schedule 3(1).

182 Safety, Occupational Hygiene and Workplace Environment Act B.E. 2554 (2011). (Section 8).

183 Occupational Safety and Health Standards 1989 (S 1967.07/ S 1955.04(7)).

Some countries have a **National Action Plan (NAP)** to reduce the risks associated with the use of pesticides. In Belgium, the NAPAN Programme 2018-2022 was a NAP developed under Directive 2009/128/EC. To achieve the overall objective of sustainable use of pesticides, the document envisaged a series of interventions at both national and regional level, including training for professionals working with plant protection products and inspection of the equipment for their application, and information and general awareness-raising on pesticides and their alternatives.

International instruments and frameworks on pesticides


The International Code of Conduct on Pesticide Management (FAO/WHO 2014) is a voluntary framework that defines HHPs as pesticides that present particularly high levels of acute or chronic hazards to health or the environment according to internationally accepted classification systems, such as from the WHO or the Globally Harmonized System of Classification and Labelling of Chemicals (GHS), or their listing in relevant binding international agreements or conventions. Some older pesticides are listed under the Stockholm Convention on Persistent Organic Pollutants for global elimination or restriction, since they persist in the environment, can bioaccumulate, cause adverse effects and able to be transported over a long range.

The GHS is an internationally agreed system to standardize chemical hazard classification and communication. The WHO has updated the Recommended Classification of Pesticides by Hazard and Guidelines to Classification 2019 to take account of the GHS criteria. Whilst the GHS has been adopted for pesticides by over 50 countries, many use other classification systems, such as the FAO Guidelines for the Registration of Pesticides and the FAO Guidelines on Good Labelling Practice for Pesticides.

Collective agreements adopted by trade unions and employers' organizations have resulted in increased OSH protections for agricultural workers, including seasonal workers.

- Collective bargaining in Brazil's fruit sector has reduced the vulnerability of seasonal workers (Oxfam 2019). Poor working conditions are widespread among seasonal workers in Brazilian farms producing tropical fruit for export. These workers are employed on temporary contracts and have few rights compared to permanent workers. However, all types of workers complain of poor OSH practices and inadequate protection against exposure to pesticides, resulting in occupational injury and diseases. On fruit farms in the São Francisco valley, which spans the states of Pernambuco and Bahia, unions and employers have agreed a sector-wide collective agreement. This covers OSH measures ranging from the provision of weather shelters, eating facilities, toilets and drinking water to first aid and provisions for pregnant and breastfeeding women. Research showed that collective bargaining has improved conditions for temporary and permanent workers, and that empowering workers and their employers to reach agreements is likely to lead to improved outcomes compared to audit and enforcement.

Awareness-raising initiatives play an important role at community level in educating workers on the safe use of pesticides in the working environment. They can be organized by national or sectoral authorities, social partners or non-governmental organizations (NGO)s.

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- The General Directorate of Agriculture and Livestock in Al Dhahirah, Oman organized a two-day workshop for farmers on the safe and effective use of pesticides (ALROYA 2020). The workshop involved lectures on the dangers of pesticides to human health and practical training sessions to educate farmers on safe work practices. Farmers were also trained on modern safe techniques in agriculture and alternatives to pesticides.
 - In the United States, Farmworker Justice is a non-profit organization aimed at improving living and working conditions of migrant and seasonal farmworkers¹⁸⁴. In May 2022, Farmworker Justice convened a two-day virtual Environmental Justice Symposium on farmworkers and the climate crisis, with subject matter experts and participants representing health, legal, academic, environmental and other organizations. The aim of the Symposium was to understand how the climate crisis is affecting farmworker communities and to develop actionable recommendations and best practices. Policy suggestions from the symposium for reducing the risk of hazardous pesticide exposures included increasing funding for pesticide safety training for farmworkers, requiring pesticide manufacturers to provide product safety labels in Spanish and investing in pesticide biomonitoring to assess farmworker exposures. The organization also developed a training-of-trainers curriculum focused on pesticide hazards, field sanitation and heat illness, to prepare health promoters for outreach and the education of farmworkers in their communities. In addition, it provides different materials on the safe use of pesticide for farmworkers, including fact sheets, issue briefs and webinars.

Management of agrochemicals at the workplace level

To ensure the safety and health of workers who may be exposed to pesticides, a thorough risk assessment should be carried out at the workplace level to identify hazards, assess risks, and implement appropriate control measures. The first step is to identify which pesticides are present in the workplace and the workers exposed to them. Workers may face a range of exposure pathways, including inhalation, ingestion, or dermal contact, depending on their sector of employment and the specific tasks carried out. For new work activities involving the use of pesticides or if new pesticides are introduced, hazards should be identified and the risks assessed before the new process is started.

The risk assessment should then consider the safety and health impacts, taking into account the severity of the possible consequences combined with the likelihood of the occurrence. A risk assessment would be required for each task, including mixing, decanting, spraying or other application method, transportation and storage.

Based on the risk assessment, the hierarchy of controls should be applied in order to eliminate or minimize the risks from pesticide exposures. The most effective way to prevent exposure to HHPs is through elimination or substitution with viable, less toxic alternatives. PPE should only be relied upon where it is not possible or practicable to control exposure by one or more of the other control measures. Choosing the appropriate level of PPE depends on the hazard level of the product and anticipated exposure, which are largely determined by the type of pesticide, the phases of use (mixing, loading, applying, cleaning), the application method, the applicator or operator and the application conditions (FAO/WHO 2020). An example of an HHP hierarchy of controls is shown in figure 11.

¹⁸⁴ Workplace Safety and Health for Farmworkers: Pesticide Hazards, Field Sanitation, and Heat Illness.

► Figure 11: Example of an HHP Hierarchy of Controls

<div>More effective</div> <div>↑</div> <div>↓</div> <div>Less effective</div>	Elimination	Physically remove the chemical	Eliminate HHPs and use an alternative pest control method, e.g. biopesticides or techniques such as cover cropping.
	Substitution	Replace the chemical	Substitute the HHP with a less toxic pesticide.
	Engineering controls	Isolate workers from the chemical	Use a system that minimizes the generation or emission of a pesticide, suppresses or contains a pesticide within a controlled area, or delivers the pesticide in a way that reduces misting e.g. using extraction ventilation equipment to remove vapours after treatment or changing nozzle parameters, droplet size or spray pattern.
	Administrative controls	Change the way work is performed	Put in place work systems and practices to provide protection for workers, e.g. adjust work tasks or schedules to limit the time workers are exposed to chemicals and create written operating procedures on handling hazardous substances.
	Personal Protective Equipment (PPE)	Protect the worker with PPE	Ensure workers wear appropriate PPE, e.g. gloves, overalls, masks with filters and safety glasses, as deemed relevant by risk assessment.

Once measures to be taken have been identified, the workplace should determine who will be responsible for implementing and overseeing the new measures, as well as an appropriate timeline for their implementation based on what actions have been determined to be a priority. A plan of action may also include worker training and regular checks to ensure the appropriate measures are still in place.

Training programmes can be used to promote pesticide safety in the workplace. For example, a study by Damalas and Koutroubas (2017) in Northern Greece found that intensive seminars relating to pesticide use were associated with increased levels of knowledge of pesticides and beliefs about pesticide hazard control, and were accompanied by elevated safety behaviour in farmers. Education topics included use of spraying equipment, application parameters, PPE and risks to human health and the environment.



► InFocus

Heat stress and heavy personal protective equipment (PPE)

Farmworkers who apply pesticides often wear specialized protective equipment that increases their risk of heat stress (Union of Concerned Scientists 2019). Some farmworkers wear double-layered clothing when applying pesticides, potentially protecting them from the serious health consequences of pesticide exposure but exacerbating the threat to their health from heat (Watson et al. 2023). Importantly, workers may also be less compliant with PPE recommendations under uncomfortable heat stress conditions. Recommendations for tropical situations should always focus on providing sufficient protection for pesticide users while ensuring that they can work comfortably and efficiently if PPE is necessary (FAO/WHO 2020).

