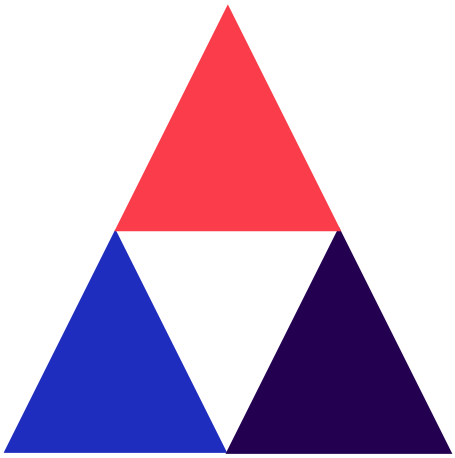
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Occupational safety and health in extreme weather events and changing weather patterns

Report for discussion at the Meeting of Experts on Occupational Safety and Health in Extreme Weather Events and Changing Weather Patterns
(Geneva, 20–24 April 2026)



Occupational Safety and Health and Working Environment Branch (OSHE)
Geneva, 2026

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▶ Abbreviations

ACGIH	American Conference of Governmental Industrial Hygienists
FAO	Food and Agriculture Organization of the United Nations
ILO	International Labour Organization
IPCC	Intergovernmental Panel on Climate Change
MIA	major industrial accident
NASA	National Aeronautics and Space Administration
NIOSH	National Institute for Occupational Safety and Health
OEL	occupational exposure limit
OSH	occupational safety and health
OSHA	Occupational Safety and Health Administration
PPE	personal protective equipment
PTSD	post-traumatic stress disorder
SDS	sand and dust storm
SEWA	Self-Employed Women's Association
UNDRR	United Nations Office for Disaster Risk Reduction-
UTCI	Universal Thermal Climate Index
UN	United Nations
UNCCD	United Nations Convention to Combat Desertification
UV	ultraviolet
WBGT	wet bulb globe temperature
WHO	World Health Organization
WMO	World Meteorological Organization

▶ Introduction

1. Extreme weather events and changing weather patterns are increasingly affecting the safety and health of workers worldwide. At least 2.41 billion workers – 71 per cent of the working population – are estimated to be exposed to excessive heat alone, resulting in 22.85 million injuries globally each year. [1] Beyond heat, workers face risks from a variety of weather-related hazards, including extreme cold, heavy precipitation and tropical cyclones. As weather events become more frequent and severe, and as weather patterns shift, these impacts are expected to intensify, creating an increased risk to workers' safety and health.

2. While many countries already have laws and policies addressing long-standing workplace hazards like extreme temperatures, the intensification of weather events and their associated risks expose gaps in policy frameworks. To keep pace with a changing climate, occupational safety and health (OSH) frameworks may need to be reviewed and strengthened to ensure workers are adequately protected from increasingly unpredictable conditions. The ILO has already developed research materials on the topic, including *Ensuring safety and health at work in a changing climate* and *Heat at work: Implications for safety and health*. [2]

3. During its 111th Session in June 2023, the International Labour Conference adopted the resolution concerning a just transition towards environmentally sustainable economies and societies for all. It states that governments, in consultation with employers' and workers' organizations, should 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.

4. As a follow-up, the Governing Body adopted an action plan at its 349th Session (October–November 2023), which included the organization of a tripartite meeting on OSH in extreme weather events and changing weather patterns. The *Global Strategy on Occupational Safety and Health 2024–30 and plan of action for its implementation*, [3] adopted at the same session, proposed that this meeting take the form of a meeting of experts.

5. The meeting of experts intends to provide concise guidance in the form of conclusions to ILO constituents on how to include considerations on OSH in extreme weather events and changing weather patterns within national policy frameworks. The conclusions will build upon and complement the ILO *Guidelines for a just transition towards environmentally sustainable economies and societies for all*. They could also address: the need for resilient, robust and responsive OSH policies in the context of extreme weather events and changing weather patterns; the strengthening of coordinated inter-institutional responses for prevention and emergency preparedness and response; and preventive workplace-level measures with a high potential for replicability, while remaining adaptable to circumstances and contexts.

[1] ILO, *Heat at Work: Implications for Safety and Health – A Global Review of the Science, Policy and Practice*, 2024.

[2] Due to length limitations of this Meeting of Experts report, research and policy efforts are presented in a summarized manner. Additional information and examples can be found in these two previous ILO reports.

[3] The ILO *Global Strategy on Occupational Safety and Health 2024–30* highlights that OSH concerns related to extreme weather events and changing weather patterns should be positioned high on global and national policy agendas, with key partnerships secured at national and international levels. It furthermore states that research should be conducted, and policy and technical tools developed, on current and emerging OSH issues, including the impact of climate change and extreme weather events on OSH, as on OSH in crisis preparedness and response.

6. **Chapter 1** provides a general overview of OSH in extreme weather events and changing weather patterns. A summarized overview of international and national policy responses *in a broad sense* is presented.

7. **Chapter 2** provides a more detailed and in-depth summary of OSH policy responses *per identified hazard*, starting with excessive heat. It then addresses sand and dust storms (SDSs), droughts and wildfires, high precipitation and floods, extreme cold and tropical cyclones. Finally, it explores associated hazards and exposures: changes in vector distribution; increases in agrochemical use; changes in air quality and increased exposure to air pollution; increased exposure to ultraviolet (UV) radiation; and increased risk for major industrial accidents (MIAs).

8. **Chapter 3** provides an analysis of the law and practice, and conclusions for consideration for the way forward.

▶ 1. Overview of OSH in extreme weather events and changing weather patterns

9. The Earth is warming at an unprecedented rate. [4] While natural climate variability can contribute to extreme weather events, human-induced changes to atmospheric conditions are amplifying their occurrence. This has resulted in more frequent, intense, widespread and prolonged events, claiming lives and threatening livelihoods across the globe. [5]

10. According to the World Meteorological Organization (WMO), an **extreme weather event** is rare at a particular place and time of year, with unusual characteristics in terms of magnitude, location, timing or extent. [6] They are short-term, intense weather occurrences that can lead to immediate risks and often result in injury, death and damage to infrastructure. Examples of these events include, but are not limited to, heatwaves, cold waves, heavy precipitation, drought, tornadoes and tropical cyclones. [7]

11. Disasters associated with weather-related hazards have almost doubled compared to the previous 20 years. [8] Between 1970 and 2021, there were 11,778 reported disasters attributed to weather extremes, resulting in 2,087,229 deaths and US$4.3 trillion in economic losses. Asia accounted for 31 per cent of these disasters, while over 90 per cent of reported fatalities occurred in developing economies. [9] Data focusing on occupational impacts specifically is limited or not available.

12. **Compound events** involve two or more extreme events occurring simultaneously or successively, or combinations of events that lead to an extreme impact when combined. [10] These include, for example, compound hot, dry and windy events which can increase the risk of wildfires or SDSs.

[4] National Aeronautics and Space Administration (NASA) Goddard Institute for Space Studies, "GISS Surface Temperature Analysis (GISTEMP v4)"; Climatic Research Unit (University of East Anglia) and Met Office, "Temperature"; National Centers for Environmental Information (NCEI), "Climate Monitoring".
[5] Marina Romanello et al., "The 2024 Report of the Lancet Countdown on Health and Climate Change: Facing Record-Breaking Threats from Delayed Action", *The Lancet* 404, No. 10465 (2024), 1847–1896.
[6] WMO, "Extreme Weather".
[7] WMO, "Extreme Weather".
[8] United Nations Office for Disaster Risk Reduction (UNDRR), "Climate Action and Disaster Risk Reduction".
[9] WMO, "Atlas of Mortality and Economic Losses from Weather, Climate and Water-Related Hazards (1970-2021)", 2023.
[10] Sonia I. Seneviratne et al., "Weather and Climate Extreme Events in a Changing Climate" in Valérie Masson-Delmotte et al., eds, *Climate Change 2021 – The Physical Science Basis, contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC)* (Cambridge: Cambridge University Press, 2023), 1513–1766.

Compound events can cause much more damage than individual events. The probability of these events has likely increased due to weather-related changes and is expected to continue to grow with a further changing climate. [11]

13. In contrast to extreme weather events which are sudden and brief, **changing weather patterns** refer to gradual and persistent changes in climate behaviour, with the potential to disrupt ecosystems and pose long-term risks to OSH. Examples include the steady increase in temperatures, shifts in seasonal cycles and variations in precipitation.

▶ Box 1. Example of an extreme weather event versus a changing weather pattern

A heatwave is an example of an extreme weather event. It is a brief episode of extreme temperatures (defined by local meteorological criteria) that poses immediate, severe risks to workers. Heatwaves can lead to spikes in heat-related injuries, illnesses and fatalities (for example, from heatstroke). In contrast, the steady year-by-year increase in average temperatures, evidenced by progressively hotter and longer summers, more frequent hot days, as well as warmer nights, indicates a changing weather pattern. Correspondingly, many workdays are now hotter than in the past, even if not "extreme" by meteorological definition. As a result of these temperature increases, workers may face chronic heat stress that accumulates over time, leading to health risks such as cardiovascular strain and kidney injuries. Importantly, 90 per cent of workers' excessive heat exposures and 80 per cent of related occupational injuries occur outside of official heatwaves. *

* ILO, *Heat at Work*.

14. While the present report addresses extreme weather events and changing weather patterns, it also highlights associated hazards and exposures, including changes in vector distribution, increases in agrochemical use, increased exposure to air pollution and UV radiation, as well as increased risk for MIAs. A heatwave combined with intense sun exposure increases UV radiation risks for outdoor workers; wildfires produce air pollution, leading to acute and chronic respiratory conditions; and prolonged drought or shifts in seasonal patterns can drive greater reliance on agrochemicals. Changes in warm weather patterns can expand the territory of vectors into new areas. Similarly, flooding or storms can trigger MIAs, with severe consequences for workers, surrounding communities and infrastructure.

1.1. Occupational safety and health impacts

15. Extreme weather events and changing weather patterns can contribute to occupational injury and illness, but in different ways. Extreme events often cause immediate impacts, like a flood causing drowning or physical trauma, or a heatwave leading to heatstroke. Changing weather patterns can affect OSH through gradual but persistent exposure, causing cumulative and often subtler health impacts. For instance, hazards such as rising temperatures, altered precipitation levels and prolonged droughts can exacerbate occupational risks by reducing air quality, prolonging allergy seasons, expanding vector range and increasing reliance on agrochemicals to maintain yields.

16. Workers face a number of health outcomes linked to weather-related hazards which may take the form of both immediate, acute impacts (such as fatal and non-fatal injuries or drownings), as well as longer-term and chronic conditions and illnesses (such as cancers, cardiovascular and renal diseases, respiratory conditions and macular degeneration, among others). [12] Acute and chronic mental health impacts must also be considered given the risk of stress-related conditions that

[11] Seneviratne et al., "Weather and Climate Extreme Events in a Changing Climate".
[12] ILO, *Ensuring Safety and Health at Work in a Changing Climate: Global Report*, 2024.

may arise from direct exposure to extreme weather events and uncertainties associated with income or livelihood disruptions. [13] There is evidence that repeated exposure to these events results in cumulative psychological effects, leading to more severe mental health impacts. [14]

17. Taken together, extreme weather events, changes in weather patterns and their associated exposures can cumulatively or synergistically pose risks to OSH. [15] Workers are rarely exposed to a single hazard in isolation; rather, they may face overlapping exposures such as high temperatures combined with air pollution, wildfire smoke and strenuous physical activity, or floods that both cause injury and exposure to hazards in damaged infrastructure. Some groups of workers may be particularly vulnerable to the risks, such as pregnant women, elderly and young workers, migrant workers and those with existing chronic health conditions, among others.

1.2. International standards and other ILO instruments relevant to OSH in extreme weather events and changing weather patterns

18. There are no international treaties specifically related to OSH in extreme weather events and changing weather patterns. Those that do exist are concerned with disaster preparedness and response and are broad in focus, for example, the Sendai Framework for Disaster Risk Reduction 2015–2030, which aims to promote disaster risk resilience, including for workplaces. [16]

19. Several international labour standards related to OSH, although not specifically concerned with weather, offer a framework for addressing impacts on workers, enterprises and communities (see the Appendix). In the context of a safe and healthy working environment being recognized as a fundamental principle and right at work, and consequently obliging Member States to respect, promote and realize its principles, the Occupational Safety and Health Convention, 1981 (No. 155), and the Promotional Framework for Occupational Safety and Health Convention, 2006 (No. 187), both designated as fundamental Conventions, are of particular importance. Conventions Nos 155 and 187, and their accompanying Recommendations, [17] require Member States to formulate, implement and periodically review a coherent national policy on OSH. Convention No. 155 also sets out employer duties to ensure workplaces are without risk to health. [18] The right to remove oneself is particularly relevant in the context of extreme weather events, such as floods, tropical cyclones and wildfires, which can develop rapidly and pose immediate threats to worker safety. Under Convention No. 155, [19] this right grants workers the legal authority to stop working or evacuate the workplace when faced with imminent and serious danger. Workers are obliged to notify their supervisor upon withdrawing, allowing employers to safeguard others potentially exposed to the same risk. Convention No. 155 and the Occupational Safety and Health Recommendation, 1981 (No. 164), mandate cooperation between management and workers, typically through joint OSH committees, which play a central role in developing, implementing and maintaining complementary responsibilities for managing OSH risks related to extreme weather events and changing weather patterns.

[13] ILO, *Ensuring Safety and Health at Work in a Changing Climate*; ILO, *Heat at Work*.
[14] Ang Li and Claire Leppold, "Long-Term Mental Health Trajectories Across Multiple Exposures to Climate Disasters in Australia: A Population-Based Cohort Study", *The Lancet Public Health* 10, No. 5 (2025), e391–e400.
[15] ILO, *Ensuring Safety and Health at Work in a Changing Climate*.
[16] UNDRR, *Sendai Framework for Disaster Risk Reduction 2015-2030*, 2015.
[17] The Occupational Safety and Health Recommendation, 1981 (No. 164), and the Promotional Framework for Occupational Safety and Health Recommendation, 2006 (No. 197).
[18] Article 16.
[19] Article 13.

20. Furthermore, the prescriptions contained in the Protocol of 2002 to the Occupational Safety and Health Convention, 1981, concerning the recording and notification of occupational accidents and diseases, can serve as a valuable tool for collecting data and generating national statistics that reveal the impact of extreme weather events and changing weather patterns on worker health and safety.

21. According to the Biological Hazards in the Working Environment Convention, 2025 (No. 192), the national policy shall take account of the impact of climate and environmental risks on exposure to biological hazards and the need to take adequate action to prevent and address identified risks. [20] As stated in the Biological Hazards in the Working Environment Recommendation, 2025 (No. 209), exposure to biological hazards in the working environment includes transmission through the air and via vectors and other transmitters, such as water. [21] Thus, climate-related hazards, such as vector-borne diseases, floods and air pollution, may fall within the scope of Convention No. 192.

22. The Employment and Decent Work for Peace and Resilience Recommendation, 2017 (No. 205), which addresses crisis situations arising from conflicts and disasters, is also a relevant instrument in the context of extreme weather events. It suggests that there should be prevention, mitigation and preparedness for crises, through actions such as: (a) identification of risks and evaluation of threats; (b) risk management, including contingency planning, early warning, risk reduction and emergency response preparedness; and (c) prevention and mitigation of adverse effects.

23. The *Guidelines on occupational safety and health management systems, ILO–OSH 2001* [22] provide that emergency prevention, preparedness and response arrangements should be established and maintained as part of the workplace OSH management system. The increase in extreme weather events has highlighted the need for their integration into workplace emergency planning. It is important that organizations create detailed emergency response plans tailored to specific events that may arise, as each will require a different response plan. This includes plans for MIAs that may be triggered by weather events.

24. The ILO *Guidelines for a just transition towards environmentally sustainable economies and societies for all* identify several OSH considerations, including the recommendation for assessments of increased or new OSH risks resulting from weather-related changes and identification of adequate prevention and protection measures to ensure OSH.

25. As indicated throughout Chapter 2, other ILO instruments, as well as codes of practice and technical guidelines, also have provisions applicable to OSH in extreme weather events and changing weather patterns, as specified in the appendix.

1.3. National policy response relating to OSH in extreme weather events and changing weather patterns: General trends

26. Many countries have implemented national laws targeting weather events and patterns, as well as long-standing hazards like excessive heat and UV radiation. These event- and hazard-specific law and practice examples are provided in Chapter 2. In addition to these specific national policy responses, countries address risks related to extreme weather events and changing weather patterns through provisions in either general OSH laws or in broader climate-related legislation.

[20] Article 4(d).
[21] Para. 5(a) and (c).
[22] 3.10.3, Emergency prevention, preparedness and response.

27. Some national legislation, for example, provides that work should be **prohibited in exceptional weather circumstances**. In Uruguay, legislation requires employers to suspend work in rural areas when adverse weather conditions (for example, rain, winds and thunderstorms) risk the safety and health of workers. [23] The law also stipulates that employers may reassign workers to alternative tasks that do not pose a risk while weather conditions persist. In the Philippines, work cannot be started or continued in timbered areas during periods of high winds, extremely heavy fogs and other hazardous weather conditions. [24]

28. OSH legislation often contains provisions aimed at protecting workers and workplaces in cases of **weather-related emergencies**. Many jurisdictions require workplaces to implement disaster response and risk reduction plans for hazards like floods, wildfires and storms. In Egypt, for example, employers should carry out an analysis of expected "natural risks and disasters" and prepare an emergency plan for the protection of workplaces and workers in the event of such a disaster. [25] Chilean law requires annual emergency drills regarding catastrophe or disaster risks. [26] China requires integration with local authorities for coordinated disaster management [27] and Belgium requires systematic prevention strategies through a dynamic risk management framework. [28] Such disaster and response plans are closely linked to the concept of early warning systems (see box 2).

29. Furthermore, some countries **identify and adopt targeted strategies for worker groups at high risk** from weather events. In Thailand, the Homeworkers Protection Act [29] forbids working in extreme and potentially hazardous temperatures.

