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Review

Working in Extreme Heat, an Invisible Occupational Risk: Legislation, Risk Management and Policy Recommendations for Türkiye: Turkish Thoracic Society Workshop Report on the Regulation of Working Conditions in Extreme Heat

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ABSTRACT

Extreme heat, amplified by climate change, has become a predictable and escalating occupational hazard in Türkiye, increasing the burden of heat-related illnesses, traumatic workplace injuries, and productivity losses among both outdoor and indoor workers, particularly in labor-intensive sectors and among vulnerable populations. This Turkish Thoracic Society workshop report synthesizes interdisciplinary expert input and available evidence to propose a practical, prevention-focused framework for regulating working conditions in extreme temperatures. The recommendations were systematically developed through four thematic interdisciplinary working groups and finalized by plenary consensus. Key recommendations include explicitly defining employers' duties to assess, prevent, and manage extreme weather–related risks within Occupational Health and Safety Law No. 6331; establishing secondary regulations that operationalize temperature/Wet-Bulb Globe Temperature (WBGT)-triggered work–rest schedules, hydration and cooling requirements, and acclimatization protocols; and standardizing objective heat-stress monitoring using the WBGT index (aligned with ISO 7243). The report prioritizes engineering and administrative controls (shading, ventilation/cooling, shift adjustments, rest areas, and "buddy systems") over reliance on personal protective equipment, and calls for strengthened labor inspection capacity "through the lens of climate change." Additional policy actions include integrating heat-related outcomes into occupational disease and injury surveillance systems, enhancing inter-institutional coordination for rapid reporting and work-stoppage mechanisms during extreme heat events, and implementing multilingual, sector-specific training and emergency preparedness pathways. Protecting informal and migrant workers, seasonal agricultural laborers, and individuals with chronic cardiopulmonary disease is highlighted as a core priority for equity and climate justice.

KEYWORDS: Health policies, environmental disorders, occupational and environmental lung diseases, occupational disorders, workshop report

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INTRODUCTION

In the era we are currently in, which we call the Anthropocene-Capitalocene, the earth has begun to warm up due to the increasing production of carbon dioxide, a commonly known greenhouse gas. Each year is hotter than the previous one, and temperature records are being broken.

The World Health Organization (WHO) reports that there are approximately 175,000 deaths annually in Europe due to extreme heat.[1] Globally, this number is around 500,000, and deaths are increasing due to climate change and urbanization.[2] If this continues, deaths could reach 2.3 million by the end of the century.[3]

Türkiye is located in the Mediterranean climate zone, a region highly vulnerable to both the current and projected impacts of global climate change. Research indicates that the greatest increases in temperature in our country are predicted to occur in the Southeast, Aegean, and Mediterranean regions. If no measures are taken, it is predicted that summer temperatures in these regions will be 4–7 °C higher by 2100.[4] Rising summer temperatures and increasingly frequent heat waves adversely affect worker health, exposing both indoor and outdoor workers to increased risk of severe morbidity and potentially fatal outcomes. The human body's tolerance to heat has a critical limit between 40 °C and 50 °C. In conditions of extreme heat and humidity, and in direct sunlight, the risk of heat stress, heat syncope, and heatstroke increases after 20–30 minutes if adequate precautions are not taken.[2] If left untreated, it can rapidly worsen and lead to death. Children, older adults, individuals with chronic illnesses, and individuals with low socioeconomic status are at higher risk. To protect against heatstroke, exposure time should not exceed two hours at temperatures above 32 °C and one hour during high humidity and physical activity. It should also be noted that individual differences may exist.

Main Points

- Predictable occupational risk: Extreme heat is no longer an exceptional event but a permanent occupational hazard in Türkiye, significantly increasing the risk of heat-related morbidities, workplace accidents, and traumatic injuries.
- Legislative necessity: Current Turkish legislation lacks specific provisions for extreme temperatures; the report recommends explicitly defining the employer's obligation to manage climate-related risks within Occupational Health and Safety Law No. 6331 and establishing secondary regulations for work–rest arrangements.
- Standardized risk assessment: The Wet-Bulb Globe Temperature index should be the standard for objective heat stress monitoring, facilitating the implementation of dynamic, threshold-based work–rest schedules and acclimatization protocols.
- Protection of vulnerable groups: Strengthened protection mechanisms are required for high-risk populations, including informal migrant workers, seasonal agricultural workers, and individuals with chronic respiratory or cardiovascular diseases.
- Integrated action framework: A comprehensive policy approach must prioritize engineering and administrative controls—such as hydration plans, shading systems, and inter-institutional coordination—to ensure effective emergency response and medical surveillance.