Recommendations for the use of pesticides in hot conditions, as outlined in the Guidelines for Personal Protection when Handling and Applying Pesticides (FAO/WHO 2020), include:

- Avoiding use of pesticides whose handling and application require the use of PPE that is uncomfortable, expensive, or not readily available.
- Adjusting tasks or workplace conditions to minimize heat stress.
- Organizing work early and late in the day to avoid the hottest times and ensuring that spraying is not done if the temperature is greater than 30°C.
- Scheduling rest periods long enough to allow the body to cool down.
- Drinking plenty of water before and after work.
- Selecting a level of PPE appropriate for the task according to the minimum PPE requirements on the label (namely not over-protecting the body).

Havenith et al. (2011) looked at improvements to protective clothing to alleviate heat strain whilst maintaining protection against chemicals. Selectively permeable membranes with low vapour-resistance were compared to textile-based outer layers with similar ensemble vapour-resistance, and also layers with increased air permeability. Heat strain was shown to be significantly higher with selectively permeable membranes, compared to air permeable ensembles. This was reflected in higher values of core and skin temperatures, as well as heart rate. Based on protection requirements, it is concluded that air permeability increases can reduce heat strain levels, allowing optimization of chemical protective clothing.

► ILO Guidance related to agrochemicals

The Chemicals Convention, 1990 (No. 170) and Chemicals Recommendation, 1990 (No. 177), are the main ILO instruments addressing hazards relating to chemicals. They are both general in scope and concern all risks relating to chemicals, including agrochemicals. Some selected excerpts from the Convention are below.

Article 10

1. Employers shall ensure that all chemicals used at work are labelled or marked as required by Article 7 and that chemical safety data sheets have been provided as required by Article 8 and are made available to workers and their representatives.

Article 12

Employers shall:

(a) ensure that workers are not exposed to chemicals to an extent which exceeds exposure limits or other exposure criteria for the evaluation and control of the working environment established by the competent authority, or by a body approved or recognised by the competent authority, in accordance with national or international standards;

(b) assess the exposure of workers to hazardous chemicals;

(c) monitor and record the exposure of workers to hazardous chemicals when this is necessary to safeguard their safety and health or as may be prescribed by the competent authority;

(d) ensure that the records of the monitoring of the working environment and of the exposure of workers using hazardous chemicals are kept for a period prescribed by the competent authority and are accessible to the workers and their representatives.

Article 13

1. Employers shall make an assessment of the risks arising from the use of chemicals at work, and shall protect workers against such risks by appropriate means, such as:

(a) the choice of chemicals that eliminate or minimise the risk;

(b) the choice of technology that eliminates or minimises the risk;

(c) the use of adequate engineering control measures;

(d) the adoption of working systems and practices that eliminate or minimise the risk;

(e) the adoption of adequate occupational hygiene measures;

(f) where recourse to the above measures does not suffice, the provision and proper maintenance of personal protective equipment and clothing at no cost to the worker, and the implementation of measures to ensure their use.

2. Employers shall:

(a) limit exposure to hazardous chemicals so as to protect the safety and health of workers;

(b) provide first aid;

(c) make arrangements to deal with emergencies.

Convention No. 170 and Recommendation No. 177 are supplemented by an ILO code of practice on Safety in the Use of Chemicals at Work (1993).

Two codes of practice, Safety and Health in Agriculture (2011) and Safety and Health in Forestry Work (1998), give additional information on the safe handling of hazardous chemicals such as pesticides, including detailed guidelines on hazard descriptions, control strategies, exposure mitigation, medical surveillance and other issues.



► Climate change and mental health

Global warming will have a devastating impact on the environment, causing issues such as rising sea levels, desertification, ocean acidification and changes to the freshwater cycle. The resulting changes to land structure, increasing food scarcity, loss of natural resources and unavailability of clean water sources will affect people's ability to work, causing job insecurity, reduced productivity, and loss of livelihoods.

Workers may feel distress related to financial and workload problems and from loss of hope for the future of their community (Sartore et al. 2008). For communities which rely heavily on one particular employment sector, climate change has the potential to have devastating consequences. For example, in Alaska, the seafood industry employs more than 62,000 workers (Goodell 2023). If the fish stocks are depleted due to the impacts of climate change there could be serious impacts on local fisheries.

Specific occupations, including first responders, farmers, forestry and fishing workers, public safety workers and healthcare workers, are at higher risk for adverse mental health outcomes due to climate change (Schulte et al. 2023).

Worsened mental health has also been observed in healthcare professionals working in disaster relief (Doherty 2013) and disaster recovery work has been associated with higher physical symptoms, which in turn has been associated with higher post-traumatic stress disorder (PTSD), depression and anxiety (Lowe et al. 2016). Rates of PTSD among first responders have ranged from 13 per cent to 18 per cent up to four years following large-scale response events (Benedek et al. 2007). Among Australian firefighters with PTSD, a large proportion (77 per cent) also presented with simultaneously occurring mental health conditions, such as depression, panic disorder or phobic disorders (Benedek et al. 2007). For those who work in the environmental sector, concerns about the climate could lead to over-commitment to work (Brooks and Greenberg 2023). Prolonged exposure to heat in construction workers has been linked to difficulty concentrating, irritableness, and frequent mood swings (Karthick et al. 2022).

Suicide rates in farmers can be triple the rate of suicide in urban males (Bennett and McMichael 2010). In India, for example, an estimated 100,000 farmers took their own lives between 1993 and 2003, for reasons such as water shortages and decreased crop yields (Deshpande 2002). Climate change will also affect seasonal and transient farmworkers such as fruit pickers and sheep shearers, as increasingly stressful environmental conditions and unpredictable crop yields have major impacts on livelihoods (Bennett and McMichael 2010). Low-dose pesticide exposures, if chronic, have been associated with poor mental health (Khan et al. 2019). For instance, the Agricultural Health Study of over 19,000 pesticide applicators linked long-term use of pesticides to higher rates of depression (J. D. Beard et al. 2014).

The different climate change impacts may adversely affect mental health in different ways. For example, excessive heat can lead to sleeping disorders, occupational behavioural changes, and a lowered ability to concentrate, all of which may impact work safety and productivity. Increased temperatures could also be associated with increased cases of suicide and suicidal behaviour, hospital attendance or admission for mental illness, and poor community health and well-being (Thompson et al. 2023).

Exposure to extreme weather events and climate-related disasters can cause or exacerbate mental health effects such as stress, anxiety, depression, substance abuse, PTSD and suicide (Schulte et al. 2023). Indeed, experiences from a number of regions across the world, including Bangladesh, the Philippines and the Caribbean, demonstrate how extreme climate events are linked with an increased burden of PTSD, depression, anxiety, stress and suicide in people of all ages (Stewart 2022). In the workplace, this can lead to increased job tension, higher turnover intentions and workplace hostility, and stress about extreme weather could impede the ability to make essential work-related decisions (Brooks and Greenberg 2023). Indeed, the damage to mental health caused by long-term stressful events, such as droughts, is often gradual and accompanied by persistent feelings of weakness, despair and hopelessness (Bennett and McMichael 2010).

Whilst there is emerging evidence of associations between poor air quality, both indoors and outdoors, and poor mental health in general, as well as specific mental disorders (Bhui et al. 2023), extremely limited evidence exists with regard to worker populations specifically.

For businesses and employers, there are significant costs to be considered. For instance, employers in the United Kingdom alone are already losing up to £45 billion each year due to poor mental health among their workforce (Deloitte 2020). This is only set to get worse in the face of increasing climate disasters. Despite its importance, a report published by the Grantham Institute and Institute of Global Health Innovation found that fewer than 1 per cent of 54,000 medical research papers that mentioned climate change from 2011-21 also discussed mental health (Lawrence et al. 2021). The same report found cases of psychological trauma caused by climate-driven disasters exceed those of physical injury by a ratio of 40:1. Despite the serious human and economic costs, there is limited guidance for employers regarding protecting workers from adverse mental health conditions related to climate change (Schulte et al. 2023).