30. In the event that extreme weather events pose an imminent and serious danger to the life or health of workers, many countries ensure workers have the **right to remove** themselves from the hazardous situation without fear of retaliation or any undue consequences, aiming to safeguard their safety and health. European Union Council Directive 89/391/EEC, for example, establishes that employers should "take action and give instructions to enable workers in the event of serious, imminent and unavoidable danger to stop work and/or immediately to leave the work place and proceed to a place of safety". [30]

31. One major type of response to extreme weather events is the **adaptation of the working environment**, such as modifying physical infrastructure and changing working schedules. Some OSH laws specifically include workplace measures to protect workers from extreme weather events. European Union directives, for example, provide that: "[t]emporary 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", [31] and "[w]hen workers are employed at workstations outdoors, such workstations must as far as possible be arranged so that workers: (a) are protected against inclement weather conditions and if necessary

[23] Decree 38/022 on work in adverse weather conditions in rural areas, of 27 January 2022.
[24] Section 1423 of the Occupational Safety and Health Standards (as amended, 1989).
[25] Section 215 of the Labour Code (No. 12 of 2003).
[26] Section 19 of Supreme Decree No. 44 of 2024.
[27] Work Safety Law.
[28] Workplace Welfare Code.
[29] Section 21 of the Home Workers Protection Act B.E.2553 (2010).
[30] Article 8(3)(b) of Council Directive 89/391/EEC of 12 June 1989 on the introduction of measures to encourage improvements in the safety and health of workers at work.
[31] Sections 4.1.6 and 4.3.6(d) of Annex II of Directive 2009/104/EC of the European Parliament and of the Council of 16 September 2009 concerning the minimum safety and health requirements for the use of work equipment by workers at work.

against falling objects". [32] In Jordan, 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. [33]

32. **Social protection measures** can also be important tools for protecting workers' health and safety from the impacts of extreme weather events and changing weather patterns. Algeria, for example, offers unemployment benefits in case of adverse weather conditions, covering events such as extreme heat, rain, snow, strong winds and sandstorms. [34] Spain allows workers up to four days of leave if severe weather prevents them from reaching their workplace, with extensions granted until conditions improve. [35] In Austria, workers in the construction industry receive compensation when bad weather prevents completion of work. [36] Brazil's legislation provides employment protections during national calamities (pandemics, floods, landslides, and so on), such as telework arrangements, job suspensions and social security benefits. [37] In France, the French Building Federation has secured a decree recognizing heatwaves as eligible under the weather-related unemployment scheme, allowing employers to claim compensation for work stoppages during official heat alerts between 1 June and 15 September. [38]

33. It is also important to acknowledge the existence of **non-legislative responses.** These measures include initiatives by meteorological agencies such as **early warning systems** (box 2), technical guidelines issued by regulatory bodies or professional associations, training programmes aimed at building capacity, and awareness-raising campaigns. In addition, given the crucial role of social dialogue in implementing, monitoring and adapting OSH policies, **collective agreements** between employers' and workers' organizations, negotiated to regulate terms and conditions of employment, can address OSH issues related to extreme weather events and changing weather patterns. Similarly, **joint workers' and employers' OSH committees** can contribute to the negotiation and decision-making processes on OSH matters within this context. [39]

▶ Box 2. Early warning systems

Early warning systems play a key role by integrating hazard monitoring, forecasting, risk assessment, communication and preparedness to enable timely action ahead of hazardous events. A multi-hazard early warning system addresses several hazards of similar or different type in contexts where hazardous events may occur alone, simultaneously, or cumulatively over time, taking into account interrelated effects. [1] Early warning systems can support both short-term action and long-term planning by enabling scenario building and forecasting, as well as helping to monitor and address climate-related health risks, such as vector-borne diseases or respiratory conditions. Early alerts about emerging diseases facilitate preventive measures like vaccination and worker education. [2] Likewise, information on UV radiation enables organizations to implement sun safety policies, provide personal protective equipment (PPE) and sunscreen, and educate workers about risks like skin cancer and vision damage. In some countries, early warning systems are already in use in work settings, such as in the United Arab Emirates, where

[32] Section 21.3 of Annex I of Council Directive 89/654/EEC of 30 November 1989 concerning the minimum safety and health requirements for the workplace.
[33] Article 9(a) of Regulation No. 31 of 2023 – Regulation of Occupational Safety and Health and the Prevention of Occupational Hazards in Institutions for the Year 2023.
[34] Executive Decree 97–45 which creates the "National Fund for Paid Holidays and Unemployment Due to Adverse Weather Conditions in the Construction, Public Works and Irrigation Sectors", 4 February 1997 [in French].
[35] Royal Decree-Law 8/2024 [in Spanish].
[36] Construction Workers' Bad Weather Compensation Act.
[37] Act 14.437/2022 [in Portuguese].
[38] Fédération française du bâtiment, "Chômage Intempéries – La Canicule Officiellement Indemnisée", 2024.
[39] Various examples of non-legislative responses, including collective agreements, are included in previous ILO reports: ILO, *Ensuring Safety and Health at Work in a Changing Climate*; and ILO, *Heat at Work*.

government workers are advised to work from home during heavy rain, and in Greece, where outdoor workers are given tailored advice to mitigate the impact of excessive heat. [3]

[1] UNDRR, "The Sendai Framework Terminology on Disaster Risk Reduction: "Early warning system"", 2017. [2] WMO, "Early warning system". [3] WMO and UNDRR, *Global Status of Multi-Hazard Early Warning Systems: 2024*, 2024.

▶ 2. Policy and practice on OSH in extreme weather events and changing weather patterns

34. Following the overview presented in Chapter 1, Chapter 2 provides a detailed summary of OSH policy responses to specific hazards. It begins with heatwaves and excessive heat, then addresses: SDSs; droughts and wildfires; high precipitation and floods; extreme cold, blizzards, and winter storms; and, lastly, tropical cyclones. The chapter concludes with an analysis of associated hazards and exposures: changes in vector distribution; increased use of agrochemicals; increased exposure to air pollution; increased exposure to UV radiation; and increased risk for MIAs.

2.1. Heatwaves and excessive heat

35. The year 2024 was the hottest on record, and the first in which the average annual global temperature exceeded +1.5°C compared to pre-industrial levels. [40] Extreme temperatures of over 40°C are becoming increasingly frequent in many parts of the world. [41] By the end of this century, it is likely that all regions of the world will see increased health risks associated with excessive heat. [42] In response to the rapid rise in the intensity, frequency and duration of extreme heat, the United Nations Secretary-General issued a call to action on extreme heat in July 2024, highlighting the protection of workers as one of four critical action areas. [43]

36. Heatwaves are defined by the WMO as a period of marked and unusually hot weather persisting for at least two consecutive days. [44] They are acute, extreme events that trigger formal warnings and emergency responses. Excessive heat, in turn, refers to any thermal condition that exceeds the body's capacity to maintain a safe internal temperature during physical activity/work, and it can occur during routine seasonal hot periods. The focus of public health policy and meteorological services on heatwaves does not fully reflect the risks posed by excessive heat in occupational settings. Workers, particularly those in outdoor or poorly ventilated indoor environments, may be exposed to excessive heat well before a heatwave is officially declared, or even without one. Nine out of ten worker exposures to excessive heat, and eight out of ten occupational injuries linked to heat, occur outside declared heatwaves. [45] From an OSH perspective, this underscores the need to extend focus beyond heatwaves to daily and cumulative heat exposures, which can impair health, reduce productivity and, in severe cases, cause heat-related illnesses or fatalities, even in the absence of an official heatwave.

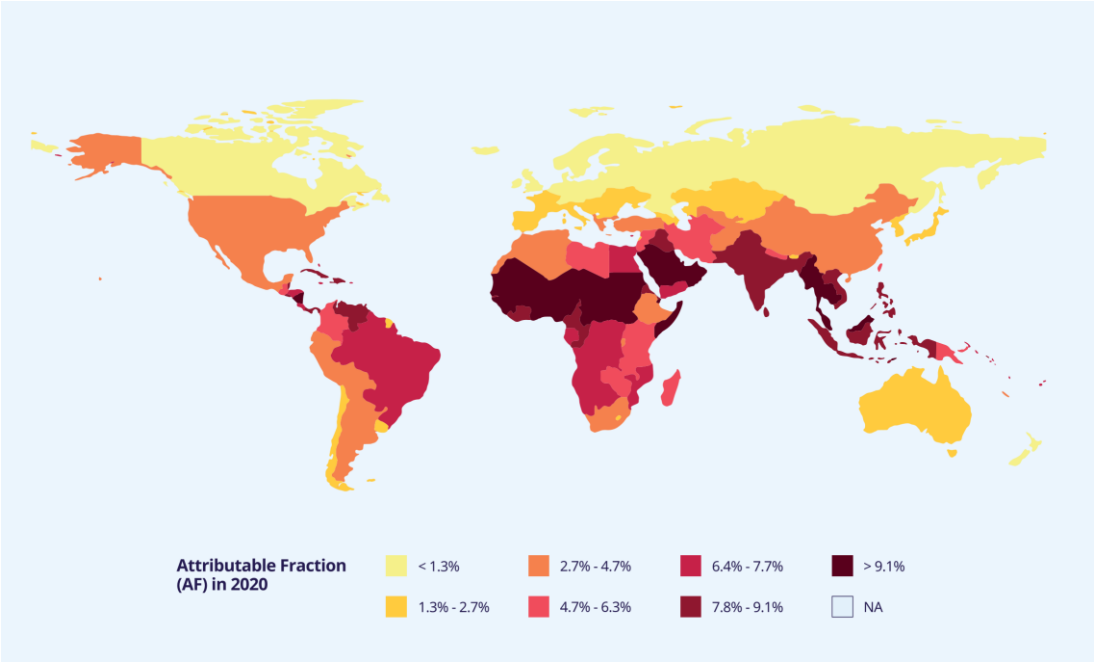
[40] Copernicus Climate Change Service, *The 2024 Annual Climate Summary: Global Climate Highlights 2024*, 2025.
[41] WMO, "Extreme Weather".
[42] IPCC, *Climate Change 2023: Synthesis Report*, 2023.
[43] United Nations, "Secretary-General's Call to Action on Extreme Heat".
[44] WMO, *Guidelines on the Definition and Characterization of Extreme Weather and Climate Events*, 2023.
[45] ILO, *Heat at Work*.

37. Every year, an estimated 2.41 billion workers will face excessive heat while at work, equal to around 71 per cent of the global workforce. [46] Regions with the highest workforce exposure to excessive heat are Africa, the Arab States, and Asia and the Pacific (92.9, 83.6 and 74.7 per cent of the workforce, respectively). However, excessive heat impacts workers in all regions of the world, including those previously unaffected. Since 2000, workforce exposure to excessive heat increased most rapidly in Europe and Central Asia.

38. There are an estimated 22.85 million injuries and 18,970 deaths annually related to excessive heat at work. [47] Health impacts associated with heat stress resulting from excessive heat include heatstroke, heat exhaustion, heat syncope, heat cramps, rhabdomyolysis, kidney disorders and cardiovascular disease. [48] Loss of income and other stressors related to excessive heat have been frequently linked to mental health impacts, including psychological distress, depression, anxiety and irritability. [49]

39. The regions with the highest proportion of occupational injuries attributable to excessive heat are Africa and the Americas (7.2 and 6.7 per cent of all occupational injuries, respectively). The Americas, and Europe and Central Asia are the regions with the most rapidly increasing heat-related occupational injuries since 2000. [50]

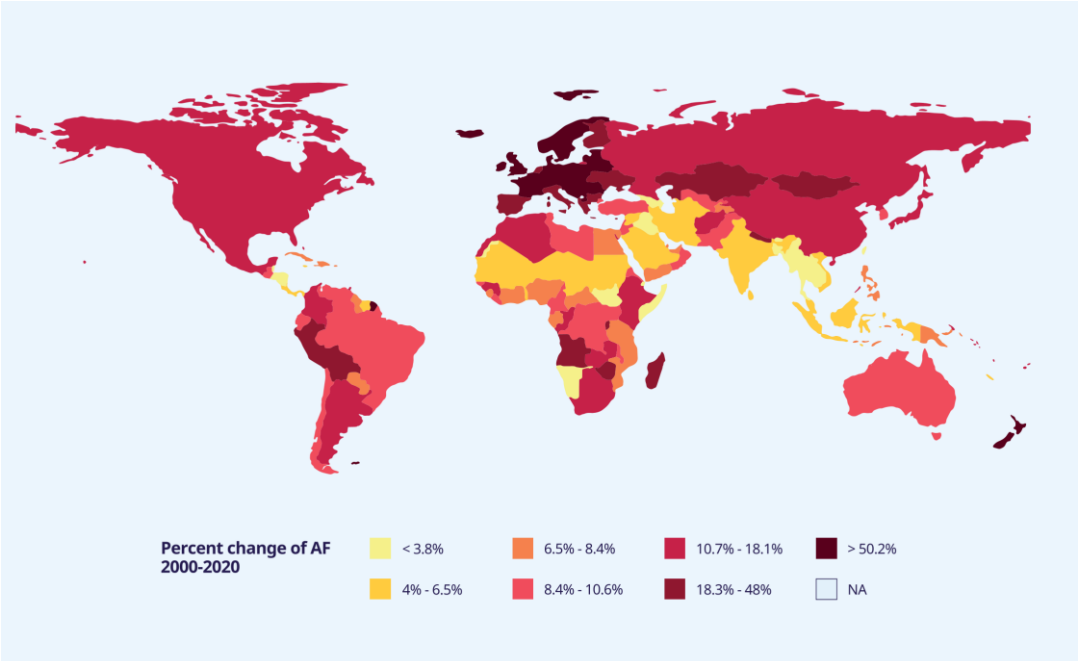
▶ Figure 1. Prevalence of fatal occupational injuries attributable to excessive heat by country in 2020



Source: ILO, *Heat at Work*.

[46] ILO, *Heat at Work*.
[47] ILO, *Heat at Work*.
[48] ILO, *Ensuring Safety and Health at Work in a Changing Climate.*
[49] Mustapha Amoadu et al., "Impact of Climate Change and Heat Stress on Workers' Health and Productivity: A Scoping Review", *The Journal of Climate Change and Health* 12, No. 100249 (2023).
[50] ILO, *Heat at Work*.

▶ **Figure 2. Change in prevalence of fatal occupational injuries attributable to excessive heat in 2020 relative to 2000**



Source: ILO, *Heat at Work*.

40. Elevated temperatures can also lead to reduced work productivity, as excessive heat may render conditions unsuitable for work or require a reduction in pace. Recent evidence shows that productivity declines by 2.3 per cent for every degree Celsius above 19°C. [51] The medical treatment of affected workers imposes further economic costs. An estimated US$361 billion could be saved globally if OSH measures to prevent occupational injuries related to excessive heat were implemented. [52]

41. Excessive heat affects all sectors, but the highest risks are faced by outdoor workers in physically demanding jobs and indoor workers in poorly ventilated workplaces and unregulated environments. [53] Such jobs are typically found in agriculture, natural resource management, construction, manufacturing, refuse collection, emergency repair work, transport, tourism and sports. [54] Those wearing heavy clothing or PPE, such as pesticide sprayers and firefighters, can face heightened risk. Moreover, excessive heat can make protective gear intolerable, increasing exposure to hazards like chemicals and dust. [55]

42. The risks associated with excessive heat are unevenly distributed across the workforce, with certain groups facing significantly higher vulnerability due to physiological, social or occupational factors. Migrant and informal economy workers, often employed in low-wage, high-risk sectors such as agriculture and construction, may lack adequate training and access to OSH protections. Additionally, due to language barriers, limited legal safeguards and financial pressures, they may

[51] Leonidas G. Ioannou et al., "The Impact of Workplace Heat and Cold on Work Time Loss". *Journal of Occupational and Environmental Medicine* 67, No. 6 (2025), 393–399.
[52] ILO, *Heat at Work*.
[53] ILO, *Heat at Work*.
[54] Joseph Wilson et al., "Death of 51-year-old Barcelona Street Sweeper from Heatstroke Stirs Labor Unrest in Southern Europe", *Fortune*, 24 July 2025; ILO, *Working on a Warmer Planet: The Impact of Heat Stress on Labour Productivity and Decent Work*, 2019.
[55] Climate Rights International (CRI), *"My Body is Burning": Climate Change, Extreme Heat, and Labor Rights in Bangladesh*, 2025.

lack the awareness or authority to report unsafe conditions or take necessary breaks. Young workers may also lack the awareness and experience to adequately respond to exposures. Women may be disproportionately affected in workplaces lacking gender-responsive measures, especially where uniforms or equipment are not adapted to their needs. [56] Heat exposure during pregnancy specifically has been linked to adverse impacts on maternal, foetal and neonatal health. [57] Older workers and those with underlying health conditions or disabilities are at increased risk due to reduced thermoregulation and higher susceptibility to heat-related illnesses. [58]

43. With a view to facilitating the analysis of policies and practices related to heatwaves and excessive heat, specific elements are presented below.

2.1.1. Temperature indicators and thresholds

44. A common policy and practice implemented by national authorities is the use of indicators to define acceptable temperature thresholds, based on workplace circumstances and work intensities. Many countries use the wet bulb globe temperature (WBGT), the most well-known and widely adopted indicator to assess workplace heat. [59] A series of large-scale multi-country evaluations reported that the WBGT is the most effective heat stress indicator for evaluating the risk of heat-related illnesses. [60] Rather than using expensive instrumentation, the WBGT may be estimated using local weather data or local air temperature and humidity data with some adjustment for sunlight. [61] Some regions have telephone applications that allow timely updates for the WBGT. In Brazil, for example, the Government developed a free mobile app to help workers and employers evaluate heat exposure in outdoor work environments and rural areas without artificial heat sources, indicating appropriate control measures. [62] It is important to note, however, that in many low-resource settings, the use of such applications may not be feasible.