In a study evaluating Occupational Health and Safety (OHS) in the construction sector in Türkiye,[5] it was reported that most occupational accidents occurred during the summer in 2007 and 2008. Long working hours and the adverse effects of hot summer weather on workers can be cited as reasons for this situation. Especially for those working in heavy, labor-intensive jobs in hot and humid environments, heat is a significant source of occupational hazard.[6]

When the body fluids lost through sweating in very hot environments are not adequately replenished, the risk of health problems increases. In work environments with high temperatures, acute health risks increase, and short-term fainting occurs when 10–12% of body fluid is lost. It is stated that overweight, underweight, and elderly workers are at greater risk.[7]

In our country, heat waves are not defined as disasters. However, in the European Bank's classification, it ranks first and is considered a silent, insidious disaster. In addition, deaths caused by heat waves are not recorded in our country.

In light of these findings and the increasing temperatures in our country, there is a clear need for specific, policy-oriented frameworks tailored to the Turkish occupational health context. Therefore, the Turkish Thoracic Society (TTS, *Türk Toraks Derneği*) Environmental Issues and Lung Health Working Group planned to hold a workshop titled "Regulation of Working Conditions in Extreme Heat". At the workshop held in Ankara on April 5, 2025, interdisciplinary knowledge sharing took place. The primary objective of this workshop was to address the existing knowledge gap by synthesizing interdisciplinary experts' opinions to develop a practical, prevention-focused framework and to formulate concrete policy recommendations for regulating working conditions in extreme temperatures.

WORKSHOP DEFINITIONS AND METHODOLOGY

Definitions

Heat Wave: Defined as an abnormally and disturbingly high level of heat, usually humid, lasting or expected to last for three days or more over a wide area.

Heat Stress: The net (overall) heat load an employee may be exposed to due to the combined contributions of metabolic temperature, environmental factors, and clothing requirements. It begins when the body cannot compensate for this excessive load. As heat stress approaches the limits of human tolerance, further increases become unacceptable and can lead to heat strain and the development of heat-related illnesses. Occupational heat stress and the risk of heat-related illness increase among outdoor and indoor workers who are exposed to excessive heat or whose work involves hot environments.

Heat Exhaustion: A more advanced stage of heat stress. Fluid and electrolyte loss occurs.

Heat Stroke: A stage requiring immediate medical intervention, where thermoregulation has completely collapsed**.**

Outdoor Workplace: Defined as workplaces where workers are exposed to weather conditions (such as solar radiation, humidity and temperature).

The Wet-Bulb Globe Temperature (WBGT) index is one of the most common environmental measures used to assess the risk of heat stress in work environments.[8] WBGT estimates the heat load of the human body by considering the ambient temperature, humidity, radiant heat (heat emitted by the sun or hot surfaces), and airflow. Thus, it helps to determine the level of risk to thermal comfort and health (e.g., heatstroke, dehydration, fatigue) for workers in hot environments.

Methods

This study was designed as a qualitative, consensus-based workshop aimed at formulating policy recommendations. The workshop aimed to consult the views and knowledge of all disciplines and institutions related to the subject, using purposive sampling. Invitation letters were sent to the Ministry of Health and the Ministry of Labour and Social Security, requesting the participation of their representatives in occupational health matters. The Association of Public Health Specialists (*Halk Sağlığı Uzmanları Derneği*), the Turkish Medical Association (*Türk Tabipleri Birliği*), the Occupational Lung Diseases Working Group of our society, the Ankara Municipality, the Confederation of Turkish Trade Unions (TÜRK-İŞ), the Revolutionary Workers' Unions Confederation (DİSK), and the International Labour Organization's (ILO) Türkiye Representation were also invited to participate, each with at least one representative. In addition, a lawyer working on "labor and social security law" and an academic meteorologist were also invited to the workshop. At least one representative from each component participated, resulting in a total of 24 experts.