► InFocus

The association between psychological distress and occupational heat stress in Thai workers

A study by Tawatsupa et al. (2010) looked at the relationship between self-reported heat stress, psychological distress and overall health status in Thai workers. 18 per cent of the cohort (>40,000 subjects) often worked under heat stress conditions and men experienced heat stress more often than women. Working under heat stress conditions was associated with worse psychological distress. Men aged between 15 and 29 years reported the highest prevalence of psychological distress, with the study suggesting a potential link between heat stress and the high rates of suicide and distress in young men in Thailand.

Conclusions

Key takeaways

Despite some positive steps, the impacts of climate change continue to pose significant challenges to the safety and health of workers in many regions and sectors. A number of key takeaways were identified following this review:

Workers are currently facing serious health impacts from climate change-related hazards

Billions of workers are exposed every year to hazards exacerbated by climate change, and these figures are only likely to get worse. Strong evidence demonstrates that numerous health conditions in workers have been linked to climate change, including cancer, cardiovascular disease, respiratory illnesses, kidney dysfunction, reproductive disorders, and mental health conditions, among many others. According to new ILO estimates, every year 22.85 million occupational injuries, 18,970 deaths and 2.09 million disability-adjusted life years (DALYs) are attributable to excessive heat alone. Thousands more die each year from pesticides (>300,000), workplace air pollution (>860,000), parasitic and vector diseases (>15,170) and solar UV radiation (>18,960 deaths annually due to non-melanoma skin cancer).

Current OSH policies may need to be adapted and new, climate change-specific policies created

Existing OSH laws and policies in many cases already integrate climate-related hazards. Nevertheless, Member States from various regions are adopting new policies to better respond to some hazards induced or aggravated by climate change, such as excessive heat in the workplace. Furthermore, as climate change hazards evolve and intensify, it may be necessary to re-evaluate existing legislation or create more new regulations and guidance. OSH considerations should be mainstreamed into climate-related policies, and climate concerns should be integrated into OSH practice. However, the current lack of monitoring and evaluation of policies and strategies may make it difficult for policymakers to determine the best course of action.

Enhanced research and a stronger evidence base are needed to guide response

At present, the scientific evidence base is extremely limited in many critical areas and what does exist is frequently focused on public health, rather than occupational health. Aside from heat stress, little is known about the most effective interventions to protect workers from the many impacts of climate change. Research is needed to develop and evaluate the effectiveness of preventive OSH measures in different countries and sectors, and to estimate the economic costs and benefits of such policies and interventions. Furthermore, global burden of exposure and disease data is needed in many areas.

Social dialogue is the foundation for an effective OSH response in a changing world of work

Collaboration between governments and social partners is needed for the development of climate change mitigation and adaptation policies, as workers and employers are best placed to take appropriate action in the workplace. Collective agreements at the national level are beginning to include climate change-related provisions. Workplace cooperation and specifically, bilateral OSH committees should be established at the workplace level to enable workers and employers to engage in social dialogue.

The needs of workers in the most vulnerable situations should be considered

Some worker populations may be especially vulnerable to the effects of climate change and therefore may need extra protective measures. For example, agricultural workers and other outdoor workers carrying out heavy labour in hot climates may be exposed to a cocktail of hazards, including excessive heat, UV radiation, air pollution, vector-borne diseases, and agrochemicals. Nevertheless, workers in indoor settings such as factories and offices cannot be overlooked.

Other considerations

The increased political profile of the climate-health nexus

In December 2023, COP28 marked a critical moment for action and global cooperation to address the triple planetary crisis of climate change, biodiversity loss and pollution. For the first time ever, COP28 included a Health Day in its agenda, emphasizing the importance of prioritizing human health in the response to and fight against climate change. This focus on health resulted in bold commitments, including a Declaration of Climate and Health endorsed by over 120 countries, with over US\$1 billion pledged toward projects related to health and climate change. Following COP28, the World Economic Forum launched a key report, *Quantifying the Impact of Climate Change on Human Health* (WEF 2024). The findings of the analysis showed that by 2050, climate change is likely to cause an additional 14.5 million deaths and \$US12.5 trillion in economic losses worldwide. It is hoped that the increased political profile of the climate-health nexus will lead to an enhanced ability to negotiate for worker safety and health, given that workers are often more vulnerable to the impacts of climate change than the public.

Connections should be made with existing global normative instruments

Any new legislation or policies should capitalize on common ground with existing legislation, such as global normative instruments.

- ▶ **Greenhouse gas reduction:** Multilateral environmental agreements aimed at mitigating climate change through the reduction of greenhouse gas emissions are key to tackling air pollution. Key treaties include the 2005 Kyoto Protocol and the 2015 Paris Agreement. The UNFCCC is an international treaty to combat “dangerous human interference with the climate system”, in part by stabilizing greenhouse gas concentrations in the atmosphere.
- ▶ **Extreme weather events:** International responses to extreme weather events, in the form of international treaties, frameworks and committees, are mainly concerned with disaster preparedness and response. They include the 1992 Convention on Transboundary Effects of Industrial Accidents, UNEP/UN Office for the Coordination of Humanitarian Affairs Joint Environment Unit, UNEP Awareness and Preparedness for Emergencies at Local Level programme and the Sendai Framework for Disaster Risk Reduction 2015-2030.
- ▶ **Chemical safety:** The Global Framework on Chemicals (GFC), adopted in 2023 at the Fifth Session of the International Conference on Chemicals Management in Bonn, Germany, aims to prevent or, where prevention is not feasible, minimize harm from chemicals and waste to human health and the environment and utilizes a multisectoral and multi-stakeholder approach. The GFC calls for stakeholders to take effective measures to phase out HHPs in agriculture where the risks have not been managed and where safer and affordable alternatives are available (Target A7). Other multilateral environmental treaties related to chemical safety include the Stockholm Convention on Persistent Organic Pollutants, the Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade, the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and the Minamata Convention on Mercury.

Interdepartmental coordination within governments is the cornerstone of coherent action

OSH policies and programmes should be coordinated among government departments, including ministries of labour and ministries of health, to ensure policy coherence. Climate change is an issue where the health concerns of workers and the public at large clearly interconnect, however frequently the two areas of health exist in separation. It may be beneficial to integrate OSH initiatives with public health campaigns. Also, some countries now have government departments dedicated entirely to climate change, for example, the Ministry of Climate Change and Environmental Coordination in Pakistan, the Ministry of Climate and Environment in Poland and the Ministry of Climate Change and Environment in the United Arab Emirates. Ensuring that OSH concerns are integrated into their action and programmes is vital.

The workplace can contribute to broad mitigation strategies

Enterprises are playing an important role in climate change mitigation strategies, by finding ways to reduce workplace emissions and implementing sustainable work practices. In 2018, 89 per cent of global carbon dioxide emissions came from fossil fuels and industry (ClientEarth 2022). The manufacturing industry, transportation, food production, mining and construction sectors have all been significant contributors (United Nations n.d.). However, industry has the potential to reduce its emissions by 7.3 Gt yearly by embracing passive or renewable energy-based heating and cooling systems, improving energy efficiency and addressing other pressing issues, like methane leaks (UNEP 2020). Employers have been implementing various measures to cut carbon emissions, for example, exploiting reuse opportunities from waste, reducing the carbon impact of their supply chains, reducing lighting, heating and cooling needs, and reducing the amount and impact of business transportation (NIBUSSINESSINFO.CO.UK n.d.). Moreover, employers are introducing eco-friendly workplace initiatives which aim to reduce the environmental impact of OSH such as using sustainable equipment and creating workplace recycling programmes.