45. Some countries use the heat index, which can be a useful substitute for the WBGT, as a metric to assess workplace heat stress. [63] Since the heat index uses air temperature and relative humidity, it can be measured with affordable tools, making it a practical method for evaluating heat stress risks in occupational settings. However, it has limitations, as it does not account for radiant heat or air speed, and there is limited empirical evidence supporting adjustments of its thresholds according to work intensity or clothing. A further drawback of the heat index is that the guidance it offers for initiating a heat stress prevention programme is not robustly backed by evidence. [64]

[56] ILO, *Heat at Work*.
[57] Darshnika P. Lakhoo et al., "A Systematic Review And Meta-Analysis Of Heat Exposure Impacts On Maternal, Fetal And Neonatal Health", *Nature Medicine* 31, No. 2 (2025), 684–694.
[58] ILO, *Ensuring Safety and Health at Work in a Changing Climate*; ILO, *Heat at Work*.
[59] ILO, *Heat at Work*.
[60] Andreas D Flouris, Leonidas G Ioannou and Lars Nybo, "Working in a Warming World: Translating Thermal Physiology to Policy-Relevant Information", *Temperature* 9, No. 3 (2022), 223–226; Leonidas G Ioannou et al., "Indicators to Assess Physiological Heat Strain – Part 1: Systematic Review", *Temperature* 9, No. 3 (2022), 227–262; Leonidas G Ioannou et al., "Indicators to Assess Physiological Heat Strain – Part 2: Delphi Exercise", *Temperature* 9, No. 3 (2022), 263–273; Leonidas G Ioannou et al., "Indicators to Assess Physiological Heat Strain – Part 3: Multi-Country Field Evaluation and Consensus Recommendations", *Temperature* 9, No. 3 (2022), 274–291.
[61] WHO and WMO, "Climate Change and Occupational Heat Stress: Technical Guidance by WHO and WMO" (unpublished).
[62] FUNDACENTRO, "Monitor IBUTG".
[63] Thomas E. Bernard and Ivory Iheanacho, "Heat Index and Adjusted Temperature as Surrogates for Wet Bulb Globe Temperature to Screen for Occupational Heat Stress", *Journal of Occupational and Environmental Hygiene* 12, No. 5 (2015), 323–333.
[64] Courtney E. Morris et al., "Actual and Simulated Weather Data to Evaluate Wet Bulb Globe Temperature and Heat Index as Alerts for Occupational Heat-Related Illness", *Journal of Occupational and Environmental Hygiene* 16, No. 1 (2019), 54–65.

46. The universal thermal climate index (UTCI) is a thermal index that considers air temperature, relative humidity, wind speed and radiant temperature.[65] However, its use in occupational settings has limitations, as it assumes a fixed exposure duration of two hours, a moderate metabolic rate of 135 W/m^2, and free behavioural adaptations regarding clothing. These assumptions make it challenging to apply the UTCI to many real-world work scenarios.[66]

47. Regarding thresholds, OSH authorities typically distinguish between two broad categories of temperature limits – occupational exposure limits (OELs) and thermal comfort limits.

48. OELs are intended to protect workers in various non-office settings (for example, construction, agriculture, transportation, heavy industry and mining) from heat-related illnesses. In these contexts, exposure limits commonly rely on indicators such as the WBGT. WBGT-based thresholds help employers determine when they need to apply additional safeguards, such as rest breaks, hydration protocols or engineering controls.

49. Thermal comfort limits, by contrast, are generally applied in office environments, where the objective is to maintain productivity, comfort and work quality. These limits often use simpler indices, such as the Humidex, the Discomfort Index or dry-bulb temperature ranges, to establish upper temperature boundaries that trigger measures such as increased ventilation, cooler air supply or relaxed dress codes.

50. National authorities may elect to combine or adapt to these approaches. For example, they may specify separate WBGT-based limits for low-, medium- or high-intensity outdoor work, while adopting thermal comfort guidelines for office settings. Regardless of the exact framework, the following considerations are important for policy development and implementation.

- Work intensity-specific limits: heat stress can vary dramatically with the level of physical exertion. High-intensity tasks (for example, heavy manual labour) create more metabolic heat than low- or moderate-intensity tasks. It is important to designate separate, lower limits for strenuous work compared to less strenuous work, such as desk-based tasks.
- Indoor versus outdoor environments: where work is performed can significantly impact heat exposure. For this reason, it is advisable to differentiate limits for outdoor settings, where workers face additional risks from direct solar radiation, versus indoor settings, where workers may be susceptible to heat generated by equipment or inadequate ventilation. However, several countries only make provision for maximum temperature thresholds for enclosed premises/indoor work, as employers can more readily control indoor temperatures with measures like ventilation.[67]
- Workers in vulnerable situations and inclusivity: certain groups are at higher risk of heat-related illnesses, including older workers, pregnant workers, individuals with pre-existing medical conditions, and workers with disabilities. Additionally, women may have a reduced thermoregulatory capacity compared to men, which can increase their risk in certain occupational settings. Migrant workers who are not yet acclimatized to local conditions are also at a heightened risk. Stricter exposure thresholds that account for these vulnerabilities can enhance worker protection.

[65] Climate-ADAPT European Environment Agency, "Thermal Comfort Indices: Universal Thermal Climate Index (1979-2020)".
[66] WHO and WMO, "Climate Change and Occupational Heat Stress: Technical Guidance by WHO and WMO" (unpublished).
[67] EUROGIP, *Working in extreme heat and heatwaves: What legislation and preventive measures at international level?*, 2023.

51. Countries often provide a range of acceptable temperatures for specific workplace circumstances, both by integrating temperature limits into their legislation and/or publishing technical recommendations through their OSH authorities. When these limits are exceeded, work is often prohibited, or protective measures are required. Table 1 provides examples.

▶ Table 1. Selected examples of workplace temperature thresholds

ILO regions	Country	Heat stress assessment	
		Heat stress indicator	Safety threshold (work intensity/risk)
Africa	Mozambique [1]	WBGT	24.7°C (very heavy work) to 33.7°C (sitting at rest, light work)
	South Africa [2]	WBGT	30°C
The Americas	Brazil [3]	WBGT	24.7°C (very heavy work) to 33.7°C (sitting at rest, light work)
	Chile [4]	WBGT	30°C (low) 26.7°C (moderate) 25°C (heavy) *(continuous work)*
	Costa Rica [5]	Heat Index	<91 (low risk) 91–102 (moderate risk) 103–124 (high risk) ≥125 (extreme risk)
The Arab States	Qatar [6]	WBGT	27.8°C–29.4°C (low risk) 29.5°C–31°C (moderate risk) 31.1°C–32°C (high risk) ≥32.1°C (extreme risk)
	Saudi Arabia [7]	Thermal Work Limit Indicator [8]	140-220 W/m^2 (low risk) [9] 115-140 W/m^2 (intermediate risk) <115 W/m^2 (high risk)
Asia and the Pacific	China [10]	Air temperature	35–36.9°C (moderate risk) 37–39.9°C (high risk) >40°C (extreme risk) *(outdoor work only)*
	India (Tamil Nadu state) [11]	Wet bulb temperature	30°C *(factories only)*
	Japan [12]	WBGT	33.0°C (sedentary) 30.0°C (low) 28.0°C (moderate) 26.0°C (high) 25.0°C (very high) *(acclimatized workers)*
	Singapore [13]	WBGT	<31°C (low risk) 31°C–32.9°C (moderate risk) ≥33°C (high risk) *(outdoor workers)*

ILO regions	Country	Heat stress assessment	
		Heat stress indicator	Safety threshold (work intensity/risk)
	Thailand [14]	WBGT	34.0°C (light work) 32.0°C (moderate work) 30.0°C (heavy work)
	Viet Nam [15]	Air temperature	34°C (light) 32°C (medium) 30°C (heavy) *(indoor only)*
Europe and Central Asia	Austria [16]	Air temperature	19°C–25°C (low physical stress) 18°C–24°C (normal physical effort) *(indoor climate in workspaces)*
	Belgium [17]	WBGT	29.0°C (light work) 26.0°C (medium-heavy work) 22.0°C (heavy work) 18.0°C (very heavy work)
	Greece [18]	WBGT	>32.5°C (mild) >31.5°C (moderate) >30.5°C (high) >30.0°C (very high) *(complete work stoppage)*
	Hungary [19]	Air temperature	31.0°C (intellectual) 31.0°C (light) 29.0°C (medium) 27.0°C (heavy work)
	Portugal [20]	Air temperature	22°C 25°C (except in certain climatic conditions) *(commercial, office and service establishments only)*
	Spain [21]	Air temperature	17°C–27°C (sedentary work) 14°C–25°C (light work)
		Relative humidity	70% (all other rooms) 50% (rooms with risk of static electricity)
		Air flow	0.25 m/sec (normal conditions) 0.50 m/sec (sedentary work in excessive heat) 0.75 m/sec (active work in excessive heat)

Note: Data valid as of July 2025. Data from ILO, *Heat at Work*, and ILO, *Ensuring Safety and Health at Work in a Changing Climate*, updated following subsequent research.

[1] Annex III, table 3 of Decree No. 94/2024 of 30 December, [in Portuguese]. [2] Table 1 of *Occupational Health and Safety Act of 1993, Physical Agents Regulations, 2024*. [3] Annex 3 of Regulatory Standard No. 15. [4] Section 96 of the Regulations on Basic Health and Environmental Conditions in the Workplace (Decree No. 594/1999) [in Spanish]. [5] Annex 1 of "Regulation for the Prevention and Protection of Workers Exposed to Heat Stress", No. 39147-S-TSS of 2015 [in Spanish]. [6] Ministerial Decision No. 17 of 2021, Qatar's Ministerial Decision on Heat Stress, 25 May 2021. [7] National Council for Occupational Safety & Health, *Guideline: Preventing Effects of Working in High-Temperature*, 2024. [8] The Thermal Work Limit Indicator takes into consideration ambient air temperature, humidity, radiant temperature and wind speed. [9] For the Thermal Work Limit, lower values indicate higher risk, unlike other indicators, such as the WBGT, where higher values indicate higher risk. [10] Section 8 of "Notice on Printing and Distributing Measures for the Management of Heatstroke Prevention and Cooling" [in Chinese]. [11] Section 17A of the Ventilation

and Temperature. Tamil Nadu Factories Rules, 1950. [12] Establishment of basic measures for preventing heat stroke in the workplace (Basic information 0420 No. 3 of 2020) [in Japanese]. [13] Ministry of Manpower, "Enhanced Measures to Reduce Heat Stress Risks for Outdoor Workers", 2023. [14] Ministerial Regulations on Heat, Light, and Noise B.E.2559 (2016). [15] Circular No. 26/2016/TT-BYT. [16] Article 28 of the Workplace Ordinance [in German]. [17] Code of Well-being at Work, Book V on Thermal Environmental Factors [in French]. [18] Hellenic Ministry of Labour and Social Affairs, "Addressing Occupational Heat Stress During the Summer", table 7 of Annex Circular 34666/03.06.2024 [in Greek]. [19] Section 7 of the Joint Decree on the Minimum Level of Occupational Safety Requirements for Workplaces 3/2002 (II. 8.) [in Hungarian]. [20] Section 11 of the Decree-Law No. 243/86 [in Portuguese]. [21] Annex III of Royal Decree No. 486/1997 [in Spanish].

52. Countries with cooler climates tend to adopt more conservative thresholds, reflecting lower population acclimatization to heat. For example, Belgium sets limits at 18°C for very heavy work and 29°C for light work, whereas Thailand allows up to 30°C and 34°C, respectively. Establishing differentiated thresholds based on workload and acclimatization status is a strategy for effectively mitigating heat stress.

53. Legislation usually includes exemptions or modified provisions for certain types of work, specific locations or sectors. For instance, in Qatar, [68] the national measures to protect workers from heat stress do not apply to activities undertaken by companies working on oil and gas projects. 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.

2.1.2. Work bans

54. Some countries that regularly experience extreme heat have prohibited outdoor work during the hottest parts of the day. In some cases, countries impose work bans based on pre-fixed dates, regardless of the heat levels during that period. For example, in Oman, outdoor work is prohibited from 12.30 p.m. to 3.30 p.m. from 1 June to 31 August. [69] In the United Arab Emirates, outdoor work is prohibited from 12.30 p.m. to 3 p.m. from 15 June to 15 September. [70] Similar provisions are found in Bahrain, [71] Kuwait, [72] Qatar [73] and Saudi Arabia. [74] Other countries establish a temperature limit to apply work bans. This is the case in China, where outdoor open-air work must be stopped for the day when the maximum daily temperature reaches 40°C or above. [75]

55. Regardless of work bans, workers should have the right to remove themselves from a dangerous work situation without undue consequences. In Qatar, for example, in addition to prohibiting work on specific dates and at certain temperatures, the right to stop working is guaranteed for workers who have good reason to believe that heat stress poses a threat to their safety or health. They must inform their supervisors so that they can assess the situation and they cannot be dismissed, subjected to discrimination or deprived of their rights. [76]

2.1.3. Emergency preparedness and response

56. Effective emergency preparedness and response plans are crucial for addressing workplace heat stress incidents, equipping workers and supervisors with the skills to identify early signs of heat-

[68] Article 8 of Ministerial Decision No. 17 of 2021 – Heat Stress Legislation in Qatar.
[69] Ministerial Decision No. 286 of 2008, as amended by Ministerial Decision No. 322 of 2011.
[70] Ministerial Decree No. 401 of 2015 concerning the determination of midday working hours.
[71] Ministerial Order No. 3 of 2013.
[72] Ministerial Decision No. 535 of 2015.
[73] Article 2 of Ministerial Decision No. 17 of 2021 – Heat Stress Legislation in Qatar.
[74] Ministerial Resolution No. 1/1559.
[75] Section 8(1)(1) of the "Notice on Printing and Distributing Measures for the Management of Heatstroke Prevention and Cooling".
[76] Article 6 of Ministerial Decision No. 17 of 2021 – Heat Stress Legislation in Qatar.

related illnesses and act in the event of accidents. In Japan, employers must monitor workplace temperature via WBGT in real time, establish a system for reporting symptoms, and ensure appropriate response measures, such as removal from work, body cooling and medical assistance. [77] In China, employers are required to implement heatstroke emergency plans, conduct regular heat illness drills and maintain emergency medical supplies. [78] In Brazil, employers are required to establish heat-specific emergency plans, provide the necessary means and resources for first aid or referral to medical care, and ensure that all those involved in potential emergency situations are informed. [79]

2.1.4. Health surveillance for high-risk workers

57. The Occupational Health Services Convention, 1985 (No. 161), provides that occupational health services should conduct surveillance on factors in the working environment that may affect workers' health, as well as surveillance of workers' health in relation to work. [80] In the context of addressing risks from excessive heat, worker health surveillance helps identify individual risk factors, provide feedback and assess the effectiveness of preventive measures. [81] It is recommended that a worker's ability to cope with excessive heat should be evaluated before starting a job and periodically thereafter, especially before the hot season, through medical history, physical examination, relevant tests and a review of medications. [82]

58. In the United States of America, the National Institute for Occupational Safety and Health (NIOSH) recommends medical surveillance in case of occupational exposure to heat, encompassing medical examinations and monitoring of sentinel health events to evaluate an individual's capacity to deal with heat stress both before and periodically during the placement. [83] In Costa Rica, [84] legislation requires workers to be part of a health surveillance programme, which focuses on monitoring kidney health and function. Legislation in several countries (for example, Bahrain, [85] Belgium, [86] Japan, [87] Saudi Arabia [88] and South Africa [89]) recommends medical assessments for high-risk workers in certain heat-related situations and evaluations of their fitness to work in hot conditions.

2.1.5. Identification of worker groups in vulnerable situations

59. In general, pregnant women, children, older adults and persons with disabilities or pre-existing medical conditions are more at risk of health impacts from extreme heat. [90] Seasonal or migrant

[77] Section 612-2 of the Occupational Safety and Health Regulations, as amended in 2025.
[78] "Notice on Printing and Distributing Measures for the Management of Heatstroke Prevention and Cooling".
[79] Regulating Standard No. 9 (NR–9), Physical, chemical, and biological agents [in Portuguese].
[80] Articles 1(a), 5(b) and 5(f).
[81] Francesco Chirico and Nicola Magnavita, "The significant role of health surveillance in the occupational heat stress assessment", *International journal of biometeorology* 63, No. 2 (2019), 193–194.
[82] ILO, *Heat at Work*.
[83] NIOSH, Criteria for a Recommended Standard: Occupational Exposure to Heat and Hot Environments, Revised Criteria 2016.
[84] Regulations for the prevention and protection of workers exposed to heat stress (Executive Decree N°MTSS-017-2015) [in Spanish].
[85] Article 171 of Law No. 36 of 2012, in Chapter 15 "Occupational Safety and Health & Work Environment".
[86] Section 6 of the Code of Well-being at Work, Book V, Title 1 on thermal environmental factors [in French].
[87] Section 66 of the Industrial Safety and Health Law (Law No. 57 of 8 June 1972), as amended, NATLEX database.
[88] Section 4.1.12 of the "Procedural Guidelines for Occupational Safety and Health for Preventing the Effects of Exposure to Direct Sun and Heat Stress 2021".
[89] *Occupational Health and Safety Act of 1993, Physical Agents Regulations, 2024.*
[90] Guéladio Cissé et al., "Health, Wellbeing, and the Changing Structure of Communities" in Bettina Menne et al., eds, *Climate Change 2022: Impacts, Adaptation and Vulnerability,* contribution of Working Group II to the Sixth Assessment Report of the IPCC (Cambridge: Cambridge University Press, 2022), 1041–1170; Heat.gov, "Inside Oklahoma City's battle against extreme heat".

workers, informal economy workers or those with a lower socio-economic status can also be more at risk. Despite the increased risks, however, these worker groups are frequently neither covered by national policies to protect workers nor receive the same treatment as other workers. In certain countries, there are legal provisions dedicated to specific vulnerable groups of workers. For example, the European Union prohibits the employment of young people in work in which there is a risk to health from extreme heat.[91] In Mexico, legislation prohibits the assignment of pregnant workers to tasks in environments with adverse thermal conditions.[92] In Cyprus, 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; and pregnant or breastfeeding women).

▶ Box 3. Self-Employed Women's Association (SEWA) in India

SEWA, a trade union and cooperative operating in India, represents 1.8 million women working in the informal economy. In 2024, recognizing the disproportionate impact of heat on its members, who often lack social security, SEWA launched a pilot heatwave insurance system covering 52,000 members across 22 districts. * The programme proved highly effective, with 88 per cent of participants receiving benefits when temperatures exceeded district-specific thresholds for consecutive days, indicating unsafe working conditions. By compensating for lost earnings during extreme heat, this scheme allowed women to protect their health without compromising their livelihoods.

* IndustriALL, "SEWA India Provides Members with Heat Wave Insurance", 2024.