In the morning sessions, experts presented theoretical information on the subjects to establish a shared scientific baseline. In the afternoon, participants were divided into four groups, each representing a different area of expertise, and each group developed proposals focusing on a specific theme. Each group discussion was guided by a moderator and recorded by a rapporteur. The topics were determined as follows: 1) legal regulations; 2) risk assessment; 3) training; and 4) emergency interventions. Suggestions were made after discussions with all groups. Following group discussions, the proposals were shared with all participants in a plenary assembly, revised based on feedback from open discussion, and finalized by qualitative consensus among all attendees rather than through a formal voting mechanism. This report contains the systematic recommendations developed during the workshop and the findings that can be evaluated at the policy level. As the primary objective was to synthesize multidisciplinary expert opinions into a practical framework, no statistical analysis was performed.

KEY COMPONENTS OF OCCUPATIONAL HEALTH AND SAFETY MANAGEMENT

The following sections present the direct outputs and consensus-based recommendations generated by the four thematic working groups. To distinguish the workshop's findings from general explanatory text, the specific proposals developed by the participants are outlined below as targeted recommendations. These outputs are structured around four main pillars identified as critical during the group discussions:

Legal Regulations

The legal system of the Republic of Türkiye is based on the principle of a hierarchy of norms. At the top of this hierarchy is the Constitution of the Republic of Türkiye, followed by international conventions, laws, Presidential decrees, and regulations. Each lower-level regulatory norm must be consistent with the norm at the next higher level. Strengthening protection against heat stress in occupational settings requires legal regulations at different levels of this hierarchy. Accordingly, the proposals developed in the workshop have been grouped under two main headings: primary (at the legal level) and secondary (at the regulatory level).

Primary legislation: proposals for regulation at the law level

The basic legal framework regarding OHS in Türkiye is determined by the OHS Law No. 6331.

Article 4 of the law requires the employer to conduct a risk assessment. Article 5 regulates the "principles of protection against risks". Clause (c) of this article stipulates that the employer must "combat risks at their source".

Scientific data clearly show that extreme temperatures resulting from climate change pose an OHS risk to employees. The increased frequency of deaths and illnesses due to exposure to extreme temperatures necessitates addressing this risk at its source in workplaces. Therefore, the employer's obligation to combat climate change is already implicit in current legal provisions.

Recommendation:

Add the following statement to Article 5 of Law No. 6331: "The employer is obliged to develop a policy for combating extreme weather conditions in the workplace and to analyze and prevent workplace risks related to extreme weather conditions".

This regulation is of great importance in raising awareness of occupational health risks associated with extreme weather events and climate change, institutionalizing a preventive approach, and protecting employee health.

Secondary legislation: proposals for regulations at the regulation level

In the hierarchy of norms, the second-level instruments subordinate to laws are Presidential Decrees and regulations. The changes and additions that may be made within the scope of secondary legislation are listed below:

a. Regulation on Labour Inspection

Currently, labor inspections are carried out by the Guidance and Inspection Directorate of the Ministry of Labour and Social Security. Inspections are carried out in two ways: "programmed inspection" and "unprogrammed inspection upon complaint".

Recommendations:

1. A change should be made in the Regulation on Labour Inspection to increase the competence of labor inspectors in recognizing and evaluating OHS risks related to climate change by providing them with specialized training. In addition,

2. A clear provision should be introduced that the inspections should be carried out "through the lens of climate change".

Thus, the inspection processes will cover not only the existing physical conditions but also the effects of climatic factors on occupational safety.

b. New Regulation Proposals

Current legislation does not contain specific regulations for workers in extreme heat or other extreme weather conditions. Therefore, it is proposed that new regulations addressing climate change and extreme weather events be developed. The proposed regulation titles are:

1. "Regulation on the Effects of Extreme Weather Events on Worker Health",

2. "Worker Health Regulation" (expanded to include climatic and environmental factors),

3. "Regulation on Workers in Hot, Enclosed Environments".

These regulations should specify implementation principles for topics such as risk assessment, workplace organization, protective measures, rest areas, health surveillance, and training.

c. Working Hours and Rest Arrangements

Recommendations:

1. Through an amendment to the Working Hours Regulation under the Labour Law, working hours and break arrangements during high temperatures should be defined by a temperature-threshold-based system.

For this purpose: a table should be prepared that determines working hours, break times, and fluid supplementation requirements according to air temperature,

2. Special provisions should be established for vulnerable groups and for workers who cannot take breaks because of the nature of their work. Accordingly, it is proposed that a regulation be introduced to prevent these groups from working between 10:30 and 15:30 when air temperatures are 32 °C or higher.