Greening practices can also bring new OSH challenges

Green industries and technologies are rising to respond to this global emergency and may help in mitigation over the long term. However, green technologies may in some cases create or amplify OSH hazards and risks, especially if the appropriate infrastructure and OSH protections have not yet been developed. OSH programmes and policies will need to account for this. For example:

- ▶ Solar panels and energy-efficient compact fluorescent lamps contain hazardous chemicals, such as lead, cadmium and mercury, which pose a hazard for those working in recycling (ILO 2023).
- ▶ The health risks associated with chemicals used in the production of lithium-ion batteries that power electric vehicles are also a serious concern. Cobalt, for instance, is often mined in artisanal informal operations, which lack even basic OSH measures. Workers in these contexts may be exposed to high levels of dust, toxic gases and other hazards, which can lead to respiratory illnesses, skin conditions, impaired thyroid function and tumours (Wahlqvist et al. 2020). At a battery plant in Hungary, 300 workers who had been denied PPE went on strike in June 2023 after an outbreak of vomiting, diarrhoea and rashes (ETUI 2023). No OELs have been established for many of the hazardous chemicals in these batteries, including lithium and cobalt (ETUI 2023).
- ▶ Workers in the renewables energy sector are also at risk. For example, a number of safety incidents have been reported for workers in offshore wind farms, ranging from carbon monoxide and sulphur hexafluoride releases, and workers lost overboard. 350 incidents were reported in 2022 in the United Kingdom alone (ETUI 2023).

Education for stakeholders on risks and protection measures

Training programmes are needed to educate employers and workers on the risks of climate change and practical protection measures based on climate change assessments and the hierarchy of controls.

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► **The impacts of climate change on occupational safety and health**
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► Annex: A selection of tools and resources relevant for climate change

1. ILO tools and resources

Title	Hazard(s)	Description	Link
Codes of Practice (Chronologically arranged)			
Safety and health in construction (Revised edition) (2022)	Excessive heat UV radiation Air pollution Vector-borne diseases Extreme weather events	The code promotes the implementation of OSH management systems as well as cooperation between employers and workers and their representatives. It promotes a preventative safety and health culture in which the right to a safe and healthy working environment is respected throughout the construction project life cycle.	https://www.ilo.org/sector/Resources/codes-of-practice-and-guidelines/WCMS_861584/lang-en/index.htm
Safety and health in textiles, clothing, leather and footwear (2022)	Excessive heat Air pollution Vector-borne diseases Extreme weather events	The purpose of this code is to provide practical guidance for those, both in the public and private sectors, who have obligations, responsibilities, duties and rights regarding safety and health in the textiles, clothing, leather and footwear industries.	https://www.ilo.org/global/topics/safety-and-health-at-work/normative-instruments/code-of-practice/WCMS_841128/lang-en/index.htm
Safety and health in shipbuilding and ship repair (Revised edition) (2019)	Excessive heat Extreme weather events	This code of practice promotes occupational safety and health (OSH) management systems as well as cooperation between employers and workers and their representatives. The revised code contains comprehensive guidance on how to improve OSH in the industry and sets out how governments, shipowners, employers, workers and their representatives should work together in doing so.	https://www.ilo.org/sector/Resources/publications/WCMS_618575/lang-en/index.htm
Safety and health in opencast mines (2018)	Excessive heat UV radiation Extreme weather events	This revised code reflects the many changes in the industry, its workforce, the roles of the competent authorities, employers, workers and their organizations, and the development of new ILO instruments on occupational safety and health (OSH), including the Safety and Health in Mines Convention, 1995 (No. 176). To this effect, the new code is based on the principles of the Convention, including risk assessment, addresses issues such as the interaction between large-scale and small-scale artisanal miners and also comprises a section on automated machinery, a development that has great potential to change the work carried out by nearly all workers in opencast mines worldwide.	https://www.ilo.org/sector/Resources/publications/WCMS_617123/lang-en/index.htm
Safety and health in ports (Revised 2016)	Excessive heat UV radiation Air pollution Vector-borne diseases Extreme weather events	The text revises and updates the 2005 edition of the ILO Code of practice on safety and health in ports, which had replaced two former ILO publications: Guide to safety and health in dock work (1976) and Safety and health in dock work, An ILO code of practice (second edition, 1977).	https://www.ilo.org/sector/activities/sectoral-meetings/sectoral-meetings/WCMS_546257/lang-en/index.htm

Safety and health in the use of machinery (2013)	Excessive heat Extreme weather events	This code of practice sets out principles concerning safety and health in the use of machinery and defines safety and health requirements and precautions applicable to governments, workers and employers, and also to designers, manufacturers and suppliers of machinery.	https://www.ilo.org/global/topics/safety-and-health-at-work/normative-instruments/code-of-practice/WCMS_164653/lang-en/index.htm
Safety and Health in Agriculture (2011)	Excessive heat UV radiation Vector-borne diseases Agrochemicals Extreme weather events	This Code of Practice on Safety and Health in Agriculture provides further guidance on appropriate strategies to address the range of OSH risks encountered in agriculture in order to prevent – as far as is reasonably possible – accidents and diseases for all those engaged in this sector.	https://www.ilo.org/global/topics/safety-and-health-at-work/normative-instruments/code-of-practice/WCMS_161135/lang-en/index.htm
Safety and health in the iron and steel industry (2005)	Excessive heat UV radiation	This code, which reflects the many changes in the industry, its workforce, the roles of the competent authorities, employers, workers and their organizations, and the development of new ILO instruments on occupational safety and health, focuses on the production of iron and steel and basic iron and steel products, such as rolled and coated steel, including from recycled material.	https://www.ilo.org/global/topics/safety-and-health-at-work/normative-instruments/code-of-practice/WCMS_112443/lang-en/index.htm
Safety and health in shipbreaking: Guidelines for Asian countries and Turkey (2004)	Excessive heat UV radiation Air pollution Vector-borne diseases	These guidelines aim to ensure safe work in shipbreaking, providing advice on the transformation of a mainly informal economy activity into a more formal organized one.	https://www.ilo.org/global/topics/safety-and-health-at-work/normative-instruments/code-of-practice/WCMS_107689/lang-en/index.htm
Safety and health in ports (2003)	Excessive heat UV radiation Vector-borne diseases Extreme weather events	The practical recommendations in this code are intended to provide relevant guidance to ILO constituents and all those responsible for or involved in the management, operation, maintenance and development of ports. This code of practice replaces two former ILO publications: "Guide to safety and health in dock work" (1976) and "Safety and health in dock work , An ILO code of practice" (second edition, 1977).	https://www.ilo.org/global/topics/safety-and-health-at-work/normative-instruments/code-of-practice/WCMS_107615/lang-en/index.htm
Safety and health in the non-ferrous metals industries (2001)	Excessive heat UV radiation	This code, which deals with the production of metal in bulk, focuses on foundries and on the production of primary non-ferrous metals, including from recycled material.	https://www.ilo.org/global/topics/safety-and-health-at-work/normative-instruments/code-of-practice/WCMS_107713/lang-en/index.htm
Safety in the use of synthetic vitreous fibre insulation wools (glass wool, rock wool, slag wool) (2001)	Excessive heat	This code defines major principles and approaches concerning safety requirements and precautions in the use of insulation wools (glass wool, rock wool and slag wool).	https://www.ilo.org/global/topics/safety-and-health-at-work/normative-instruments/code-of-practice/WCMS_107790/lang-en/index.htm
Safety and health in forestry work (1998)	Excessive heat UV radiation Extreme weather events	The objective of this code is to protect workers from occupational safety and health hazards in forestry work and to prevent or reduce the incidence of illness or injury by providing practical guidelines.	https://www.ilo.org/global/topics/safety-and-health-at-work/normative-instruments/code-of-practice/WCMS_107793/lang-en/index.htm