2.1.6. Recognition of illnesses related to excessive heat

60. The List of Occupational Diseases Recommendation, 2002 (No. 194), suggests that a national list of occupational diseases should be established, comprising, to the extent possible, the diseases contained in its Annex, which includes "diseases caused by exposure to extreme temperatures".

61. In Tunisia,[93] several diseases caused by work in temperatures greater than 28°C, such as muscle cramps with profuse sweating and oliguria, are included in its list of occupational diseases. In Namibia,[94] legislation refers to "diseases caused by hot or cold work environments, and all work involving exposure to the risk concerned". In France,[95] the list of occupational diseases caused by working in high temperatures includes muscle cramps, oliguria and urinary chloride equal to or less than 5 g/litre. Brazil[96] includes various illnesses related to working in high temperatures in its national list of occupational diseases, such as urticaria and male infertility. In Lebanon,[97] the list of occupational diseases includes diseases caused by exposure to extreme heat above national

[91] Article 7 of Council Directive 94/33/EC of 22 June 1994 on the protection of young people at work.
[92] Federal Regulation of Occupational Safety and Hygiene and the Working Environment, 2014 [in Spanish].
[93] Table 83 of the Joint Ministerial Decree of the Ministers of Health and Social Affairs of 1995 defining the list of tables of occupational diseases [in French].
[94] Regulations relating to the health and safety of employees at work (Government Notice No. 156 of 1997), Annexure A, 2(1) Notifiable Occupational Diseases, NATLEX database.
[95] Tables of occupational diseases provided for in Article R. 461-3, Table No. 58: Occupational diseases caused by working at high temperatures [in French].
[96] Ordinance GM/MS Nº 1.999/2023 [in Portuguese].
[97] Section 1.2.8 of Decree 14229 of 2005, NATLEX database [in French].

averages. Other countries also recognize illnesses related to excessive heat, such as heatstroke, including China, [98] Malaysia [99] and Mauritius. [100]

2.1.7. Workplace-level protection measures

62. Convention No. 155 and its accompanying Recommendation No. 164 provide for workplace-level OSH measures, including regulating temperature in the workplace. [101] In this context, employers are responsible for addressing heat-related hazards through a comprehensive approach that includes assessing risks of excessive heat exposure and implementing appropriate preventive measures, guided by the hierarchy of controls. The ILO code of practice on ambient factors in the workplace (2001) outlines measures employers are recommended to take to protect workers from excessive heat, such as ventilation and cooling systems, work-rest regimes and hydration strategies. [102]

63. Technical recommendations have been developed by organizations such as the Occupational Safety and Health Administration (OSHA), NIOSH and the American Conference of Governmental Industrial Hygienists (ACGIH) on interventions that can be implemented to prevent heat stress. These include breaks in cool and shaded rest areas, hydration strategies, and changes in work time and tasks. Additionally, in some countries OSH legislation focuses on specific workplace measures, such as acclimatization programmes, ventilation, PPE and buddy systems. Some federal states also have regulations providing for protection measures in case of heat exposure that complement national legislation. [103]

64. As climate-related risks intensify, collective agreements have increasingly become mechanisms with which to address them. These agreements help define additional measures at sectoral and enterprise levels and, in the case of heat-related risks in the workplace, have led to improved OSH protections for workers across various industries, as described in box 4.

▶ Box 4. Collective agreements

In Spain, the national collective agreement for the construction sector makes provision for adjusting working hours during heatwaves. [1]

In 2023, one of the largest unions in the United States negotiated a five-year deal with a major global package delivery company to address the heat-related risks faced by drivers, providing air conditioning, fans, water and water fountains, ice machines, improved ventilation for the companies' trucks, exhaust heat shields and acclimatization measures for new employees. [2]

Note: Additional examples and further details can be found in ILO, *Ensuring Safety and Health at Work in a Changing Climate* (2024) and ILO, *Heat at Work* (2024).

[1.] Section 166 of the "General Collective Agreement for the Construction Sector", 2017 Resolution of the Directorate General for Employment, *Official Gazette* [in Spanish]. [2.] *National Master United Parcel Agreement: For the Period August 1, 2023 through July 31, 2028*, 2023–28.

[98] Administrative Measures on Heatstroke Prevention (AMHP2012) [in Chinese].
[99] Section 32 of the Factories and Machinery Act 1967, NATLEX database.
[100] Section 1.2.7. of the Occupational Safety and Health Act 2005 (Act No. 28 of 2005), List of Notifiable Occupational Diseases.
[101] Para. 3(c) of Recommendation No. 164.
[102] Chapter 8: Heat and Cold.
[103] For example, in California, in the United States, employers must take steps to protect workers from heat illness in both indoor and outdoor workplaces under the California Code of Regulations, Title 8 (T8CCR), providing water, shade, cool-down rest breaks, and so on. Other states have similar legislation on heat, including Colorado, Minnesota, Oregon and Washington, DC.

65. The following workplace measures are reviewed individually: acclimatization, hydration, cool and shaded rest areas, ventilation, work organization adjustments, training and education, and the supply of PPE and other safety equipment. Workplace heat mitigation should be adapted to resource levels, prioritizing basic measures, such as hydration and shaded rest areas, where capacity is limited, and more advanced interventions where feasible.

Acclimatization

66. Introducing heat acclimatization regimes is essential for workers who are not yet adapted to excessive heat. Individuals vary significantly in their ability to tolerate heat stress, depending on whether their bodies have undergone physiological adjustments to cope with high temperatures. [104] Workers with no or no recent (that is to say, during the previous three weeks) exposure to extreme heat should be considered non-acclimatized. Exposure of workers to excessive heat for two or more hours per day will typically result in increased tolerance over a one- to two-week period. This process, known as acclimatization, leads to reduced cardiovascular strain and a lower risk of hyperthermia during periods of excessive heat. [105]

67. Several countries provide for acclimatization in their legislation. Mexico has a specific six-day acclimatization protocol. On the first day, workers are assigned 50 per cent of their usual work duration, with a 10 per cent increase daily until full exposure is reached. Workers returning after nine or more days of absence must follow a four-day acclimatization period. [106] Saudi Arabia recommends an acclimatization period of 7 to 14 days for new workers, starting at 20 per cent exposure on day one, and increasing by no more than 20 per cent each additional day. Experienced workers follow a faster schedule, reaching full duties by day four. [107] Similar provisions on acclimatization are also found in the legislation of Costa Rica, [108] Japan, [109] Qatar [110] and Singapore. [111]

Hydration

68. Hydration is essential for health and workers should stay adequately hydrated by accessing safe drinking water. [112] Workers should have easy access to potable water throughout the day in all areas of the worksite, even in remote locations, to encourage frequent consumption. [113] Supplies should be ample and free from chemicals or other contaminants. [114] Carrying personal water

[104] Sheila Arbury, Matthew Lindsley and Michael Hodgson, "A Critical Review of OSHA Heat Enforcement Cases: Lessons Learned", *Journal of occupational and environmental medicine* 58, No. 4 (2016), 359–363; Andreas D. Flouris, "Human Thermoregulation", in Julien D. Périard and Sébastien Racinais, eds, *Heat Stress in Sport and Exercise* (Springer, Cham, Switzerland, 2019), 3–27.
[105] Matt B. Brearley et al., "Influence of Chronic Heat Acclimatization on Occupational Thermal Strain in Tropical Field Conditions", *Journal of occupational and environmental medicine* 58, No. 12 (2016), 1250–1256; Julien D. Périard et al., "Cardiovascular Adaptations Supporting Human Exercise-Heat Acclimation", *Autonomic Neuroscience* 58, No. 12 (2016), 52–62; Julien D. Périard, Thijs M. H. Eijsvogels and Hein A. M. Daanen,"Exercise Under Heat Stress: Thermoregulation, Hydration, Performance Implications, and Mitigation Strategies", *Physiological Reviews* 101, No. 4 (2021), 1873–1979; Harry Brown et al., "Seasonal Heat Acclimatisation in Healthy Adults: A Systematic Review", *Sports Medicine* 52, No. 9 (2022), 2111–2128.
[106] Section 7.3.4 of NOM-015-STPS-2001 [in Spanish].
[107] Guidelines for the Prevention of the Effects of Work in Hot Places 2024.
[108] Regulation for the Prevention and Protection of Workers Exposed to Heat Stress, No. 39147-S-TSS of 2015 [in Spanish].
[109] Basic information 0420 No. 3 of 2020 [in Japanese].
[110] ILO, *Heat Stress Legislation in Qatar,* 2021.
[111] Ministry of Manpower, "Enhanced Measures to Reduce Heat Stress Risks for Outdoor Workers".
[112] Jacob F. Piil et al., "High prevalence of hypohydration in occupations with heat stress–Perspectives for performance in combined cognitive and motor tasks", *PLoS ONE* 13, No. 10 (2018).
[113] U.S. Department of Labor, Occupational Safety and Health Administration, *Heat Illness Prevention: Keeping Workers Well-Hydrated,* 2023.
[114] WHO, *Guidelines for Drinking-Water Quality: Fourth Edition Incorporating the First and Second Addenda*, 2022.

bottles encourages workers to hydrate regularly. [115] When possible, especially during breaks, cooling drinks, ice slurry or crushed ice can reduce discomfort, lower core body temperature and enhance productivity. [116] Furthermore, during prolonged physical activity in the heat, sodium intake plays a significant role in preventing excessive sodium loss via sweating, which may lead to hyponatremia. [117]

69. A number of international labour standards relevant to OSH contain provisions on workers' access to adequate supplies of safe drinking water, including the Work in Fishing Convention, 2007 (No. 188), [118] the Maritime Labour Convention, 2006, as amended (MLC, 2006), [119] the Hygiene (Commerce and Offices) Convention, 1964 (No. 120), [120] the Plantations Convention, 1958 (No. 110), [121] the Safety and Health in Construction Convention, 1988 (No. 167), [122] the Safety and Health in Mines Recommendation, 1995 (No. 183), [123] the Occupational Health Services Recommendation, 1985 (No. 171), [124] the Occupational Safety and Health Recommendation, 1981 (No. 164), [125] and the Welfare Facilities Recommendation, 1956 (No. 102). [126] Besides these instruments, ILO codes of practice, such as the code of practice on ambient factors in the workplace, and the code of practice on safety and health in construction, [127] contain further guidance on hydration.

70. Several countries have implemented hydration regulations to protect workers from heat stress. In South Africa, when employee exposure is at or above the time-weighted average safety threshold of 30°C, employers are required to provide sufficient potable water, and employees should be encouraged to drink water regularly during shifts and rehydrate between them. [128] Similarly, Japan's regulations recommend that employers monitor the intake of water and mineral salts by workers by creating control tables and conducting regular worker hydration checks during working hours. [129] In Singapore, besides providing cool or cold drinking water near work areas, employers should also ensure outdoor workers rehydrate at least hourly with a recommended intake of 300ml per hour, or more depending on work intensity. [130]

[115] Andreas D. Flouris et al., *Assessment of Occupational Heat Strain and Mitigation Strategies in Qatar – Key Findings* (ILO, 2019).
[116] P. M. S. Tan and J. K. YeW. Lee, "The Role of Fluid Temperature and Form on Endurance Performance in the Heat", *Scandinavian Journal of Medicine & Science in Sports* 25, No. S1 (2015), 39–51; Nathan B. Morris et al., "Sustainable Solutions to Mitigate Occupational Heat Strain – An Umbrella Review of Physiological Effects and Global Health Perspectives", *Environmental Health* 19, No. 95 (2020); Sharifah B Alhadad et al., "Thermoregulatory Responses to Ice Slurry Ingestion During Low and Moderate Intensity Exercises with Restrictive Heat Loss", *Journal of Science and Medicine in Sport* 24, No. 1 (2021), 105–109.
[117] Costas A. Anastasiou et al., "Sodium Replacement and Plasma Sodium Drop During Exercise in the Heat When Fluid Intake Matches Fluid Loss" *Journal of Athletic Training* 44, No. 2 (2009), 117–123.
[118] Article 27(b) and Annex III, para. 78.
[119] Regulation 2.5 and Standard A2.5.2, para. 5 and para. 9(c); Regulation 3.1 and Guideline B3.1.6, para. 5(c); Regulation 3.2, para. 1; Regulation 3.2 and Standard A3.2, para. 1; Regulation 3.2 and Standard A3.2, para. 2(a); Regulation 3.2 and Standard A3.2, para. 7; Regulation 5.1.3 and Guideline B5.1.4, para. 8.
[120] Article 12.
[121] Article 13(2).
[122] Article 32(1).
[123] Para. 25(c).
[124] Para. 8(b).
[125] Para. 3(o).
[126] Para. 11(e).
[127] Section 7.2.
[128] *Occupational Health and Safety Act of 1993, Physical Agents Regulations, 2024.*
[129] Basic information 0420 No. 3 of 2020 [in Japanese].
[130] Ministry of Manpower, "Enhanced Measures to Reduce Heat Stress Risks for Outdoor Workers".

Cool and shaded rest areas

71. Designated cooling spaces are essential for worker recovery after exposure to heat. In many countries, employers are required to provide cool and shaded rest areas to protect workers from heat stress. In China, for example, heatstroke prevention regulations specify that rest areas must be ventilated and equipped with cooling devices to allow workers to recover. [131] Similarly, Japan's OSH legislation requires air-conditioned or shaded rest areas, along with access to cold towels, ice and electrolyte drinks. [132] Brazil requires thermally comfortable recovery spaces for workers when WBGT levels exceed prescribed limits. [133] In Qatar, employers are required to provide shaded resting areas that are easily accessible to workers and effective in protecting them from sunlight and high temperatures during rest breaks. [134]

Work breaks

72. Introducing work breaks or work-rest cycles enables workers to leave hot areas of the worksite to rehydrate and allow the body to cool. For moderate-intensity work, hourly breaks of 10–15 minutes in shaded areas can prevent rises in core body temperature for exposures of up to 29°C WBGT, but longer breaks are needed in higher temperatures. [135] Regulations in several countries mandate periodic cooling breaks to allow workers exposed to heat to rest. In India, guidelines from the National Disaster Management Authority recommend increasing the frequency and length of rest breaks for outdoor work. [136] In Saudi Arabia, guidelines from the National Council for Occupational Safety and Health require employers to ensure that workers exposed to the risks of working in hot places are given adequate breaks. [137] In Singapore, employers are required to provide hourly rest breaks of at least 10 minutes for heavy physical work when the WBGT reaches 32°C, and at least 15 minutes when the WBGT exceeds 33°C, with longer rest periods required as the WBGT increases. [138]

Ventilation

73. An effective method for preventing workplace heat stress, particularly in indoor work environments, is introducing engineering controls through active ventilation. These methods, such as using a fan or an air conditioning system, are often more effective than passive cooling methods such as resting, removing clothing or PPE, or relying on natural ventilation. [139] In outdoor settings, depending on humidity, misting ventilation systems have proven effective at reducing ambient air temperature. In Belgium, [140] artificial ventilation devices should be installed within 48 hours if maximum temperature limits are exceeded. Whenever WBGT levels exceed the limits set for indoor environments or environments with artificial heat sources, Brazil requires that the air ventilation system be adjusted. [141] The preventive measures established in Chile to be

[131] Notice on the issuance of measures for the administration of heatstroke prevention and cooling measures, Safety Supervision General Anjian [2012] No. 89.
[132] Basic information 0420 No. 3 of 2020 [in Japanese].
[133] NR-9, Physical, chemical, and biological agents [in Portuguese].
[134] Article 4(4) of the Decision of the Minister of Administrative Development, Labour and Social Affairs No. (17) of 2021 on the Necessary Precautions to Protect Workers from Heat Stress.
[135] ILO, *Heat at Work*.
[136] Annexure 4 of the *National Guidelines for Preparation of Action Plan: Prevention and Management of Heat Wave,* 2019.
[137] Section 4.1.10 of the *Procedural Guidelines for Occupational Safety and Health for Preventing the Effects of Exposure to the Direct Sun and Heat Stress 1442-2021*.
[138] Ministry of Manpower, "Enhanced Measures to Reduce Heat Stress Risks for Outdoor Workers".
[139] ILO, *Heat at Work*.
[140] Section 2.1 of the Code of Well-being at Work, Book V, Title 1 on thermal environmental factors [in French].
[141] NR-9, Physical, chemical, and biological agents [in Portuguese].

implemented in workplaces during high temperatures include natural ventilation and the use of air conditioning, fans or other equally effective methods. [142] In Germany, if the air temperature in the room exceeds 26°C, protection measures such as ventilation systems, relaxation of clothing regulations and electric fans should be implemented. [143]

Work organization adjustments

74. Implementing job rotation and schedules allows workers who perform physically demanding tasks and/or who work in hot areas of a worksite to be assigned less intense workloads or to work in cooler areas. When feasible, work that is physically demanding and takes place in hot environments should be planned for cooler times of the day, and regular maintenance or repair work to be carried out in hot areas should be scheduled for cooler annual seasons. Legislation in Cyprus states that working hours should be organized so that heavy work is carried out in the coolest hours of the day. [144] Brazil requires the rescheduling of physically demanding tasks to cooler periods. [145] In Germany, if the air temperature in the room exceeds 26°C, protection measures include flexitime arrangements to shift working hours. [146]

Training and education

75. Formal training allows workers to know how to protect themselves from heat-related risks at work. [147] Effective training on the risks of excessive heat should be carried out regularly, particularly before warmer seasons, to raise awareness of the signs and symptoms of heat-related illnesses. A heat stress training programme should include information about the risks of excessive heat, hydration, and the recognition and treatment of heat-related illnesses. [148] The use of administrative controls, such as infographics and posters, and the placing of signs in high-risk and rest areas can serve as preventive measures. In Belgium, workers exposed to extreme temperatures must be trained in risk assessments, temperature limits, preventive measures, recognition of symptoms, individual factors affecting thermal load and safe practices. [149] Similar provisions exist in Japan [150] and Mexico. [151]

PPE supply and other safety equipment

76. In line with the hierarchy of controls, PPE should only be used when no other control measures can effectively prevent heat stress. Simpler forms of PPE, such as hats, neck covers, loose-fitting and breathable clothing, can often be practical and cost-effective in reducing heat stress risks for both outdoor and indoor workers. [152] In Chile, employers must provide workers with PPE, including hats, sunglasses and sunscreen. [153] Eswatini, [154] Fiji [155] and Italy [156] also have legislation

[142] Ministry of Labour and Social Welfare, "Preventive Measures for Workplaces in High Temperatures", 2024.
[143] Section 4.4 of the "Technical Rules for Workplaces: Room Temperature ASR A3.5" [in German].
[144] Section 5.3 of the Code of Practice for the Thermal Stress of Workers (Decree K.D.P. 206/2020) [in Greek].
[145] NR-9, Physical, chemical, and biological agents [in Portuguese].
[146] Section 4.4 of the "Technical Rules for Workplaces" [in German].
[147] Climate Rights International (CRI), "My Body is Burning", 2025.
[148] ILO, *Heat at Work*.
[149] Section 8 of the Code of Well-being at Work, Book V, Title 1 on thermal environmental factors [in French].
[150] Basic information 0420 No. 3 of 2020 [in Japanese].
[151] NOM-015-STPS-2001 [in Spanish].
[152] ILO, *Heat at Work*.
[153] Section 7.4 (109.b) of Decree No. 594/1999 [in Spanish].
[154] Section 9(4) of the Occupational Safety and Health Act (No. 9 of 2001).
[155] Section 53 of the "Health and Safety at Work (General Workplace Conditions) Regulations 2003".
[156] Section 1.9.2.5 of the Consolidated Law on Health and Safety at Work (Legislative Decree 81/08).

regarding the provision of PPE and other safety equipment to protect workers from excessive heat.