This provision will contribute both to reducing health risks caused by heat stress and to preventing workplace accidents.

Risk assessment and key topics

The most critical step in managing working conditions in extreme heat is establishing a comprehensive and dynamic risk assessment process.

Recommendations:

1. Defining the scope and context: clarifying the boundaries of the workplace, the activities performed, job descriptions, and monitoring mechanisms;

2. Identifying the hazard: defining the physiological and environmental components of heat stress and determining the influencing factors;

3. Determining the environmental heat: identifying indicators such as temperature, humidity, airflow, and radiant heat through field measurements; The use of the WBGT index (according to ISO 7243 standard),

4. Identification of risky areas: determining critical processes, work points, and time periods in terms of extreme heat,

5. Identification of vulnerable groups: identifying susceptible or unprotected groups (pregnant women, the elderly, those with chronic diseases, children and young workers, women, migrants, disabled individuals, etc.),

6. Classification of heat-related illnesses: identifying clinical presentations, early warning signs, and possible complications,

7. Assessment of probability and severity: analyzing the risk considering exposure duration, intensity, workload, and recovery possibilities,

8. Rating and determining the acceptability of the risk,

9. Establishment of control steps: planning engineering, administrative arrangements, and personal protective equipment (PPE) according to the prevention hierarchy,

10. Implementation, monitoring, and assignment of responsibilities: environmental and health monitoring and surveillance, training programs, emergency procedures,

11. Recording and communication of findings, including documentation, reporting, notification, and periodic review processes, should be implemented.

Legislation and policy recommendations

1. It is recommended that workplaces with a high risk of heat stress be categorized as the "very hazardous class", taking into account the WBGT index, and that appropriate OHS processes be implemented.

2. It is necessary to identify groups that require special policies, to consider thermal comfort a risk factor during the workplace establishment phase, and to determine measurement periods (e.g., the hottest months of the year).

3. The list of occupational diseases included in the current "Republic of Türkiye Regulation on the Determination of Loss of Earning Capacity in the Workforce and Occupation" does

not cover health effects related to thermal comfort. Addressing this deficiency requires publishing a new version.

Appendix 1 details how the WBGT index is used in the fields of OHS, sports, and military training, as well as the measurement methods and application examples. Thanks to these applications, heat stress is objectively monitored across different environments, and preventive and corrective measures are implemented according to risk level, thereby protecting the health and performance of workers, athletes, or soldiers.

Workplace implementation and prevention strategies

Recommendations:

1. Establishing early warning systems or seeking advice from scientific experts;

2. Defining an emergency communication chain and creating a higher authority notification mechanism;

3. Providing appropriate ventilation and shading systems;

4. Regulating working hours: frequent shift changes, short breaks, fluid and electrolyte support (water, buttermilk, etc.);

5. Expanding training programs: recognizing the risk, methods of coping with heat, and psychological support mechanisms (e.g., psychologist support for irritability and behavioral changes);

6. Improving rest areas: cooling, fluid intake, air circulation and air conditioning support;

7. Customizing health surveillance: implementing intensified and risk-based health monitoring protocols, and providing appropriate work clothing and PPE.

Inter-institutional coordination and monitoring mechanisms

Strengthening inter-institutional coordination is necessary for the early diagnosis and prevention of health problems in working life.

Recommendations:

1. Inspections of workplaces where health problems are reported should be increased.

2. The emergency notification and subsequent work stoppage mechanism should be clarified at the ministry level;

3. The activities carried out by subcontracting firms should be evaluated according to the main workplace hazard class and risk analyses, and health surveillance should be carried out accordingly.

4. Health surveillance should be provided through workplace nurses in environments where it is difficult to have a physician present at all times;

5. Dietitian consultation should be added.

6. The number of labor inspectors should be increased;

7. Specialist physicians in occupational health should be assigned to conduct inspections.

Informal employment and vulnerable groups

Informal employment poses a serious risk, especially for women, children, the elderly, and migrant workers.

Recommendations:

1. Family physicians should be informed about the risks associated with extreme heat and encouraged to be vigilant in reporting potential cases.