Recording and notification of occupational accidents and diseases (1996)	Excessive heat UV radiation Vector-borne diseases Extreme weather events	The code gives more prominence to the effective use of collected, recorded and notified data for preventive action than to the elaboration of statistics.	https://www.ilo.org/global/topics/safety-and-health-at-work/normative-instruments/code-of-practice/WCMS_107800/lang-en/index.htm
Accident prevention on board ship at sea and in port (1996)	Excessive heat Extreme weather events	This code's practical recommendations are intended for use by all those who have responsibility for safety and health on board ship.	https://www.ilo.org/global/topics/safety-and-health-at-work/normative-instruments/code-of-practice/WCMS_107798/lang-en/index.htm
Safety in the use of chemicals at work (1993)	Agrochemicals	The practical recommendations of this code of practice are intended for the use of all those who have a responsibility for safety in the use of chemicals.	https://www.ilo.org/wcmsp5/groups/public/---ed_protect/---protrav/---safework/documents/normativeinstrument/wcms_107823.pdf
Prevention of major industrial accidents (1991)	Air pollution Extreme weather events	The practical recommendations of this code of practice are intended for the use of all those who have responsibility for the prevention of major industrial accidents.	https://www.ilo.org/global/topics/safety-and-health-at-work/normative-instruments/code-of-practice/WCMS_107829/lang-en/index.htm
Safety, health and working conditions in the transfer of technology to developing countries (1988)	Excessive heat Extreme weather events	The objectives of this code include: to ensure the appropriate design, proper installation and safe operation and use of new equipment, processes, projects and related products being transferred to developing countries; to provide the means of analysing, from the standpoint of safety and health and conditions of work, existing technologies imported by developing countries and of modifying them to remove the hazards discovered by the analyses; to provide guidance in the setting up of administrative, legal and educational frameworks within which preventive and remedial measures can be implemented.	https://www.ilo.org/wcmsp5/groups/public/---ed_protect/---protrav/---safework/documents/normativeinstrument/wcms_107831.pdf
Safety and health in the construction of fixed offshore installations in the petroleum industry (1981)	Extreme weather events	The code seeks to provide guidance on the standards of safety and health to be observed during the construction of fixed offshore installations. It provides practical advice for all persons who have responsibility for safety and health during the construction of fixed offshore installations in the petroleum industry and who may be framing provisions on the subject.	https://www.ilo.org/global/topics/safety-and-health-at-work/normative-instruments/code-of-practice/WCMS_107850/lang-en/index.htm
Occupational exposure to airborne substances harmful to health (1980)	Air pollution	These guidelines provides guidance for protection from occupational exposure to airborne substances.	https://www.ilo.org/wcmsp5/groups/public/---ed_protect/---protrav/---safework/documents/normativeinstrument/wcms_107851.pdf

Guidance materials and tools			
Occupational safety and health in a just transition (2023)	Excessive heat UV radiation Air pollution Vector-borne diseases Extreme weather events	This policy brief is part of the ILO Just Transition Policy Brief series and is intended to present the linkages between a just transition and occupational safety and health (OSH), providing stakeholders with information and recommendations for implementation.	https://www.ilo.org/global/topics/green-jobs/publications/just-transition-pb/WCMS_895605/lang-en/index.htm
Chemicals and climate change in the world of work: Impacts for occupational safety and health (2023)	Excessive heat UV radiation Air pollution Agrochemicals Vector-borne disease Extreme weather events	This report examines the interconnectedness of climate change, chemicals and the world of work, discussing common risks and hazards and exploring action to be taken at the national and workplace level toward mitigating these risks.	https://www.ilo.org/global/topics/safety-and-health-at-work/areasofwork/chemical-safety-and-the-environment/WCMS_887111/lang-en/index.htm
Technical guidelines on biological hazards in the working environment (2023)	Vector-borne diseases	The objective of the Technical Guidelines on Biological Hazards adopted by the 346th Session of ILO's Governing Body in November 2022 (GB.346/INS/17/3) is to provide governments, employers, workers, and their organizations with key principles for the effective management of biological hazards in the working environment, in line with ILO standards and principles.	https://www.ilo.org/global/topics/safety-and-health-at-work/resources-library/publications/WCMS_887758/lang-en/index.htm
Managing chemical risk in the agriculture sector. Application booklet (2022)	Agrochemicals	This booklet provides general guidelines for Globally Harmonized System of Classification and Labelling of Chemicals (GHS) implementation and practical guidance to the agriculture sector for effectively managing chemical risks.	https://www.ilo.org/americas/publicaciones/WCMS_861054/lang-en/index.htm
Diagnostic and exposure criteria for occupational diseases - Guidance notes for diagnosis and prevention of the diseases in the ILO List of Occupational Diseases (revised 2010) (2022)	Excessive heat UV radiation Agrochemicals Vector-borne diseases Extreme weather events	The List of Occupational Diseases Recommendation, 2002 (No. 194), adopted by the International Labour Conference in 2002, annexed a list of occupational diseases which was revised in 2010. The revised 2010 ILO List of Occupational Diseases represents the most recent ILO work in this regard. The guidance notes provide information and criteria to be considered in the diagnosis and prevention of the diseases included in the ILO List of Occupational Diseases (revised 2010).	https://www.ilo.org/global/topics/safety-and-health-at-work/resources-library/publications/WCMS_836359/lang-en/index.htm
WASH@Work: a Self-Training Handbook (revised) (2021)	Excessive heat Agrochemicals Vector-borne diseases Extreme weather events	This revised handbook includes four self-training modules which adapt existing ILO training tools on OSH to provide workers and employers with the necessary skills to implement the general principles contained in relevant ILO instruments.	https://www.ilo.org/global/docs/WCMS_828427/lang-en/index.htm
WISCON - Work Improvement for Small Construction Sites (2021)	Excessive heat UV radiation Extreme weather events	This action manual provides information for improving safety, health and working conditions on small construction sites by employers and workers.	https://www.ilo.org/global/topics/labour-administration-inspection/resources-library/publications/WCMS_815703/lang-en/index.htm

Work Improvements in Small Enterprises (WISE) (2018)	Excessive heat UV radiation	This manual includes practical recommendations for employers and workers, including full-colour illustrations, on how to improve key aspects of safety, health and productivity including materials handling, workstations and work tools, machine safety, working environment, the control of hazardous agents, provision of welfare facilities and improvements in work organization.	https://www.ilo.org/global/topics/safety-and-health-at-work/resources-library/training/WCMS_621054/lang--en/index.htm
Global manual for WIND: Practical approaches for improving safety, health and working conditions in agriculture (2014)	Excessive heat Air pollution Extreme weather events Agrochemicals	This global manual constitutes a practical and effective tool to support continuous efforts to materialize safety and health at work for families and communities.	https://www.ilo.org/global/topics/safety-and-health-at-work/resources-library/training/WCMS_241020/lang--en/index.htm
HealthWISE - Work Improvement in Health Services - Action Manual (2014)	Excessive heat Extreme weather events	HealthWISE is a practical, participatory quality improvement tool for health facilities. It encourages workers and managers to work together to improve workplaces and practices with low-cost solutions. Topics include occupational safety and health, personnel management and environmental health.	https://www.ilo.org/global/docs/WCMS_237276/lang--en/index.htm
WARM: Work Adjustment for Recycling and Managing Waste (2010)	Excessive heat UV radiation	This is an action manual for waste collectors and communities to promote their joint actions in improving safety, health and efficiency in waste collection and management.	https://www.ilo.org/asia/publications/WCMS_126981/lang--en/index.htm
Work Improvement for Safe Home (WISH): Action manual for improving safety, health and working conditions of home workers (2006)	Excessive heat	The WISH (Work Improvement for Safe Home) action manual responds to the immediate need of home workers and provides them with practical, easy-to-implement ideas to improve their safety, health and working conditions.	https://www.ilo.org/asia/publications/WCMS_099070/lang--en/index.htm