2.2. Sand and dust storms

77. SDSs are weather events where strong winds lift large quantities of particulate matter from surfaces into the atmosphere, intensifying air pollution. A dust storm results from surface winds raising dust into the air and reducing visibility to less than 1,000 metres, although severe events may produce zero visibility. [157] Although there is no strict delineation between sandstorms and dust storms, sand particles are usually larger, and sandstorms usually have a limited arial extent and localized impacts. [158] The duration of SDS events varies from a few hours to several days. [159] Dust storms frequently occur in dryland regions [160] and in the "dust belt" (that is to say, North Africa, the Middle East and East Asia). Climate phenomena such as desertification and drought increase SDS occurrence. [161]

78. SDSs negatively affect human health in both source and impact areas, due to intensified exposure to airborne particulate matter. [162] Epidemiological research has established a correlation between SDSs and the increased risk of respiratory morbidity and cardiovascular mortality. [163] They may cause inflammatory and allergic lung diseases, including asthma, chronic obstructive pulmonary disease and lung fibrosis, [164] and may contribute to the transmission of infectious diseases like valley fever and meningitis. [165] Other health impacts include pregnancy concerns, cognitive difficulties and birth problems. [166] SDSs can also impact mental health as they may cause stress, anxiety, depression, grief, strains on social relationships and post-traumatic stress disorder (PTSD). [167] Dust may also impact visibility, settle onto equipment, and disrupt the operation or functioning of machinery, potentially leading to accidents and injuries. [168]

79. SDSs pose serious risks to outdoor workers, such as those in agriculture, construction, transportation and any outdoor work environment. Agricultural workers are especially exposed, with the poorest and most vulnerable communities most often affected. [169] Individuals at heightened health risk include older adults and those with existing conditions, such as respiratory and heart disease and diabetes. [170]

80. Depending on the severity of the storm, work may have to be halted for its duration. When work can proceed safely, extra precautions are required in the use of machinery and equipment to

[157] Grant H. McTainsh and James R. Pitblado, "Dust storms and related phenomena measured from meteorological records in Australia", *Earth Surface Processes and Landforms* 12, No. 4 (1987), 415–424.
[158] United Nations Environment Programme (UNEP), WMO and United Nations Convention to Combat Desertification (UNCCD), *Global Assessment of Sand and Dust Storms*, 2016.
[159] UNCCD, *Sand and Dust Storms Compendium: Information and Guidance on Assessing and Addressing the Risks*, 2022.
[160] New South Wales (NSW) Health, "Dust storms", 2023.
[161] Food and Agriculture Organization of the United Nations (FAO), "Sand And Dust Storms (SDS): A Transboundary Issue of Growing Concern", 2022.
[162] UNCCD and FAO, *Guideline on the Integration of Sand and Dust Storm Management into Key Policy Areas*, 2024.
[163] Kaung Suu Lwin et al., "Effects of Desert Dust and Sandstorms on Human Health: A Scoping Review", *GeoHealth* 7, No. 3 (2023).
[164] American Thoracic Society, "Sand and Dust Storms: Acute Exposure and Threats to Respiratory Health", *American Journal of Respiratory and Critical Care Medicine* 198, No. 7 (2018), 13–14.
[165] Lwin et al., "Effects of Desert Dust and Sandstorms on Human Health", *GeoHealth*.
[166] Hamidreza Aghababaeian et al., "Global Health Impacts of Dust Storms: A Systematic Review", *Environmental Health Insights* 15, (2021), 1–28.
[167] UNCCD, *Sand and Dust Storms Compendium*.
[168] Australian WorkSafe Act, "Smoke, pollen and dust in the workplace".
[169] UNCCD and FAO, *Guideline on the Integration of Sand and Dust Storm Management into Key Policy Areas*.
[170] NSW Health, "Dust storms".

ensure workers remain visible to operators. In road construction, this includes stabilizing roadbeds to prevent material movement, verifying that visibility vests remain effective in high-dust conditions, and ensuring that equipment operators maintain clear sightlines, for example by cleaning windows frequently. For building construction, dust control measures include installing cloth or plastic curtains; using water sprays; early use of air conditioning; and sealing openings, while considering fire safety, to limit dust entry. Both road and building construction should also address how goggles and masks affect visibility and communication. These protection measures complement those needed in the hot, dry environments where SDSs occur, like hydration and sun protection. Overall, source mitigation measures should be in place to reduce dust generation during both normal conditions and SDS events. [171] Most current air quality monitoring and early warning systems do not register SDSs, as they are not equipped to measure the relevant particulate matter. Integrating the capacity for SDS prediction and tracking into meteorological forecasts could strengthen anticipatory action to protect workers. [172]

81. Some countries have developed specific frameworks to address SDS risks in the workplace. The United Arab Emirates adopted a technical guideline on workplace risks from adverse weather, outlining actions for each severity level, including SDSs. [173] Winds gusts over 75 km/h and/or sandstorms with visibility of less than 30 metres are classified at the "catastrophic severity level", requiring all external work to stop. Gusts between 50 km/h and 75 km/h and/or sandstorms with visibility of less than 100 metres are classified at the "major severity level". Various types of work should be subject to limitations in these cases, including the cancellation of all external driving and the suspension of work at height. Gusts between 38 km/h and 49 km/h and/or sandstorms are classified at the "moderate severity level", with restrictions such as cancelling non-essential driving and suspending external lifting operations. The guideline also recommends further controls, including postponing any driving in high winds that may lead to losing control of vehicles, adopting warning alarms when visibility is reduced due to SDSs, and removing high-risk items, such as scaffolding structures and heavy cranes, during extreme high wind. The guideline does not specify threshold values for concentrations of inhalable particulate matter.

82. Public health institutions in several countries advise workers to take protective measures during SDSs. The Chinese Centre for Disease Control and Prevention, [174] for example, recommends that those who must stay outdoors for occupational reasons, such as traffic police, sanitation workers and construction workers, should take personal protective measures, including the use of masks, wind-proof glasses, and hats or gauze kerchiefs to avoid damage to the skin, hair and ears.

2.3. Droughts and wildfires

83. According to the WMO, drought "is a slow onset phenomenon caused by a lack of rainfall", leading to water shortages. [175] The proportion of global land experiencing extreme drought has significantly increased, from 15 per cent in the 1950s to 44 per cent in 2013–2024, [176] affecting an estimated 55 million people every year. [177] Arid and semi-arid regions, primarily in Africa, Central

[171] UNCCD, *Sand and Dust Storms Compendium.*
[172] UNCCD and FAO, *Guideline on the Integration of Sand and Dust Storm Management into Key Policy Areas*.
[173] Abu Dhabi Public Health Centre, Abu Dhabi Occupational Safety and Health System Framework, "Technical Guideline Dealing with Adverse Weather Conditions", 2024.
[174] Chinese Center for Disease Control and Prevention (China CDC),"Health Tips for Sandy and Dusty Weather", March 2023.
[175] WMO, "Drought".
[176] Romanello et al., "The 2024 Report of the Lancet Countdown on Health and Climate Change"; *The Lancet*, 1847–1896.
[177] WHO, "Drought".

and West Asia, and Australia face an escalating risk. [178] Droughts severely threaten crops and livestock, disrupt livelihoods and are considered the world's costliest disaster associated with a natural hazard, affecting more people than any other. [179] Changing weather patterns are shifting global rainfall and intensifying heatwaves, increasing drought risk in some regions.

84. Droughts pose various health risks for workers across different industries. In agriculture, drought can cause income and livelihood loss, which may trigger psychosocial impacts, such as stress, social isolation, anxiety, depression and suicide. [180] Drier conditions increase dust, smoke and other particulate matter, degrading air quality and raising respiratory illness risks in exposed workers. [181] Dust also heightens the risk of workers inhaling pesticides. [182] There is also a higher risk of dehydration due to limited water availability, and poor access to clean water can increase the likelihood of gastrointestinal diseases as well as skin and eye infections. [183] Furthermore, certain fungi that thrive on drought-affected trees can cause allergic reactions and diseases. [184] Outdoor workers, including construction, agriculture and landscaping workers, are most vulnerable. [185]

85. Measures to prevent OSH risks arising from droughts are generally encompassed within OSH legislation addressing exposure to heat, including the mandatory provision of safe drinking water, implementation of heat stress management protocols, and establishing rest and shaded areas for outdoor workers. Nevertheless, specific protections may also be guaranteed under broader social protection frameworks. Some countries provide social protection measures in response to climate-related events, including droughts. For example, in 2024, artisanal fishers affected by the extreme and prolonged drought in northern Brazil received a cash benefit equivalent to two minimum wages to help mitigate its impact on their livelihoods. [186]

86. One phenomenon linked to droughts are wildfires. A wildfire "is an uncontrolled burn of vegetation, which includes the burning of forests, shrublands and grasslands, savannas, and croplands". [187] They cause widespread devastation, destroying land and resources. Compound hot, dry and windy events, also known as fire weather conditions, have become more probable in some regions. [188] As a result, wildfires now burn over twice as much tree cover as they did two decades ago, with nearly 6 million more hectares lost annually – approximately the size of Croatia. [189]

[178] Tingting Wang and Fubao Sun, "Integrated Drought Vulnerability and Risk Assessment for Future Scenarios: An Indicator Based Analysis", *Science of The Total Environment* 900 (2023).
[179] WMO, "Drought".
[180] Anna Yusa et al., "Climate Change, Drought and Human Health in Canada", *International Journal of Environmental Research and Public Health* 12, No. 7 (2015), 8359–8412; Jesse D. Berman et al., "The Association Between Drought Conditions and Increased Occupational Psychosocial Stress Among U.S. Farmers: An Occupational Cohort Study", *Science of the Total Environment* 798, (2021).
[181] Yeongjin Gwon et al., "The Association between Drought Exposure and Respiratory-Related Mortality in the United States from 2000 to 2018", *International Journal of Environmental Research and Public Health* 20, No. 12 (2023).
[182] Daniel Q. Tong, "Health and Safety Effects of Airborne Soil Dust in the Americas and Beyond", *Reviews of Geophysics* 61, No. 2 (2023).
[183] Carla Stanke et al., "Health Effects of Drought: A Systematic Review of the Evidence", *PLoS Currents* 5 (2013); Bridget Knitowski, "Drought: Ten to Do Ten", *Delaware Journal of Public Health* 9, No. 5 (2023), 26–32.
[184] Paul A. Schulte, "Updated Assessment of Occupational Safety and Health Hazards of Climate Change", *Journal of Occupational and Environmental Hygiene* 20, No. 5–6 (2023), 183–206.
[185] Schulte, "Updated Assessment of Occupational Safety and Health Hazards of Climate Change".
[186] Provisional Measure No. 1.263/2024 [in Portuguese].
[187] Veronika Samborska and Hannah Ritchie, "Wildfires", *Our World in Data*, 2024.
[188] Seneviratne et al., "Weather and Climate Extreme Events in a Changing Climate".
[189] James MacCarthy et al., "The Latest Data Confirms: Forest Fires are Getting Worse", *World Resources Institute*, 18 December 2024.

87. Wildfire smoke releases large quantities of carbon dioxide, carbon monoxide and fine particulates, significantly degrading air quality and posing serious health risks. Firefighters are particularly exposed, working under physically demanding and prolonged conditions. [190] An increasing number of firefighters across the world are dying while battling wildfires. [191] Others face significant health implications, including short-term respiratory issues and long-term health effects, cardiovascular diseases and ophthalmic conditions. [192] Adverse mental health impacts have also been linked to wildfire suppression, including higher rates of PTSD and lasting psychological symptoms. [193]

88. Besides firefighters, high-risk groups include other emergency workers, medical personnel, police and construction workers involved in clean-up efforts. [194] Workers in other outdoor occupations, such as agriculture, construction, landscape, utility work and facility maintenance, can also be exposed to wildfire smoke. Workers with pre-existing respiratory and cardiovascular diseases are especially vulnerable to exacerbations of these diseases in poor air quality. [195]

89. Given these significant occupational risks, some countries have implemented measures to protect workers exposed to wildfire smoke. These include general obligations under OSH legislation, such as providing PPE, conducting workplace risk assessments, delivering appropriate training and establishing emergency response procedures. Specific legal provisions on wildfire smoke exposure are more limited and are largely reflected in targeted social protection measures and presumptive disability schemes for firefighters.

90. In the state of Victoria, Australia, legislation introduced a rebuttable presumption for forest firefighters that a diagnosis of any of 15 specified forms of cancer within 10 years of service is presumed to be due to the nature of their employment, enabling compensation claims. [196] Cancers covered are brain, bladder, kidney, non-Hodgkin lymphoma, leukaemia, breast, testicular, multiple myeloma, prostate, ureter, colorectal and oesophageal. [197] Each cancer has a specific qualifying period based on the length of employment.

91. In Canada, the National Framework on Cancers Linked to Firefighting was developed with the aim of raising awareness of cancers linked to firefighting and subsequently improve access to cancer prevention and treatment. [198] The Framework proposes action across six pillars: research on cancers linked to firefighting; research on cancer prevention and data collection; training and education in healthcare settings; diagnostic testing for firefighters; information and knowledge-sharing; and standards on health and safety and workers' compensation.

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[190] Kathleen Navarro, "Working in Smoke: Wildfire Impacts on the Health of Firefighters and Outdoor Workers and Mitigation Strategies", *Clinics in Chest Medicine* 41, No. 4 (2020), 763–769.

[191] Seher Asaf, "Ten Workers Killed Battling Wildfires in Turkey", *BBC*, 23 July 2025; Susan Nicol, "At Least Six South African Firefighters Killed Battling Wildfires", *Firehouse*, 15 July 2024; "South Korea says Wildfires Worst in its History, Death Toll Rises to 26", *Al Jazeera,* 27 March 2025; Pedro Nunes and Silvio Castellanos, "Three Firefighters Die as Portugal Battles Dozens of Wildfires", *Reuters*, 18 September 2024; Leyland Cecco, "Canada Mourns Deaths of Firefighters as Wildfires Ravage Millions of Acres", *The Guardian*, 17 July 2023.

[192] Emily Groot et al., "A Systematic Review of the Health Impacts of Occupational Exposure to Wildland Fires", *International Journal of Occupational Medicine and Environmental Health* 32, No. 2 (2019), 121–140; John R. Swiston et al., "Wood Smoke Exposure Induces a Pulmonary and Systemic Inflammatory Response in Firefighters", *European Respiratory Journal* 32, No. 1 (2008), 129–138; Sarah Elise Finlay et al., "Health Impacts of Wildfires", *PLoS Currents Disasters* 4 (2012).

[193] Isabelle Bonita, Olivia M. Halabicky and Jianghong Liu, "Exposure to Wildfires Exposures and Mental Health Problems among Firefighters: A Systematic Review", *Atmosphere* 15, No. 1 (2024), 78.

[194] ILO, *Ensuring Safety and Health at Work in a Changing Climate*.

[195] Navarro, "Working in Smoke".

[196] WorkSafe Victoria, "Presumptive Rights Compensation".

[197] Victorian Legislation, "Forests Amendment (Forest Firefighters Presumptive Rights Compensation) Act 2021 No. 46 of 2021".

[198] Health Canada, *National Framework on Cancers linked to Firefighting*, 2024.

2.4. Heavy precipitation and floods

92. Floods generate widespread devastation, loss of life, and damage to workplaces and critical infrastructure. They are often caused by heavy rainfall, rapid snowmelt or a storm surge from a tropical cyclone or tsunami. [199] Heavy precipitation will become more frequent and more intense with global weather shifts, translating into an increase in the frequency and magnitude of pluvial floods. [200] The EM-DAT database lists over 5,750 flood-related disasters in its international disaster database, making them the most frequent disaster associated with a natural hazard. [201] According to the World Bank, flood risk is global, but the most flood-exposed people live in South and East Asia. [202]

93. Floods expose workers to various hazards and risks, including biological (for example, pathogens in sewage, dead animals and mould), chemical (for example, asbestos and carbon monoxide), and physical (for example, damaged electrics, debris, lifting injuries, fatigue, hypothermia and drowning). [203] Flooding is also associated with waterborne diseases from contact with polluted water. [204] Workers at high-risk include medical personnel, firefighters, other emergency workers and construction workers involved in clean-up. A study in China found that for each 10 mm increase in daily precipitation, work-related injuries rose by 1.57 per cent on the same day and 1.47–1.14 per cent over the following three days. [205] Injuries from falls were more common on rainy days, with older adults, male workers and those with lower education most at risk. Another study reported that disruption to work due to flooding was associated with higher odds of psychological morbidity. [206]

94. Heavy rains, erosion and soil saturation can also trigger landslides. In addition to the direct risk of workers being buried, recovery workers engaged in landslide clean-up efforts are particularly exposed to health risks, including diseases, injuries and death.

95. General OSH principles apply in situations where floods or landslides pose an imminent and serious danger to the lives or health of workers, including the right of workers to remove themselves from danger without fear of undue consequences. Emergency preparedness and response measures, such as early warning systems, evacuation procedures and communication protocols, are essential to reduce risk and enable timely protective action in flood-prone workplaces.