2. Non-ILO selected tools and resources

2.1. Excessive heat

Entity	Title	Link
Resources developed by governments, OSH and health authorities and other relevant institutions		
Canadian Centre for Occupational Safety and Health (CCOHS)	Climate Change: Workplace Impacts	https://www.ccohs.ca/products/publications/climate-change
	Hot Environments	https://www.ccohs.ca/oshanswers/phys_agents/heat/heat_control.html
Department of Occupational Safety and Health, Ministry of Human Resources, Malaysia	A Brief Guidance for the Protection of Employees against the Effects of Heat Stress for Outdoor Works	https://www.dosh.gov.my/index.php/list-of-documents/osh-info/occupational-health-3/2081-a-brief-guidance-for-the-protection-of-employees-against-the-effects-of-heat-stress-for-outdoor-works/file
	Guidelines on Heat Stress Management at Workplace	https://www.dosh.gov.my/index.php/legislation/guidelines/industrial-hygiene-1/2017-guidelines-heat-stress-management-at-workplace/file
European Agency for Safety and Health at Work (EU-OSHA)	Heat at work - guidance for workplaces	https://osha.europa.eu/en/publications/heat-work-guidance-workplaces
Health and Safety Executive (HSE), UK	Heat stress in the workplace: A brief guide	https://www.hse.gov.uk/pubns/indg451.pdf
	Temperature in the workplace	https://www.hse.gov.uk/temperature/employer/heat-stress.htm
Institut National de Recherche et de Sécurité (INRS), France	Travail par forte chaleur en été. Des ressources pour sensibiliser et agir en prévention [French only]	https://www.inrs.fr/publications/essentiels/travail-forte-chaleur.html
Institution of Occupational Health and Safety (IOSH), UK	Climate change: IOSH policy position	https://iosh.com/about/what-we-do/policy-positions/climate-change
Instituto de Salud Pública de Chile (ISPCH)	Protocolo para la medición de estrés térmico [Spanish only]	https://www.ispch.cl/wp-content/uploads/2021/04/Protocolo-Medic%C3%B3n-Estr%C3%A9s-Termico.pdf
Instituto Nacional de Seguridad y Salud en el Trabajo (INSST), Spain	Cartel: Ante el calor: pequeños gestos, grandes resultados - Año 2022 [Spanish only]	https://www.insst.es/documentacion/material-divulgativo-y-audiovisual/cartel/ante-el-calor-peque%C3%B1os-gestos-grandes-resultados-ano-2022
	Folleto: Con sol es tiempo de prevención - Año 2023 [Spanish only]	https://www.insst.es/documentacion/material-divulgativo-y-audiovisual/folleto/folleto-con-sol-es-tiempo-de-prevencion-2023
National Disaster Management Authority, Ministry of Home Affairs, India	National Guidelines for Preparation of Action Plan – Prevention and Management of Heat Wave	https://ghhin.org/wp-content/uploads/heatwaveguidelines.pdf
Natural Resources Defence Council (NRDC), India	Rising Temperatures, Deadly Threat: Recommendations for Health Professionals in Ahmedabad	https://www.nrdc.org/sites/default/files/india-heat-health-professionals-IB.pdf
National Institute for Occupational Safety and Health (NIOSH), USA	Heat Stress – Recommendations	https://www.cdc.gov/niosh/topics/heatstress/recommendations.html
Occupational Safety and Health Administration (OSHA), USA	Heat Stress Guide	https://www.osha.gov/emergency-preparedness/guides/heat-stress

Safe Work Australia	Managing the risks of working in heat: Guidance material	https://www.safeworkaustralia.gov.au/sites/default/files/2021-10/Guide%20for%20managing%20the%20risks%20of%20working%20in%20heat.pdf
Workplace Safety and Health Council in Singapore (WSHC)	Heat Stress Management	https://www.tal.sg/wshc/topics/heat-stress/heat-stress-management#
Worksafe, New Zealand	Working safely in extreme temperatures	https://www.worksafe.govt.nz/topic-and-industry/temperature-at-work/working-safely-in-extreme-temperatures-gpg/
Resources developed by social partners		
Canadian Union of Public Employees (CUPE)	What is heat stress?	https://cupe.ca/heat-stress
Comisiones Obreras (CCOO), Spain	¿Cómo evaluar el riesgo de exposición al calor? [Spanish only]	https://fsc.ccoo.es/noticia:633660--_Como_evaluar_el_riesgo_de_exposicion_al_calore&opc_id=3dda05725800706e58006e74300151b1
European Trade Union Confederation (ETUC)	Adaptation to Climate Change and the world of work: A Guide for Trade Unions	https://www.etuc.org/en/publication/adaptation-climate-change-and-world-work-guide-trade-unions
European Trade Union Institute (ETUI)	Heatwaves as an occupational hazard	https://www.etui.org/publications/heatwaves-occupational-hazard
Farmworker Justice, USA	Heat-Related Illness Clinician's Guide	https://www.farmworkerjustice.org/wp-content/uploads/2021/06/2021_Heat-Stress_Clinicians-Guide_Aug-2021.pdf
	Environmental Justice Symposium materials (Report: Farmworkers and the Climate Crisis; Issue Brief: The Climate Crisis and Its Impacts on Farmworkers)	https://www.farmworkerjustice.org/climate-change/
Instituto Sindical de Trabajo, Ambiente y Salud (ISTAS), Spain	Calor en el trabajo	http://tusaludnoestaennomina.com/wp-content/uploads/2016/02/El-calor-en-el-trabajo-al-aire-libre.pdf
International Trade Union Confederation (ITUC)	Coping with climate change in the care sector	https://www.ituc-csi.org/coping-with-climate-change-in-the
Mouvement des Entreprises de France (MEDEF)	Chaleur et canicule au travail – Des outils d'information et de communication mis en ligne par le ministère du Travail [French only]	https://www.medef-meurthe-moselle.fr/fr/actualite/chaleur-et-canicule-au-travail-des-outils-dinformation-et-de-communication-mis-en-ligne-par-le-ministere-du-travail-1
	Employeurs : vos obligations pendant les vagues de chaleur [French only]	https://www.medef31.fr/fr/actualite/employeurs-vos-obligations-pendant-les-vagues-de-chaleur
OSH Reps (Victorian Trades Hall Council), Australia	Heat	https://www.ohsrep.org.au/heat
Société Suisse des Entrepreneurs (SSE), Switzerland	Protection contre la chaleur et les rayons UV [French, German and Italian]	https://baumeister.swiss/fr/securite-au-travail-sur-les-chantiers/bst/bst-protection-contre-les-rayons-uv/
Trade Union Congress (TUC), UK	Cool it! Reps guide on dealing with high temperatures in the workplace	https://www.tuc.org.uk/resource/cool-it-reps-guide-dealing-high-temperatures-workplace
UNIFOR, Canada	Heat Stress Fact Sheet	https://www.unifor.org/resources/our-resources/heat-stress-fact-sheet
Unión Sindical Obrera (USO), Spain	¿Qué es el estrés térmico y cómo nos afecta en el trabajo? [Spanish only]	https://www.uso.es/que-es-el-estres-termico-y-como-nos-afecta-en-el-trabajo/
Unite the union, UK	Health & Safety Guidance: Temperature at Work	https://resources.unitetheunion.org/media/1178/1178.pdf

2.2. Ultraviolet (UV) radiation

Entity	Title	Link
Resources developed by governments, OSH and health authorities and other relevant institutions		
Canadian Centre for Occupational Safety and Health (CCOHS)	Physical agents : Ultraviolet Radiation	https://www.ccohs.ca/oshanswers/phys_agents/ultravioletradiation.html
	Personal Protective Equipment : Eye and Face Protectors	https://www.ccohs.ca/oshanswers/prevention/ppe/glasses.html
Cancer Council, Australia	Skin cancer and outdoor work: A work health and safety guide	https://www.cancer.org.au/assets/pdf/skin-cancer-and-outdoor-work-a-work-health-and-safety-guide
Health and Safety Executive (HSE), UK	Outdoor workers and sun exposure	https://www.hse.gov.uk/skin/employ/sunprotect.htm
Institut National du Cancer, France	Professionnels travaillant en extérieur : prévenir votre risque solaire [French only]	https://www.e-cancer.fr/Comprendre-prevenir-depister/Reduire-les-risques-de-cancer/Exposition-aux-rayonnements-UV/Travail-en-plein-air
Institut National de Recherche et de Sécurité (INRS), France	Rayonnement solaire [French only]	https://www.inrs.fr/risques/rayonnements-optiques/rayonnement-solaire.html
Institution of Occupational Safety and Health (IOSH), UK	#SUNAWARENESSWEEK with top tips to protect workers	https://www.ioshmagazine.com/2020/05/05/iosh-marks-sunawarenessweek-top-tips-protect-workers
Irish Cancer Society	SunSmart advice for farmers and outdoor workers	https://www.cancer.ie/cancer-information-and-support/cancer-types/skin-cancer/sunsmart-advice-for-farmers
Ministerio de Trabajo, Empleo y Seguridad, Argentina	Exposición a radiaciones ultravioletas [Spanish only]	https://www.argentina.gob.ar/sites/default/files/2_guia_de_actuacion_y_diagnostico_-_exposicion_a_radiaciones_ultravioletas_0.pdf
The National Institute for Occupational Safety and Health (NIOSH), USA	Protecting Yourself from Sun Exposure	https://www.cdc.gov/niosh/docs/2010-116/pdfs/2010-116.pdf
Soludable, Spain	Guía de trabajo soludable [Spanish only]	https://soludable.hcs.es/wp-content/uploads/2023/09/Guia-de-trabajo-soludable.pdf
SunSmart, Australia	Free SunSmart Global UV app	https://www.sunsmart.com.au/resources/sunsmart-app
Suva, Switzerland	Liste de contrôle: Travailler à l'extérieur au soleil et sous la chaleur [French, German and Italian]	https://www.suva.ch/fr-ch/download/listes-de-contrôle/travailler-a-l-exterieur-en-plein-soleil-et-par-fortes-chaleurs/travailler-a-l-exterieur-en-plein-soleil-et-par-fortes-chaleurs--67135.F
Worksafe, New Zealand	Protecting workers from solar UV radiation	https://www.worksafe.govt.nz/topic-and-industry/work-related-health/carcinogens-and-airborne-risks/protecting-workers-from-solar-uv-radiation/
WorkSafe Victoria, Australia	Skin cancer and outdoor work: A guide for employers	https://www.worksafe.vic.gov.au/resources/skin-cancer-and-outdoor-work-guide-employers

Resources developed by social partners		
Société Suisse des Entrepreneurs (SSE), Switzerland	Protection contre la chaleur et les rayons UV [French, German and Italian]	https://baumeister.swiss/fr/securite-au-travail-sur-les-chantiers/bst/bst-protection-contre-les-rayons-uv/
Trade Union Congress (TUC), UK	Skin Cancer and Outdoor Workers. Guidance for safety representatives	https://www.tuc.org.uk/sites/default/files/extras/skincancer.pdf
	SPF is PPE	https://www.tuc.org.uk/resource/spf-ppe
Unión Sindical Obrera (USO), Spain	Las gafas de sol en el trabajo: su uso como EPI [Spanish only]	https://www.uso.es/las-gafas-de-sol-en-el-trabajo-su-uso-como-eqi/

2.3. Extreme Weather Events

Entity	Title	Link
Resources developed by governments, OSH and health authorities and other relevant institutions		
Abu Dhabi Occupational Safety and Health System Framework	OSHAD-SF technical guidelines: Dealing with adverse weather conditions	https://www.adphc.gov.ae/-/media/Project/ADPHC/ADPHC/PDF/OSHAD-SF/Technical-Guidelines/updated-TG/TG---Dealing-with-Adverse-Weather-Conditions-V30-English.pdf
Canadian Centre for Occupational Safety and Health (CCOHS)	Climate Change: Extreme Weather - Cold	https://www.ccohs.ca/oshanswers/safety_haz/climate/climate-change-extreme-weather-cold.html
	Climate Change: Workplace Impacts	https://www.ccohs.ca/products/publications/climate-change
	Safety Hazards- Forest Fires and wildfire smoke	https://www.ccohs.ca/oshanswers/safety_haz/forest_fires.pdf
Department of Defence, Government of Ireland	Preparing Businesses and Farms For Severe Weather – Be Winter Ready	https://www.gov.ie/en/publication/9e1358-preparing-your-business-for-severe-weather-stay-winter-ready/
Department of Disaster Management and Emergencies, the Turks and Caicos Island Government	Hurricane Preparedness Tips for Businesses	https://gov.tc/ddme/hurricane-tips-businesses
Labour Department, Government of the Hong Kong Special Administrative Region of the People's Republic of China	Guide on Safety at Work in times of inclement weather	https://www.labour.gov.hk/eng/public/os/D/InclementWeather.pdf
National Institute of environmental health sciences (NIEHS), USA	NIEHS wildfire response training tool	https://tools.niehs.nih.gov/wetp/public/hasl_get_blob.cfm?ID=5970
National Institute for Occupational Safety and Health (NIOSH), USA	Disaster Site Management guidance	https://www.cdc.gov/niosh/topics/emres/sitemgt.html
	Hazard Based Guidelines: Personal Protective Equipment for Workers in Hurricane Flood Response	https://www.cdc.gov/niosh/topics/emres/pre-workers.html
Occupational Safety and Health Administration (OSHA), USA	Emergency Preparedness and Response: Getting Started	https://www.osha.gov/emergency-preparedness/getting-started
Safe Work Australia	Working in hazardous weather	https://www.safeworkaustralia.gov.au/safety-topic/hazards/working-outside/working-hazardous-weather
	Bushfire smoke in the workplace	https://www.safeworkaustralia.gov.au/safety-topic/hazards/bushfire-smoke-workplace
SUVA, Switzerland	Alerte de tempête: que faire? [in French, German and Italian]	https://www.suva.ch/fr-ch/autoportrait/news-et-medias/actualites/securite-au-travail/que-faire-en-cas-de-tempete

University of California, Los Angeles Labor Occupational Safety and Health Program	Worker protection from wildfire smoke	English: https://losh.ucla.edu/wp-content/uploads/sites/37/2019/10/new-english-standard-RGB.pdf
U.S. Department of Labor (DOL), USA	Prepare Now to Keep Workers Safe During Hurricane Season	https://blog.dol.gov/2021/06/01/prepare-now-to-keep-workers-safe-during-hurricane-season
U.S. Department of Homeland Security (DHS), USA	Ready Business-Hurricane Toolkit	https://www.ready.gov/sites/default/files/2020-04/ready_business_hurricane-toolkit.pdf

Resources developed by social partners

OSH Reps (Victorian Trades Hall Council), Australia	Cold	https://www.ohsrep.org.au/cold
Trade Union Congress (TUC), UK	Cold at work? Staying safe this winter	https://www.tuc.org.uk/blogs/cold-work-staying-safe-winter
Union Sindical Obrera (USO), Spain	Medidas de prevención y consejos para trabajo con lluvia y viento en exteriores [Spanish only]	https://www.uso.es/prevencion-en-trabajo-con-lluvia-y-viento-en-exteriores/

2.4. Air pollution

Entity	Title	Link
Resources developed by governments, OSH and health authorities and other relevant institutions		
British Safety Council	Air Pollution: we must protect outdoor workers	https://www.britsafe.org/safety-management/2021/air-pollution-we-must-protect-outdoor-workers
Canadian Centre for Occupational Safety and Health (CCOHS)	Climate Change: Workplace Impacts	https://www.ccohs.ca/products/publications/climate-change
Global Action Plan, UK	Air pollution in the workplace - the manufacturing sector	https://www.actionforcleanair.org.uk/business/clean-air-workplaces
Health Service Executive (HSE), Ireland	Air Quality	https://www.hse.ie/eng/services/list/5/publichealth/publichealthdepts/env/air-quality.html
Labour Department, Government of the Hong Kong Special Administrative Region of the People's Republic of China	Checklist for risk assessment of outdoor work under high air pollution levels	https://www.labour.gov.hk/eng/public/oh/ChecklistHighAirPollution.pdf
Ministry of Manpower, Government of Singapore.	Haze guidelines and advisory for work	https://www.mom.gov.sg/haze#:~:text=MOM%27s%20guidelines%20advise%20employers%20to,not%20meant%20to%20be%20prescriptive
	Guidelines for employers on protecting employees from the effects of haze	https://www.mom.gov.sg/haze/guidelines-on-protecting-employees-from-haze
The National Institute for Occupational Safety and Health (NIOSH), USA	Air Pollution Control checklist	https://www.cdc.gov/niosh/docs/2004-101/chklists/n26air-1.htm
Safe Work Australia	Workplace exposure standards for airborne contaminants	https://www.safeworkaustralia.gov.au/doc/workplace-exposure-standards-airborne-contaminants-2024
Worksafe, New Zealand	Airborne contaminants	https://www.worksafe.govt.nz/topic-and-industry/road-and-roadside/keeping-healthy-safe-working-road-or-roadside/part-b/9-0-airborne-contaminants/