96. Some countries have also adopted specific national measures to address the OSH effects of heavy precipitation and floods. In South Africa, employers in areas where there is a substantial risk of workplace flooding are required to stay informed of any imminent flooding, including arising from water-conservation structures or any constructions that could cause water to converge or

[199] WHO, "Floods"; Section 7 of the Government Decree on the List of Occupational Diseases (769/2015) [in Finnish]; Section 80 of the Revision of the tables of occupational diseases in industry and agriculture of 2023 [in Italian]; Section 1.2.7 of Decree 14229 of 2005, NATLEX database [in French].
[200] Seneviratne et al., "Weather and Climate Extreme Events in a Changing Climate".
[201] Centre for Research on the Epidemiology of Disasters (CRED), EM-DAT, The International Disaster Database.
[202] Jun Rentschler et al., "Flood Risk Already Affects 1.81 Billion People. Climate Change and Unplanned Urbanization could Worsen Exposure", *World Bank Blogs* (blog), 28 June 2022.
[203] Government of Alberta, "Workplace Health and Safety After a Flood", 2020; Rory O'Neill, "Flood Preparation Can Save Lives", *Hazards*, March 2014.
[204] ILO and WHO, *Occupational Safety and Health in Public Health Emergencies: A Manual for Protecting Health Workers and Responders*, 2018.
[205] Tian Tian et al., "The Risk of Injuries During Work and its Association with Precipitation: New Insight from a Sentinel-Based Surveillance and a Case-Crossover Design", *Frontiers in Public Health* 11 (2023).
[206] Thomas David Waite et al., "The English National Cohort Study of Flooding and Health: Cross-Sectional Analysis of Mental Health Outcomes at Year One", *BMC Public Health* 17, No. 1 (2017), 129.

accumulate on their premises. Additionally, before such a structure is erected, employers must provide written notice to all individuals located in the potential danger zone downstream, warning them of possible flooding. [207]

97. In Mauritius, during periods of extreme weather, including, but not limited to, heavy rainfall, if the National Crisis Committee issues an order requiring individuals to remain indoors, or if a state of disaster is declared, employers are prohibited from requiring workers to attend work or to continue working if they would be exposed to such conditions. In these circumstances, workers must receive a full day's remuneration if no work can be performed due to the weather or if they have worked two hours or more, or a half day's renumeration if work stops before two hours are completed or if the worker has worked no more than two hours. [208]

2.5. Extreme cold, blizzards and winter storms

98. Extreme cold weather refers to "temperatures that are lower than historical averages to the point that it creates a dangerous environment for people, animals and critical infrastructure". [209] What constitutes extreme cold, however, varies across regions. A cold wave, specifically, is characterized by a sharp and significant drop in air temperatures that is, in turn, associated with hazardous weather including frost and ice. [210] Extreme cold has long been a concern for OSH professionals due to its effects on workers. Today, changing weather patterns may be intensifying these conditions, making the hazard more severe.

99. Extreme cold can lead to health emergencies for outdoor workers and those working in buildings that are poorly insulated or without heat. [211] High-risk groups include workers who may be required to work outdoors for extended periods, such as snow clean-up crews, sanitation workers, police officers and emergency responders. [212] Workers in construction, utilities, forestry, telecoms, agriculture and fisheries (for example, deep-sea fishing and fish processing) are also vulnerable. [213] Extreme cold can be particularly dangerous for individuals with existing health conditions, such as asthma or cardiovascular disease, and for older workers. [214] Furthermore, while extreme cold is more common in high-income countries due to colder climates, the burden of disease related to extreme cold is more severe in low and middle-income countries due to limited infrastructure and few protective resources. [215]

100. Factors affecting cold exposure of workers include air temperature, wind speed and humidity. [216] In a cold environment, the body shifts blood from the extremities and outer skin to the core. Common cold-induced illnesses and injuries include hypothermia, frostbite, trench foot and chilblains. [217] A systematic review and meta-analysis identified a higher prevalence of chilblains among outdoor workers and those frequently exposed to water, with more extensive skin

[207] Regulation 13I of the General Safety Regulations of 6 March 2025.
[208] Section 32(1A) of the Workers' Right Act (Government Gazette of Mauritius No. 87 of 23 August 2019).
[209] Cybersecurity and Infrastructure Security Agency (CISA), "Extreme Cold".
[210] WMO, *Guidelines on the Definition and Characterization of Extreme Weather and Climate Events*, 2023.
[211] WHO and WMO, "Extreme Cold", *ClimaHealth* (blog).
[212] U.S. Department of Labor, OSHA, "Cold Stress Guide".
[213] Supporting Occupational Health and Wellbeing Professionals (SOM), "Cold: Occupational Health Considerations".
[214] WHO and WMO, "Extreme Cold".
[215] Yajie Du et al., "Global Population Exposure to Extreme Temperatures and Disease Burden", *International Journal of Environmental Research and Public Health* 19, No. 20 (2022), 13288.
[216] ILO, *Heat at Work*.
[217] U.S. Department of Labor, OSHA, "Cold Stress Guide".

involvement linked to prolonged cold and damp conditions in physically demanding jobs. [218] When the hands and feet are exposed to cold, performing tasks can become more difficult and uncomfortable, while reduced sensitivity may raise the risk of injury. [219] Extended exposure to cold environments may also result in decreased cognitive performance in workers. [220] Moreover, it has been shown that there is a notable increase in incidents at chemical facilities during cold weather. [221] Refineries, chemical plants, and other sites with hazardous materials are especially vulnerable to impaired functionality and risk of failure due to extreme cold and ice formation.

101. Most OSH legislation on extreme cold has been in place for decades, especially in regions where cold has long been recognized as a workplace hazard. However, many countries do not set a specific minimum temperature threshold, particularly for outdoor work. Regulations in colder countries usually focus on indoor work and often do not require mandatory stoppages for outdoor work during extreme cold.

102. In Canada, the province of Ontario sets a minimum temperature of 18°C for enclosed workplaces. [222] Other provinces and territories, such as British Columbia, Manitoba, New Brunswick, Newfoundland and Labrador, and Nunavut, refer to the ACGIH threshold limit values for cold stress. These limits are specifically intended to protect workers from the most severe impacts of cold stress (hypothermia and frostbite) and to describe exposures to cold working conditions that it is believed nearly all workers can be repeatedly exposed to without negative health effects. [223] According to the ACGIH, workers should be protected so that the deep core temperature does not fall below 96.8°F (36°C) and in order to prevent frostbite to body extremities. [224] The wind chill temperature index is used by the ACGIH to define temperature criteria, and integrates temperature and wind speed to estimate the overall cooling power of an environment.

103. In the Russian Federation, workplace temperature standards vary according to work intensity. For very heavy work, the air temperature must be maintained between 13.0 and 15.9°C, whereas for very light (sedentary) work, the air temperature should be between 20.0 and 21.9°C. [225]

104. In countries less prone to extreme cold, legislation on cold exposure primarily focuses on work in cold storage facilities, where artificially low temperatures present localized risks. However, as these laws often do not differentiate between artificial and natural sources of cold, protective measures could apply to all forms of cold exposure, regardless of the source. In Chile, regulations define critical exposure as any condition that causes a worker's core body temperature to drop to 36°C or lower, with 35°C permitted only for a single, occasional exposure. Outdoor temperatures are deemed hazardous when at or below 10°C, particularly when combined with rain or wind. [226] In South Africa, employers must prevent cold stress where reasonably practicable, and if the time-

[218] Areti K. Kapnia et al., "Population Characteristics, Symptoms, and Risk Factors of Idiopathic Chilblains: A Systematic Review, Meta-Analysis, and Meta-Regression", *Biology* 11, No. 11 (2022), 1651.
[219] John Kushnick, "The Hidden Workplace Risks of Cold Weather", *HSM* (blog), 10 December 2024.
[220] Marika Falla, "The Effect of Cold Exposure on Cognitive Performance in Healthy Adults: A Systematic Review", *International Journal of Environmental Research and Public Health* 18, No. 18 (2021).
[221] United States Chemical Safety Board, "CSB Releases New Chemical Incident Data and Calls for Increased Attention to Process Safety Management During Winter Period", 28 December 2022.
[222] Section 129, "Occupational Health and Safety Act, R.R.O. 1990 Regulation 851: Industrial Establishments".
[223] Government of Nova Scotia, "Cold Stress Guidelines".
[224] ACGIH, *Documentation of Threshold Limit Values and Biological Exposure Indices* (TLVs and BEIs), 2023.
[225] Table 5.1 of SanPiN 1.2.3685-21 "Hygienic Standards and Requirements for Ensuring the Safety and (or) Harmlessness of Environmental Factors for Humans", 2021 [in Russian].
[226] Section 99 of Decree No. 594/1999 [in Spanish].

weighted average equivalent chill temperature [227] over a four-hour period is below 10°C, they must provide whole-body PPE with adequate insulation and limit the duration and magnitude of exposure of employees to not exceed prescribed periods.

105. Interventions to protect workers in situations of extreme cold also include sheltering workers in climate-controlled enclosures, supplying insulated PPE, and managing work schedules to alternate tasks and allow for recovery periods. Additionally, exposed workers can be supplied with adequate food that is easily digestible and able to provide the necessary caloric intake. [228] With regard to work in fishing, Convention No. 188 [229] provides that accommodation on fishing vessels shall be adequately heated, taking into account climatic conditions. At the national level, Belgium enforces strict protections, including mandatory heating for outdoor workers when temperatures fall below 5°C, and the provision of hot drinks for workers exposed to cold stress. [230] In Poland, if the temperature at the workplace drops below 10°C, the employer is obliged to provide the employee with warm work clothes. If the temperature at the workplace drops below 4°C, the employer must equip the employee with gloves and warm work shoes. [231] Some countries recognize cold-related illnesses as occupational diseases, such as the Swiss list of occupational diseases, [232] which includes frostbite.

106. Shifts in extreme temperatures are causing more damaging winter storms, with a risk that blizzards will intensify as the polar vortex is disrupted. [233] Blizzards can be defined as "[s]ustained wind or frequent gusts to 35 miles an hour or greater and considerable falling and/or blowing snow … for a period of three hours or longer". [234] Business interruption losses due to winter storms are increasing due to storm damage or when heavy snow and ice cripple infrastructure.

107. Blizzards pose significant risks to OSH by creating hazardous working conditions for outdoor workers. These risks include an increased chance of slips and falls, exposure to extreme cold, reduced visibility, transportation disruptions and potential structural damage to workplaces. [235] For instance, heavy snowstorms can cause roof collapses, a significant danger to workers. [236] Examples of dangerous tasks in blizzards are winter driving, shovelling snow, clearing snow from roofs, working at heights, repairing downed or damaged power lines, and clearing downed trees. [237]

2.6. Tropical cyclones

108. A tropical cyclone is a generic term used to describe a rapidly rotating storm that begins over tropical oceans, which can vary in speed, size and intensity. [238] Weather changes are expected to modify the intensity and frequency of tropical cyclones, and ocean warming creates conditions

[227] "Equivalent chill temperature" is the expression of wind-chill reflecting the cooling power of wind on exposed flesh, which takes into account both dry-bulb temperature and wind speed.
[228] ILO, *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.
[229] Annex III, para. 26.
[230] Code of Well-being at Work, Book V, Title 1 on thermal environmental factors [in French].
[231] Regulation of the Ministry of Labour and Social Policy of 1997.
[232] Annex 1 of the Accident Insurance Ordinance, 1982 [in French].
[233] Judah Cohen et al., "Linking Arctic Variability and Change with Extreme Winter Weather in the United States", *Science* 373, No. 6559 (2021), 1116–1121.
[234] CISA, "Extreme Cold".
[235] U.S. Department of Labor, OSHA, "Winter Weather".
[236] Barry S. Levy and Cora Roelofs, "Impacts of Climate Change on Workers' Health and Safety", *Oxford Research Encyclopedia of Global Public Health,* 2019.
[237] U.S. Department of Labor, OSHA, "Winter Weather".
[238] WMO, "Tropical Cyclone".

where storms can strengthen more quickly, resulting in higher intensities. [239] Moreover, increases in the amount of moisture in the atmosphere heighten the likelihood of extreme rainfall during tropical cyclones, which, together with rising sea levels, can increase the risk of storm surges and flooding. [240]

109. Tropical cyclones can often bring multiple hazards, such as extreme winds, heavy rainfall, storm surges and flooding, lightning and tornadoes. In the Atlantic and East Pacific, tropical cyclones are commonly referred to as "hurricanes"; in the West Pacific, they are called "typhoons"; while in the Indian Ocean and Australia, they are simply known as "cyclones". [241] The immediate impacts on workers include injuries and safety risks directly caused by the event, while secondary hazards arise from post-event conditions, such as exposure to harmful substances, environmental changes or additional safety threats. In general, the key OSH hazards associated with storms include: structural instability, with risks from: downed lines, live electrical equipment and other utilities (for example gas and water); noise; falls from height or through openings; asbestos and lead; impact to the eyes and face from flying objects; manual handling of materials/weights; discovery of unknown chemicals; cuts and lacerations; and slips, trips and falls while working. [242]

110. Between 1970 and 2021, 2,050 disasters attributed to tropical cyclones were reported worldwide, causing more than 780,000 deaths and economic losses of US$1.6 trillion. [243] Workers may be injured or killed during tropical cyclones, especially when emergency procedures are lacking. In 2024, six workers in Tennessee died after late evacuation during Hurricane Helene. [244] Similarly, during Cyclone Mora in Bangladesh in 2017, many fishing workers drowned or suffered related accidents. [245]

111. High-risk groups of workers include medical personnel, firefighters, emergency responders, construction workers involved in clean-up, and agricultural and fishing workers. First responders face risks such as drowning, physical trauma from debris, hazardous chemical exposures and water- and vector-borne diseases. [246] Clean-up workers, construction workers and other emergency personnel face secondary hazards, like unstable infrastructure and chemicals, including lead, asbestos and solvents. [247] Restoration workers have reported bacterial infections and respiratory issues, such as fever, cough, pneumonia and new-onset asthma, due to high levels of particulate matter and endotoxins. [248] Agricultural workers are impacted by land destruction, leading to acute and chronic health issues, like traumatic injuries, fatigue and mental stress. [249] Most health impacts peak within six months, though chronic conditions, such as cardiovascular disease and mental disorders, can persist for years. [250] Furthermore, workers may experience

[239] James P. Kossin et al., "Global Increase in Major Tropical Cyclone Exceedance Probability over the Past Four Decades", *Proceedings of the National Academy of Sciences* 117, No. 22 (2020), 11975–11980.
[240] Timothy M. Hall and James P. Kossin, "Hurricane Stalling Along The North American Coast And Implications For Rainfall", *npj Climate and Atmospheric Science* 2, No. 17 (2019).
[241] NASA, "What is the difference between a typhoon, cyclone, and hurricane?".
[242] ILO and WHO, *Occupational Safety and Health in Public Health Emergencies*.
[243] WMO, "Status of Mortality and Economic Losses".
[244] Lucy Siers, "Hurricanes, Flooding and Wildfires? Workers are Still Expected to Turn Up for Work", *NYU Stern Center for Business and Human Rights,* 23 October 2024.
[245] Edris Alam, "Factors of Cyclone Disaster Deaths in Coastal Bangladesh", *Heliyon* 9, No. 7 (2023).
[246] ILO, *Chemicals and Climate Change in the World of Work: Impacts for Occupational Safety and Health,* 2023; WHO, "Tropical Cyclones".
[247] ILO, *Chemicals and Climate Change in the World of Work*.
[248] Samantha L. Waddell et al., "Perspectives on the Health Effects of Hurricanes: A Review and Challenges", *International Journal of Environmental Research and Public Health* 18, No. 5 (2021), 2756.
[249] Schulte, "Updated Assessment of Occupational Safety and Health Hazards of Climate Change".
[250] Waddell et al., "Perspectives on the Health Effects of Hurricanes".

adverse mental health effects linked to emergency situations due to injury risks or economic uncertainty. [251]

112. Given the serious risks tropical cyclones pose, emergency preparedness is critical in workplaces located in cyclone-prone areas. The establishment of early warning systems is used by many countries to ensure that timely information is received and that workers can take protective action. In addition, building codes and OSH regulations often require cyclone-resistant construction, the reinforcement of workplaces, and the securing of hazardous materials, including chemicals and fuels, to mitigate risks of structural collapse, fire or toxic releases.

113. Furthermore, broader OSH legislation usually establishes the duty of employers to conduct regular drills and provide training to ensure that workers are prepared to evacuate the workplace safely and efficiently. The right of workers to remove themselves from a dangerous situation when they reasonably believe it poses a serious and imminent threat to their life or health, without fear of retaliation or loss of entitlements, is also guaranteed in many countries, thereby ensuring that evacuation can take place without delay or hesitation. In the Philippines, Labour Advisory No. 17 of 2022 provides that employees who fail or refuse to work by reason of imminent danger resulting from weather disturbances and similar occurrences should not be subject to any administrative sanction. [252]

114. Other measures can be implemented to safeguard workers during tropical cyclones, including provisions on remuneration and special allowances. In Mauritius, where a cyclone warning class III or IV is in force, workers may remain absent from work and their employer must pay them their normal rate of remuneration for the period of absence. Where the nature of the undertaking requires the worker to perform duties on the employer's premises or at any assigned location during extreme weather conditions (which include cyclonic conditions where a warning class III or IV is issued), the worker is entitled, in addition to their regular remuneration, to an allowance equal to three times the basic hourly rate for every hour worked, and an adequate free meal provided by the employer. [253]

2.7. Associated hazards and exposures

115. While this report addresses extreme weather events and changing weather patterns, it also highlights associated hazards, including shifts in vector distribution, increased reliance on agrochemicals, exposure to air pollution and UV radiation, and MIAs. These interlinked exposure scenarios often result in compounded hazards for workers and may require tailored OSH measures.