Resources developed by social partners		
Confederation of British Industry (CBI), UK	Air quality in the workplace – the most important environmental issue you probably weren't aware of	https://www.cbi.org.uk/articles/air-quality-in-the-workplace/
International Transport Workers' Federation (ITF)	Air quality	https://www.itfglobal.org/en/sector/civil-aviation/air-quality
OSH Reps (Victorian Trades Hall Council), Australia	Air Quality	https://www.ohsrep.org.au/air_quality
Trade Union Clean Air Network (TUCAN), UK	Guidance on Air Pollution for Union Reps	https://www.greenerjobsalliance.co.uk/wp-content/uploads/2019/06/TUCAN-Guidance-for-TU-Reps.pdf
Wales Trades Union Congress (TUC) Cymru, UK	Air pollution - a workplace issue	https://www.tuc.org.uk/blogs/air-pollution-workplace-issue

2.5. Vector-borne diseases

Entity	Title	Link
Resources developed by governments, OSH and health authorities and other relevant institutions		
Canadian Centre for Occupational Health and Safety (CCOHS)	Biological Hazards	https://www.ccohs.ca/oshanswers/biol_hazards
Comisión Mixta de Salud y Seguridad en el Empleo Público (CoMiSaSEP), Argentina	Dengue: Recomendaciones para Trabajadores y Organismos del Poder Ejecutivo de la Provincia de Buenos Aires [Spanish only]	https://www.plb.gba.gov.ar/archivos/comi-sasep/DENGUERECOMENDACIONESPARATRAJADORESYORGANISMOSDELODER EJECUTIVO DE LA PROVINCIA DE BUENOS AIRES_0.pdf
Department of Public Health of California (CDPH), USA	Tick-Borne Diseases: Occupational Health Toolkit	https://www.cdph.ca.gov/Programs/CID/DCDC/Pages/TickBorneDiseaseToolkit.aspx
European Agency for Safety and Health at Work (EU-OSHA)	Exposure to biological agents and related health problems in animal-related occupations	https://osha.europa.eu/sites/default/files/Biological_agents_in_animal_related_occupations.pdf
Georgia Department of Public Health, USA	HAI Resources for Healthcare Workers	https://dph.georgia.gov/epidemiology/healthcare-associated-infections/hai-resources-healthcare-workers
Health and Safety Executive (HSE), UK	Control of substances hazardous to health	https://www.hse.gov.uk/pubns/priced/L5.pdf
	Lyme Disease	https://www.hse.gov.uk/agriculture/assets/docs/lyme-disease.pdf
	West Nile Virus	https://www.hse.gov.uk/agriculture/assets/docs/west-nile-virus.pdf
Instituto Nacional de Seguridad y Salud en el Trabajo (INSST), Spain	Virus del dengue [Spanish only]	https://www.insst.es/agentes-biologicos-basebio/virus/virus-del-dengue
	Plasmodium spp. (humano y de los simios) [Spanish only]	https://www.insst.es/agentes-biologicos-basebio/parasitos/plasmodium-spp-humano-y-simios
Maryland Department of Health, USA	Tickborne disease occupational toolkit	https://health.maryland.gov/phpa/OIDEOR/CZVBD/Shared%20Documents/Tickborne%20Disease%20Occupational%20Toolkit.pdf
National Institute for Occupational Safety and Health (NIOSH), USA.	Tick-Borne Diseases: Recommendations	https://www.cdc.gov/niosh/topics/tick-borne/recommendation.html
WorkSafe BC, Canada	Tick- and other insect-borne infectious disease exposure	https://www.worksafebc.com/en/resources/health-safety/risk-advisory/tick-borne-infectious-disease-exposure?lang=en

Resources developed by social partners		
Australian Unions	Mosquito-borne diseases Fact Sheet	https://www.australianunions.org.au/factsheet/mosquito-borne-diseases/
Sindicato dos Metalúrgicos do ABC (SMABC), Brazil	Sindicato alerta categoria para o combate ao mosquito da dengue [Portuguese only]	https://smabc.org.br/sindicato-alerta-categoria-para-o-combate-ao-mosquito-da-dengue/
Sindicato dos Trabalhadores Técnico-Administrativos em Educação das Instituições Federais de Ensino Superior do Estado de Goiás (Sint IFESGO), Brazil	Todos contra a dengue [Portuguese only]	https://sint-ifesgo.org.br/noticia/todos-contra-a-dengue/

2.6. Agrochemicals

Entity	Title	Link
Resources developed by governments, OSH and health authorities and other relevant institutions		
Canadian Centre for Occupational Health and Safety (CCOHS)	Pesticides	https://www.ccohs.ca/oshanswers/chemicals/pesticides/working_safely.html
Department of Health, Victoria, Australia	Pesticides - managing spills and disposals	https://www.health.vic.gov.au/environmental-health/pesticides-managing-spills-and-disposals
European Agency for Safety and Health at Work (EU-OSHA)	Protecting health and safety of workers in agriculture, livestock farming, horticulture and forestry	https://osha.europa.eu/en/publications/protecting-health-and-safety-workers-agriculture-livestock-farming-horticulture-and
Health and Safety Executive (HSE), UK	Pesticides	https://www.hse.gov.uk/agriculture/topics/pesticides.htm
Institut de recherche Robert-Sauvé en santé et en sécurité du travail (IRSST), Canada	Connaissez-vous les effets potentiels des pesticides agricoles sur la santé? [French only]	https://www.irsst.qc.ca/media/documents/PubIRSST/DT-1153-fr.pdf?v=2024-02-27
	Pesticides - Pratiques sécuritaires et équipements de protection individuelle [French only]	https://www.irsst.qc.ca/publications-et-outils/publication/i/100965/n/pesticides-pratiques-securitaires-equipements-protection-individuelle
National Institute for Occupational Safety and Health (NIOSH), USA	Case Definition for Acute Pesticide-Related Illness and Injury Cases Reportable to the National Public Health Surveillance System	https://www.cdc.gov/niosh/topics/pesticides/pdfs/casedef.pdf
United States Environmental Protection Agency (EPA)	Pesticides	https://www.epa.gov/pesticides
Worksafe, New Zealand	Pesticides on farms	https://www.worksafe.govt.nz/topic-and-industry/agriculture/chemicals-and-fuels-on-farms/pesticides-on-farms/
Resources developed by social partners		
Central Nacional de Cooperativas (UNICOOP), Paraguay	Manual para el buen uso y manejo de plaguicidas [Spanish only]	https://www.unicoop.com.py/admin/archivos/manual-para-el-buen-uso-de-plaguicidas.pdf
Farmworker Justice, USA	Clinician's Guide to EPA's Worker Protection Standard	https://www.farmworkerjustice.org/wp-content/uploads/2020/07/FJMCN-WPS-Clinician-Guide_June-2020.pdf
	Clinician's Guide to Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA)	https://www.farmworkerjustice.org/wp-content/uploads/2012/08/2016-FIFRA-FQPA-Clinicians-Guide-Online.pdf
National Farmers Union (NFU), USA	NFU Safety on the Farm	https://nfu.org/farmsafety/

ilo.org

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