2.7.1. Changes in vector distribution

116. Vector-borne diseases are illnesses caused by parasites, viruses and bacteria and transmitted by vectors, such as mosquitoes, ticks and fleas. [254] The ILO estimates that over 15,170 workers die each year from occupational exposure to parasitic and vector diseases, which include malaria, trypanosomiasis, chagas disease, schistosomiasis, leishmaniasis, lymphatic filariasis, onchocerciasis, cysticercosis, echinococcosis, dengue, trachoma, yellow fever and rabies, representing about 7.6 per cent of all deaths from vector-borne diseases. [255] These figures are

[251] WHO, "Tropical Cyclones".
[252] Section 3 of Labor Advisory No. 17 of 2022.
[253] Section 32(4) and (6) of the of the Workers' Right Act (Government Gazette of Mauritius No. 87 of 23 August 2019).
[254] WHO, "Vector-Borne Diseases".
[255] This ILO global data is based on the 2023 ILO Global Estimates of occupational injuries and work-related illnesses.

likely underestimated due to insufficient data and difficulties in determining causality. [256] Overall, the risk is expected to grow, with a study showing that an additional 4.7 billion people may be exposed to vector-borne diseases by 2070. [257]

117. Outdoor workers are especially vulnerable to vector-borne diseases, [258] including farmers, foresters, landscapers, construction workers, delivery workers and firefighters. Emergency responders and healthcare workers who come into contact with infected individuals are also at risk, with the potential to spread disease further. [259]

118. Vector-borne diseases primarily affect tropical and subtropical regions and disproportionately impact low-income populations. However, changing weather patterns are altering their distribution and rate of spread. [260] As weather patterns change, models project a substantial expansion of regions with a suitable climate for many vector-borne diseases. [261] Consequently, outdoor workers may find themselves exposed to diseases such as Lyme disease, dengue, chikungunya and Zika in regions and/or during periods where transmission was previously unlikely. [262] Schistosomiasis is anticipated to become more prevalent in regions previously considered non-endemic, such as in parts of the Amazon Basin, and in Kenya, Lao People's Democratic Republic, Myanmar and United Republic of Tanzania. In already endemic areas, like South America, Southeast Asia and sub-Saharan Africa, its transmission season is projected to be prolonged, increasing human exposure to the parasite. [263] Warming in regions with suitable environmental conditions is expected to increase dengue cases, [264] in both endemic areas like Brazil [265] and non-endemic areas like Japan. [266]

119. Vector-borne diseases are already responsible for considerable losses in economic productivity, primarily in regions with endemic diseases, such as malaria in Africa. [267] Endemic vector-borne diseases weaken the health and physical capacity of workers, consequently increasing the number of workdays lost to ill health. [268] Moreover, the lasting health impacts of vector-borne diseases may reduce individuals' working capacity in the long term.

120. Convention No. 192 [269]requires employers to adopt preventive and protective measures as a result of an assessment of biological risks in the working environment. Enabled by risk

[256] ILO, *Biological Hazards in the Working Environment*, ILC.112/IV(1), 2022.
[257] Felipe J. Colón-González et al., "Projecting the Risk of Mosquito-Borne Diseases in a Warmer and More Populated World: A Multi-Model, Multi-Scenario Intercomparison Modelling Study", *The Lancet Planetary Health* 5, No. 7 (2021), e404–e414.
[258] Paul A. Schulte et al., "Advancing the Framework for Considering the Effects of Climate Change on Worker Safety and Health", *Journal of Occupational and Environmental Hygiene* 13, No. 11 (2016), 847–865.
[259] Nicoletta Vonesch et al., "Climate change, vector-borne diseases and working population", *Annali dell'Istituto superiore di sanita* 52, No. 3 (2016), 397–405.
[260] ILO, *Chemicals and Climate Change in the World of Work*.
[261] Joacim Rocklöv and Robert Dubrow, "Climate Change: An Enduring Challenge for Vector-Borne Disease Prevention and Control", *Nature immunology* 21, No. 5 (2020), 479–483.
[262] ILO, *Technical Guidelines on Biological Hazards in the Working Environment*, MEBH/2022/1, 2023.
[263] Kwame Kumi Asare et al., "Impact of Climate Change on Schistosomiasis Transmission and Distribution—Scoping Review", *International Journal of Environmental Research and Public Health* 22, No. 5 (2025), 812.
[264] Amir S. Siraj et al., "Temperature Modulates Dengue Virus Epidemic Growth Rates through its Effects on Reproduction Numbers and Generation Intervals", *PLOS Neglected Tropical Diseases* 11, No. 7 (2017).
[265] Hannah Van Wyk, Joseph N. S. Eisenberg and Andrew F. Brouwer, "Long-Term Projections of the Impacts of Warming Temperatures on Zika and Dengue Risk in Four Brazilian Cities Using a Temperature-Dependent Basic Reproduction Number", *PLOS Neglected Tropical Diseases* 17, No. 4 (2023), e0010839.
[266] Katsuma Hayashi, Marie Fujimoto and Hiroshi Nishiura, "Quantifying the Future Risk of Dengue under Climate Change in Japan", *Frontiers in Public Health* 10 (2022).
[267] WHO, *A Global Brief on Vector-Borne Diseases*, 2014.
[268] Charmian M. Bennett and Anthony J McMichael, "Non-Heat Related Impacts of Climate Change on Working Populations", *Global Health Action* 3, No. 1 (2010).
[269] Article 16.

assessments, such measures include elimination, control and minimization of risks following the hierarchy of controls, including PPE, surveillance of the working environment and of workers' health, supervision of work processes, precautionary measures in case of insufficient information on risks, information and training, and investigation of occupational accidents and diseases. Recommendation No. 209 [270] refers to relevant instruments, codes of practice and guidelines that should be taken into account in this context, including Recommendation No. 164, the Promotional Framework for Occupational Safety and Health Recommendation, 2006 (No. 197), the *Guidelines on occupational safety and health management systems, ILO–OSH 2001*, and the *Technical guidelines on biological hazards in the working environment*.

121. Different methods can be used to reduce or control the risk of exposure to disease-carrying vectors, including robust disease and vector surveillance, vector control measures, training on biological hazards and the use of PPE, where appropriate. [271] Effective and affordable tools for vector control include insecticidal nets, indoor residual spraying, space spraying, the use of larvicides and molluscicides, as well as targeted environmental management. [272] Administrative controls, such as a change of work hours to times when vectors are less active, also contribute to reducing exposure risk. [273] In many countries, OSH legislation already requires employers to protect workers against biological hazards, with vector-borne diseases mentioned specifically in certain instances. Examples of legislation focused on specific protective measures include environmental modifications (for example, Fiji [274]), mosquito netting (for example, Mozambique [275]), vector control (for example, Barbados [276]) and hygiene measures (for example, Costa Rica [277]). In Mexico, legislation provides for epidemiological surveillance, prevention and control of vector-borne diseases, including dengue, malaria, chagas disease, onchocerciasis, leishmaniasis, West Nile fever, rickettsiosis and chikungunya. [278]

122. In line with Recommendation No. 194, [279] in several countries national lists of occupational diseases include diseases caused by biological hazards, although vector-borne diseases are not always mentioned specifically. Brazil includes a number of vector-borne diseases in its list, such as illnesses resulting from the Aedes aegypti mosquito during work activities, including dengue, chikungunya and Zika. [280] In Latvia, the list of occupational diseases explicitly includes tick-borne encephalitis, Lyme disease and tularaemia. [281] Austria recognizes Lyme disease as an occupational illness in the agricultural sector, as well as for activities in which comparable risks exist. [282]

123. In Thailand, workers exposed to toxic microbes are required to undergo regular health check-ups. [283] In Pakistan, legislation mandates that workers should be provided with a "hygiene card", with biannual entries by an appointed factory doctor confirming they are free from contagious or

[270] Paras 20 and 21.
[271] Schulte, "Updated Assessment of Occupational Safety and Health Hazards of Climate Change".
[272] WHO, "Vector control".
[273] ILO, *Ensuring Safety and Health at Work in a Changing Climate*.
[274] Section 105 of Public Health Act 1935.
[275] Section 148(2)(e) of Legislative decree No. 48/73 of July 5, General Safety Rules at Work in Industrial Units of 1973 [in Portuguese].
[276] Section 49(c) of Safety and Health at Work Act (2005), NATLEX database.
[277] Section 254 of General Health Law 5395 of 1973 [in Spanish].
[278] Section 6 of Official Standard NOM-032-SSA2-2010 [in Spanish].
[279] Para. 1.3 of the Annex.
[280] Section A (III) of Ordinance GM/MS No. 1.999/2023 [in Portuguese].
[281] Section 2 of Cabinet of Ministers Regulation No. 908 "Procedures for Investigation and Registration of Occupational Diseases", 2006.
[282] Section 3.3 of General Social Insurance Act Appendix 1 [in German].
[283] Ministerial Regulation on the Prescribing of Criteria and Method of Conducting Health Check up of Employees and Forwarding the Results of Health Check up to Labour Inspectors, B.E. 2547 (A.D. 2004), NATLEX database.

infectious diseases. Workers diagnosed with such diseases are prohibited from working until recovery, while vaccination against these diseases is mandated. [284]

▶ Box 5. Case study: Lyme disease in Europe and the United States

Lyme disease is becoming more prevalent due to the changing climate. Warmer temperatures are enabling ticks to survive in new regions, [1] while milder winters are extending their active season. In the United States, Lyme disease incidence rose from 6.1 cases per 100,000 people in 1996 to 26.9 per 100,000 in 2023, [2] with similar trends reported in other regions of the world, including Europe. [3] Outdoor workers are at high risk of contracting the disease, [4] particularly forestry workers and farmers, with some studies showing seroprevalence rates three to five times higher than those of the general population.

[1.] Charles Ben Beard et al., "Vector-borne Diseases", in *The Impacts of Climate Change on Human Health in the United States: A Scientific Assessment*, eds. Allison Crimmins et al. (Washington: U.S. Global Change Research Program, 2016), 129–156. [2.] Centers for Disease Control and Prevention, "Lyme Disease Surveillance Data". [3.] World Health Organization (WHO) and European Centre for Disease Prevention and Control (ECDC), "Lyme Borreliosis in Europe". [4.] Nicola Magnavita et al., "Occupational Lyme Disease: A Systematic Review and Meta-Analysis", *Diagnostics* 12, No. 2 (2022).

2.7.2. Increased use of agrochemicals

124. Extreme weather events and changing weather patterns can impact pest occurrence, crop characteristics and pesticide efficacy, all of which can lead to an increased reliance on agrochemicals. [285] The abundance and distribution of pests are influenced by temperature increases and precipitation changes. Increased precipitation can accelerate soil erosion, depleting essential nutrients like nitrogen and phosphorus, and increasing reliance on chemical fertilizers. Meanwhile, pesticide efficacy declines due to greater volatilization and accelerated degradation under high moisture, elevated temperatures and direct sunlight.

125. The 916 million workers employed in agriculture worldwide [286] are disproportionately impacted by pesticide exposures, as agriculture accounts for approximately 85 per cent of all pesticide use. [287] However, workers in other sectors, including forestry, chemical industries, landscaping and vector control may also face hazardous exposures. [288] Over 95 per cent of pesticide poisonings occur in low- and middle-income countries, [289] placing their workers at serious risk.

126. The use of highly hazardous pesticides is a major concern, as it leads to serious health problems and fatalities in many regions. [290] Exposure is linked to unintentional acute pesticide poisoning, cancers, neurotoxic effects (for example, Parkinson's and Alzheimer's diseases), reproductive disorders, cardiovascular diseases, chronic obstructive pulmonary disease, endocrine disruption and immune suppression. [291] It has also been associated with increased depression and a higher suicide risk among farmers. [292] Pesticide poisoning alone has been linked to over 300,000 deaths

[284] Section 23 of the Factories Act (1934).
[285] Ilse Delcour, Pieter Spanoghe and Mieke Uyttendaele, "Literature Review: Impact of Climate Change on Pesticide Use", *Food Research International* 68 (2015), 7–15.
[286] ILOSTAT, Employment by sex and economic activity – modelled estimates from 2023.
[287] Emilie Cassou, *Pesticides* (World Bank Group, 2018).
[288] ILO, *Ensuring Safety and Health at Work in a Changing Climate*.
[289] FAO, "Introduction to Highly Hazardous Pesticides (HHP)".
[290] WHO, "Exposure to Highly Hazardous Pesticides: A Major Public Health Concern", 2019.
[291] ILO, *Ensuring Safety and Health at Work in a Changing Climate*.
[292] Mariane Magalhães Zanchi, Katiuska Marins and Ariane Zamoner, "Could Pesticide Exposure be Implicated in the High Incidence Rates of Depression, Anxiety and Suicide in Farmers? A Systematic Review", *Environmental Pollution* 331, No. 2 (2023), 121888.

annually. [293] Although evidence is limited, inorganic fertilizers have been associated with an elevated risk of cancer, while the use of organic fertilizers has been linked to infections and diarrhoeal diseases. [294]

127. The Chemicals Convention, 1990 (No. 170), and the Chemicals Recommendation, 1990 (No. 177), are the main ILO instruments addressing hazards relating to chemicals. They concern all risks relating to chemicals, including agrochemicals, and require risk assessments to identify hazards, evaluate risks and apply appropriate controls following the hierarchy of controls. The Safety and Health in Agriculture Convention, 2001 (No. 184), and the Safety and Health in Agriculture Recommendation, 2001 (No. 192), also address numerous aspects of OSH in agriculture and forestry, including standards on the sound management of chemicals used in agriculture.

128. The national legislation of several countries focuses on specific protective measures, such as safe manufacture, storage, use and disposal of agrochemicals; pesticide labelling; ventilation; the registration of pest control operators; worker information and training; and the provision of PPE. As agrochemicals represent a long-standing OSH hazard, many countries have developed comprehensive legislation on their use to protect workers. In a few cases, however, legislation addresses the combined risks of agrochemicals and excessive heat and changing weather patterns by prohibiting the application of agrochemicals during the hottest hours of the day (for example, Costa Rica). [295]

2.7.3. Changes in air quality and increased exposure to air pollution

129. Air pollution is the contamination of the indoor or outdoor environment by any chemical, physical or biological agent that modifies the natural characteristics of the atmosphere. [296] Pollutants with the strongest evidence for human health concern include particulate matter, carbon monoxide, ozone, nitrogen dioxide and sulphur dioxide. [297] Weather patterns can affect the levels and distribution of these air pollutants. [298] Heatwaves are recognized for their negative impact on air quality, [299] while an increase in wildfires has also contributed to greater emissions of particulate matter and ozone precursors. [300]

130. Globally, over 1.6 billion workers work outdoors, where they may be continuously exposed to ambient air pollution. [301] Air pollution can cause a range of acute and chronic health impacts, including cancer, respiratory disease and cardiovascular disease. [302] By 2060, the annual number of lost working days due to air pollution, which is currently around 1.2 billion, is projected to reach 3.7 billion globally. [303]

[293] Erik Jørs, Dinesh Neupane and Leslie London, "Pesticide Poisonings in Low- and Middle-Income Countries", *Environmental Health Insights* 12 (2018), 1–3.
[294] Christos F. Tagkas et al., "Fertilizers and Human Health – A Systematic Review of the Epidemiological Evidence", *Toxics* 12, No. 10 (2024), 694.
[295] Section 27 of the Occupational Health Regulations for the Handling and use of Agrochemicals (N° 41931 – MTSS) [in Spanish].
[296] WHO, "Air Pollution".
[297] WHO, "Types Of Pollutants".
[298] Henian Zhang et al., "Quantifying the Relationship Between Extreme Air Pollution Events and Extreme Weather Events", *Atmospheric Research* 188 (2017), 64–79.
[299] Kyeongjoo Park, Han-Gyul Jin and Jong-Jin Baik, "Do Heat Waves Worsen Air Quality? A 21-year Observational Study in Seoul, South Korea", *Science of The Total Environment* 884 (2023).
[300] WMO, "Vicious Circle of Climate Change, Wildfires and Air Pollution has Major Impacts", 5 September 2024.
[301] Calculations based on the ILO harmonized micro-data collection.
[302] ILO, *Exposure to Hazardous Chemicals at Work and Resulting Health Impacts: A Global Review*, 2021.
[303] OECD, *The Economic Consequences of Outdoor Air Pollution*, 2016.

131. The Working Environment (Air Pollution, Noise and Vibration) Convention, 1977 (No. 148), provides that the competent authority shall establish criteria for determining the hazards of exposure to air pollution in the working environment and, where appropriate, shall specify exposure limits. [304] The criteria and exposure limits shall be established, supplemented and revised regularly in the light of current national and international knowledge and data, taking into account as far as possible any increase in occupational hazards resulting from simultaneous exposure to several harmful factors at the workplace. Convention No. 148 [305] provides that where continued assignment to work involving exposure to air pollution is found to be medically inadvisable, every effort shall be made to provide the worker concerned with suitable alternative employment or to maintain his income through social security measures or otherwise.

132. The WHO has developed the *WHO global air quality guidelines: Particulate matter (PM2.5 and PM10), ozone, nitrogen dioxide, sulfur dioxide and carbon monoxide*, which serve as a global target for governments to improve public health by reducing air pollution.

133. National regulations often refer to air quality standards and OELs, which have been established for many workplace air pollutants. Mexico, for example, has established air quality standards for ozone, carbon monoxide, sulphur dioxide, nitrogen dioxide and some types of particulate matter. [306]

134. Mitigation policies and regulations aimed at reducing air pollution may offer the most effective longer-term protection for workers. Employers can contribute by adopting sustainable practices, such as minimizing workplace emissions, utilizing renewable energy sources and replacing outdated equipment with more environmentally friendly alternatives. In addition, administrative control measures may include rotating work tasks, developing medical surveillance programmes, improving maintenance schedules, recording pollution levels and reporting cases of occupational diseases that may be caused by air pollution. Further actions include providing PPE, such as respirators and safety glasses. [307]

135. Air quality control has become central to OSH regulations in countries with high emissions. Viet Nam requires regular workplace environmental monitoring to assess harmful factors and prohibits the use of machinery, equipment and supplies that are likely to cause environmental pollution. [308] Legislation in Samoa [309] and Fiji [310] requires employers to take effective measures to control or minimize exposure to harmful atmospheric pollutants in the workplace.

2.7.4. Increased exposure to UV radiation

136. Solar UV radiation is a form of non-ionizing radiation, categorized by wavelength, as UVA, UVB and UVC. [311] While the primary driver of ozone depletion remains the release of ozone-depleting substances, changing climate dynamics can significantly influence the behaviour and recovery of the ozone layer. Ozone concentrations are sensitive to both meteorological variability and

[304] Article 8.
[305] Article 11(3).
[306] Mexican Official Standards NOM-020-SSA1-2021, NOM-021-SSA1-2021, NOM-022-SSA1-2019, NOM-023-SSA1-2021 and NOM-025-SSA1-2021 [in Spanish].
[307] ILO, *Ensuring Safety and Health at Work in a Changing Climate*.
[308] Articles 12 and 18 of Law on Occupational Safety and Health (Law No. 84/2015/QH13) NATLEX database.
[309] Section 24(l) of the Occupational Safety and Health Act 2002.
[310] Section 59 of the Health and Safety at Work (General Workplace Conditions) Regulations 2003.
[311] International Commission on Non-Ionizing Radiation Protection, "Ultraviolet".

changes in atmospheric composition. [312] Changing weather patterns, such as less cloud cover and more sunny days will also lead to more UV radiation and increased exposures for workers. [313]

137. Short-term injuries from UV exposure, such as sunburn, skin blistering and eye damage, are normally temporary; however, long-term effects can be serious and may include cataracts, macular degeneration, pterygium, weakened immune systems and skin cancers, such as melanoma, basal cell carcinoma and squamous cell carcinoma. [314]

138. According to WHO/ILO joint estimates, 1.6 billion workers can be occupationally exposed to UV radiation every year. Over 18,960 work-related deaths occur annually due to non-melanoma skin cancer alone. The burden is highest in the Africa, Americas and Western Pacific regions, as well as among men and individuals of middle to older working age. [315] A global temperature rise of 2°C is projected to increase the carcinogenic effectiveness of UV radiation, potentially raising the excess incidence of skin cancer by 11 per cent by 2050. [316] It is therefore likely that even workers in regions with traditionally fewer days of sunlight will be at higher risk than before. Solar UV radiation is particularly problematic 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. Workers in construction and agriculture have been found to be at particularly high risk, alongside lifeguards, utility workers, gardeners, postal workers and dock workers. [317]

139. The technical guidance Protecting Workers from Ultraviolet Radiation by the International Commission on Non-Ionizing Radiation Protection, in collaboration with the ILO and the WHO, includes information regarding exposure assessment and protective measures for outdoor workers. Similarly, the ILO code of practice on ambient factors in the workplace [318] provides guidance on protection measures regarding hazardous exposures to optical radiation, including UV radiation. Measures should follow the hierarchy of controls and include 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.

140. Several countries have established protection measures for workers against risks from UV radiation in their legislation. These can include the provision of adequate PPE, such as sun cream, long-sleeved clothing, hats, glasses and gloves (for example, Belgium, [319] Brazil, [320] Chile, [321] Finland, [322] Germany, [323] Peru [324] and the Philippines [325]), protected workstations (for example,

[312] European Climate and Health Observatory, "Ground-Level Ozone", *Climate-ADAPT*, 17 March 2025.
[313] Bundesamt für Strahlenschutz, "Influence Of Climate Change On UV Exposure".
[314] Caradee Y. Wright and Mary Norval, "Health Risks Associated with Excessive Exposure to Solar Ultraviolet Radiation Among Outdoor Workers in South Africa: An Overview", *Frontiers in Public Health* 9 (2021).
[315] Frank Pega et al., "Global, Regional and National Burdens of Non-Melanoma Skin Cancer Attributable to Occupational Exposure to Solar Ultraviolet Radiation for 183 Countries, 2000–2019: A Systematic Analysis from the WHO/ILO Joint Estimates of the Work-related Burden of Disease and Injury", *Environment International* 181 (2023).
[316] Jan C. van der Leun and Frank R. de Gruijl, "Climate change and skin cancer", *Photochemical & photobiological sciences* 1, No. 5 (2002), 324–326.
[317] Swen M. John et al., "Improved Protection of Outdoor Workers from Solar Ultraviolet Radiation: Position Statement", *Journal of the European Academy of Dermatology and Venereology* 35, No. 6 (2021), 1278–1284.
[318] Chapter 7.
[319] Section 2 of the Code of Well-being at Work, Book V, Title 1 on thermal environmental factors [in French].
[320] NR-6, Annex I of Regulatory Standard No. 6 on Personal Protective Equipment [in Portuguese].
[321] Section 7.4 of Decree No. 594/1999 [in Spanish].
[322] Annex II of the Government Decree on the Selection and Use of Personal Protective Equipment at Work (427/2021) [in Finnish].
[323] Section 3(2) of the Annex of the Ordinance on Preventive Occupational Health Care.
[324] Section 22 of Regulations on collective bargaining and minimum working conditions under Law No. 31110 on the Agricultural Labour Regime and Incentives for the Agricultural, Irrigation, Agro-Export, and Agro-Industrial Sectors [in Spanish].
[325] Labour Advisory No. 3 (2016) of the *Occupational Safety and Health Standards*.

Senegal [326]) and risk assessment (for example, Germany [327]). In Chile, employers must display daily UV radiation levels at workplaces and maintain an instruction programme for workers on the risks and health consequences of exposure. [328] In Malawi, OSH legislation provides for regular medical assessments to protect workers against UV radiation risks. [329]

141. In line with Recommendation No. 194, which includes in its Annex "Diseases caused by optical (ultraviolet, visible light, infrared) radiations including laser", some countries recognize diseases caused by UV radiation as occupational. This is the case in Albania, [330] Chile, [331] Finland, [332] Italy, [333] Lebanon [334] and Switzerland. [335]

2.7.5. Increased risk for major industrial accidents

142. An MIA is a sudden event – such as a major emission, fire or explosion – occurring during activities at a major hazard installation, involving one or more hazardous substances and resulting in serious risks to workers, the public or the environment. [336] Extreme weather events, including floods, tropical cyclones and extreme temperatures, among others, can trigger MIAs by damaging installations and other critical infrastructures.

143. The term "Natural Hazards Triggering Technological Disasters"' (or Natech) is used to refer to the "interaction between natural disasters and industrial accidents". [337] Natech events typically occur as cascading events: a natural hazard initiates a technological accident, compounding its consequences. [338] Such accidents may involve fires explosions and toxic or radioactive releases at hazardous installations, including chemical plants, oil and gas pipelines, storage sites, transportation links, waste sites and mines. [339] Weather-related changes are expected to increase the frequency and intensity of these hazards, including in previously unaffected areas. [340]

144. An MIA can worsen an already hazardous extreme weather event, exposing workers to toxic chemicals, fires and explosions, which can result in burns, poisonings and severe injuries. Hazardous chemical releases, such as chlorine or ammonia, can harm communities, while fires expose workers to toxic fumes, and explosions can cause injuries from debris. High-risk occupational groups include plant operators, emergency responders such as firefighters, ambulance crews, police, construction workers and other clean-up workers.

145. Considering the potential of weather events to trigger MIAs, the Prevention of Major Industrial Accidents Convention, 1993 (No. 174), and the Prevention of Major Industrial Accidents Recommendation, 1993 (No. 181), are particularly relevant as they outline preventive and protective measures to avoid or minimize the consequences of MIAs.

[326] Section 4 of Decree No. 2006-1252 of 2006 on the Minimum Requirements for the Prevention of Certain Physical Factors in the Workplace, NATLEX database [in French].
[327] Section 6 of the Ordinance on Preventive Occupational Health Care.
[328] Section 7.4 of Decree No. 594/1999 [in Spanish].
[329] Section 62 of the Occupational Safety, Health and Welfare Act, 1997 (No. 21 of 1997), NATLEX database.
[330] Position 5 of Decree No. 594 of 2015 on the approval of the list of occupational diseases [in Albanian].
[331] Section 1(b) of Title III Classification of occupational diseases [in Spanish].
[332] Section 7 of Government Decree on the List of Occupational Diseases (769/2015) [in Finnish].
[333] Section 80 of the Revision of the tables of occupational diseases in industry and agriculture of 2023 [in Italian].
[334] Section 1.2.7 of Decree 14229 of 2005, NATLEX database [in French].
[335] Annex I of the Accident Insurance Ordinance [in German].
[336] Article 3(d) of the Prevention of Major Industrial Accidents Convention, 1993 (No. 174).
[337] Economic Commission for Europe (ECE), "The Industrial Accidents Convention and Natural Disasters: Natech".
[338] ECE, "The Industrial Accidents Convention and Natural Disasters".
[339] WHO, *Chemical Releases Caused by Natural Hazard Events and Disasters*.
[340] OECD, *The Impact of Natural Hazards on Hazardous Installations*.

146. From a policy perspective, effective responses have been well detailed and include comprehensive risk assessment, preparation of emergency plans, the integration of MIA and Natech risk management into broader accident prevention, preparedness and response frameworks, and the establishment of a strategy for communication with and training for workers. [341]

147. Within the European Union, the Seveso III Directive provides a legal framework for the control of onshore major accident hazards involving dangerous substances, to prevent them and limit their consequences for both human health and the environment. [342] The Directive explicitly addresses Natech risks and requires that environmental hazards be routinely identified and evaluated. In Germany, the Technical Rules for Plant Safety have been developed pursuant to the German Major Accidents Ordinance [343] and the Federal Emission Control Act [344] to ensure the technical safety of industrial operations. These rules concern precautions and measures related to precipitation, flooding, dangerous winds, snow and ice. In Colombia, Law No. 1523 of 2012 implemented a national policy and national system for the management of the risk of disasters [345] and, complemented by Decree No. 1347 of 2021, [346] specifically calls for Natech risk management. The Decree contains provisions on the Programme for the Prevention of Major Accidents and sets out comprehensive measures, procedures and interventions to protect workers, the population and the environment through major accident risk management in classified installations.

▶ 3. Conclusions

148. Extreme weather events and changing weather patterns, along with their associated hazards, have significantly affected the safety and health of workers globally, requiring tailored policy responses at both national and workplace levels. While the hazards examined in this report are not new to the world of work, weather-related changes are amplifying their frequency, severity and unpredictability. Impacts on workers can be significant, ranging from injuries to heat stroke, cancers and vector-borne diseases, respiratory and cardiovascular conditions, and mental health issues. The complexity of weather-related hazards, in terms of both exposures and health outcomes, underscores the need for integrated and comprehensive legal and institutional frameworks to keep pace with a rapidly evolving work environment.

149. National policy responses vary across countries and regions, reflecting their specific contexts, circumstances and priorities. These measures include: implementing control measures (ventilation, hydration, health surveillance, provision of PPE, and so on); limiting or prohibiting work during exceptional weather conditions and providing wage compensation schemes for work stoppages; granting workers the right to withdraw from unsafe conditions together with the obligation to inform their employer; requiring employers to adopt preventive and protective measures regarding exposure to weather-related hazards; and the recommendation to include weather-related illnesses in national lists of occupational diseases. In addition, certain legislation

[341] OECD, European Commission, Joint Research Centre and ECE, *Managing Risks from Natural Hazards to Hazardous Installations (Natech): A Guide for Senior Leaders in Industry and Public Authorities – Series on Chemical Accidents,* 2024.
[342] Directive 2012/18/EU of the European Parliament and of the Council of 4 July 2012 on the control of major-accident hazards involving dangerous substances, amending and subsequently repealing Council Directive 96/82/EC Text with EEA relevance.
[343] Twelfth Ordinance for the Implementation of the Federal Emmission Control Act (Major Accidents Ordinance – 12th BImSchV) [in German].
[344] Act on the Protection against Harmful Environmental Effects Caused by Air Pollution, Noise, Vibrations, and Similar Processes (Federal Emission Control Act - BImSchG) [in German].
[345] Law No. 1523 of 2012 [in Spanish].
[346] Decree No. 1347 of 2021 [in Spanish].

sets temperature thresholds and, in some cases, OELs. Strengthening OSH capacity and providing training for workers, employers, OSH committees and labour inspectors on extreme weather events and changing weather patterns was found to be critical. Some countries integrate the recording and notification of weather-related occupational injuries and diseases into national health surveillance systems.

150. The report identified **the need for governments to develop or update OSH frameworks that integrate preventive and protective approaches** in the face of extreme weather events and changing weather patterns. Such policies should be adopted through social dialogue to ensure they reflect the needs and perspectives of workers and employers. National policy responses remain fragmented in many Member States, owing to the lack of a standardized approach. While several countries have introduced laws specifically addressing excessive heat as an occupational hazard, other climate-related hazards are often excluded or only addressed under broad OSH legislation that is insufficient to tackle new challenges. A gap can be observed in legal frameworks regarding the mental health of workers exposed to extreme weather events and changing weather patterns, highlighting the need for increased research and focus on this policy issue.

151. While some public health regulations exist, specifically for excessive heat and SDSs, there is **a need for improved integration of OSH considerations into broader policies**. Integrating OSH into climate and disaster frameworks has been identified as a key mechanism to improve collaboration and coordination between relevant authorities. Currently, OSH is mostly absent from national climate legislation, disaster risk reduction strategies, and many public health and environmental policies. Early warning systems are increasingly emphasized as vital tools; however, they often fail to respond to the needs of the world of work, its constituents and OSH considerations, and may need to be expanded to reach employers and workers effectively. A more integrated approach between, for example, occupational health, public health, environmental and meteorological agencies would help to ensure that OSH is consistently included in climate adaptation and resilience planning.

152. Importantly, although **some groups of workers are at higher risk** due to their exposure, sensitivity and ability to adapt, most policies do not fully address their vulnerabilities, nor do they offer guidance on adapting protections for them. These groups include migrant workers, informal economy workers, women, older adults and those with pre-existing conditions. Informal economy workers are by definition not covered by national OSH laws, despite facing disproportionate risks, thus requiring efforts for their transition to the formal economy. Therefore, as weather-related changes intensify and existing protections fall short, it is essential to update policy frameworks to better protect these workers.

153. This report demonstrates **the need for enhanced risk assessments at the workplace level** that consider the multifaceted hazards arising from extreme weather events and changing weather patterns. Such assessments, which should also be performed whenever there are modifications in the workplace or in work practices, should consider cascading risks, as in the case of compound events. Evidence-based protection measures should be adopted for specific weather-related hazards. For example, in the case of excessive heat, these could include acclimatization, hydration, cooling areas, ventilation, shelters, adapted work schedules and PPE. Regular surveillance of workers' health, particularly among the most at risk, including regular medical check-ups, is also emphasized. Similar importance applies to the monitoring of weather-related illnesses and accidents. This report further highlights the need for increased training and awareness-raising among workers and employers about the risks related to extreme weather events and changing weather patterns. Moreover, collective agreements between workers and employers have proven to play a crucial role in addressing OSH issues by establishing additional sector- and enterprise-level protection measures.

154. Policies and workplace interventions to protect workers often vary between high- and low-income countries, possibly due to differences in resources and technology. In lower-income contexts, protective measures are often simple and cost-effective, like access to drinking water and shaded rest areas for heat-exposed workers. More developed countries may use advanced technological solutions, such as wearable devices to track vital signs. These contrasts underscore that governments and social partners must adapt policies to national contexts to ensure they are implementable and effectively protect workers from extreme weather events and changing climate patterns.

155. Finally, **existing international labour standards provide a foundation** for national policy and workplace-level measures. Several ILO instruments (for example, Conventions Nos 155, 161 and 187) offer a useful basis for developing national policy that factors in climate issues (see the Appendix). Risk- and sector-specific instruments, codes of practice and technical guidelines can provide specific guidance on addressing risks due to extreme weather events and changing weather patterns. Complementary guidelines, such as the *Guidelines for a just transition towards environmentally sustainable economies and societies for all*, can support the integration of climate resilience into OSH systems.

▶ Appendix

Examples of international labour standards and codes of practice relevant to extreme weather events and changing weather patterns and OSH

International labour standards	Other ILO guidance
Biological Hazards in the Working Environment Convention, 2025 (No. 192)	Technical guidelines on biological hazards in the working environment (2022)
Work in Fishing Convention, 2007 (No. 188)	Safety and health in construction (revised 2022)
Promotional Framework for Occupational Safety and Health Convention, 2006 (No. 187)	Safety and health in shipbuilding and ship repair (revised 2019)
Maritime Labour Convention, 2006, as amended (MLC, 2006)	Guidelines on Decent Work in Public Emergency Services (2018)
Safety and Health in Agriculture Convention, 2001 (No. 184)	Safety and health in ports (revised 2016)
Prevention of Major Industrial Accidents Convention, 1993 (No. 174)	Guidelines for a Just Transition towards Environmentally Sustainable Economies and Societies for all (2015)
Chemicals Convention, 1990 (No. 170)	Safety and health in agriculture (2010)
Indigenous and Tribal Peoples Convention, 1989 (No. 169)	Ambient factors in the workplace (2001)
Occupational Health Services Convention, 1985 (No. 161)	Guidelines on Occupational Safety and Health Management Systems (ILO-OSH 2001)
Occupational Safety and Health Convention, 1981 (No. 155)	Safety and health in forestry work (revised 2025)
Working Environment (Air Pollution, Noise and Vibration) Convention, 1977 (No. 148)	Safety in the use of chemicals at work (1993)
Plantations Convention, 1958 (No. 110)	Safety and health in opencast mines (revised 2018)
Protocol of 2002 to the Occupational Safety and Health Convention, 1981	
Biological Hazards in the Working Environment Recommendation, 2025 (No. 209)	
Employment and Decent Work for Peace and Resilience Recommendation, 2017 (No. 205)	
Promotional Framework for Occupational Safety and Health Recommendation, 2006 (No. 197)	
List of Occupational Diseases Recommendation, 2002 (No. 194)	
Safety and Health in Agriculture Recommendation, 2001 (No. 192)	

International labour standards	Other ILO guidance
Prevention of Major Industrial Accidents Recommendation, 1993 (No. 181)	
Chemicals Recommendation, 1990 (No. 177)	
Occupational Health Services Recommendation, 1985 (No. 171)	
Occupational Safety and Health Recommendation, 1981 (No. 164)	
Working Environment (Air Pollution, Noise and Vibration) Recommendation, 1977 (No. 156)	
Hygiene (Commerce and Offices) Recommendation, 1964 (No. 120)	
Reduction of Hours of Work Recommendation, 1962 (No. 116)	
Workers' Housing Recommendation, 1961 (No. 115)	
Protection of Workers' Health Recommendation, 1953 (No. 97)	