2. Training and awareness programs should be integrated into primary healthcare services.

3. Obstacles to unionization should be removed to facilitate workers' access to mechanisms for seeking their rights.

4. OHS materials and training for migrant workers should be prepared in their native languages.

Training

Sustaining measures to improve working conditions in extreme heat requires not only technical regulations but also a systematic, comprehensive training policy.

Recommendation:

Training should be planned at both the workplace and societal-awareness levels; formal, non-formal, and continuous training approaches should be implemented together.

The suggestions developed within this scope are summarized below.

Education policy and planning

Recommendations:

1. Educational content should be tailored to the nature of the work, the working environment, regional conditions, workplace and sector characteristics, geographical differences, and vulnerable groups.

2. In the mid- and long-term, training on heat stress for outdoor workers should be mandatory.

3. This training should be integrated into the Ministry of National Education curriculum, OHS laws, and emergency plans.

4. Considering the changing and increasingly severe environmental conditions due to climate change, educational curricula should be updated at regular intervals.

5. In sectors experiencing intense exposure to heat waves, such as agriculture, general public education should be conducted periodically, in view of the high risk faced by informal workers and small-scale businesses.

6. Personnel from organizations within the Ministry of Health should be assigned to these training programs; furthermore,

these topics should be integrated into widespread educational programs such as driving courses and military training.

7. Accessible telephone hotlines should be established for use during heat waves; personnel working on these hotlines should be specially trained.

8. In addition to group training in workplaces, individual counseling opportunities should be offered to employees.

Target groups for training

For training activities to be effective, the target audience should be addressed through a multi-layered structure. Accordingly, the following groups have been designated as priority training targets: politicians, managers in public institutions, managers of the Ministry of Health and the Ministry of Labour and Social Security, managers of municipalities and provincial special administrations, governors and district governors, employers and employees, trade unions and union representatives, professional organizations, relevant departments of universities, employer organizations, and civil society organizations.

Recommendation:

In training for these groups, the level of information and the depth of content should be differentiated. Policy development and supervision should be prioritized at the manager level, whereas protection and implementation skills should be prioritized at the employee level.

Training content and methodology

Recommendations:

The scope and methodology components of the trainings should include;

1. General information: climate change, physiological effects of heat stress, legislation and rights;

2. Specific information: regional, sectoral and vulnerable group-specific risks and precautions;

3. Protection and prevention: heat management in the workplace, hydration, break times, appropriate clothing selection and equipment use;

4. Action plans: preparation of specific action plans regarding excessive heat exposure in workplaces and integration of these plans into the training;

5. First aid and emergency response: practical training on steps to be taken in cases such as heatstroke, fainting, and dehydration;

6. Interactive training methods: case-based learning, simulations,

7. Practical sessions supported by audiovisual materials;

8. Support of face-to-face training with digital platforms;

9. Creation of a national training portal for standardization and accessibility of trainings;

10. Sector-specific training guides: preparation of separate guides for different sectors such as agriculture, construction, mining, and transportation;

11. Trainer training: organization of "train-the-trainer" programs to keep trainers' knowledge and skills up-to-date.

Emergency Interventions

Definition and classification of emergencies

Emergencies caused by extreme heat can manifest as both acute physiological responses and exacerbations of chronic diseases. According to evaluations conducted during the workshop, emergencies that may be encountered in extreme heat can be listed under the following subheadings: heatstroke (sunstroke); heart attack, stroke, hypertensive attack, hypoglycemia, gastroenteritis, and first- and second-degree burns; and asthma attack and exacerbation of chronic obstructive pulmonary disease (COPD).

In this context, symptoms of heatstroke can be listed as: weakness, exhaustion, fatigue, headache, dizziness, increased body temperature (≥38 °C), tachycardia, excessive sweating or inability to sweat, muscle cramps, difficulty breathing, confusion or loss of consciousness.

Recommendations:

1. First-aid steps include moving the person to a cool, shaded area, loosening or removing clothing, providing a cool shower or cooling the body with a damp towel or cloth, and placing the person on their back with their arms and legs elevated.

2. If the person is conscious and has no nausea, give them either a solution of one teaspoon of baking soda and one teaspoon of salt in one liter of water or soda. If they are unconscious, place them in the recovery (coma) position and call 112. In case of respiratory arrest, perform cardiopulmonary resuscitation and, if available, use an automated external defibrillator.

3. For those with existing chronic conditions, such as hypertension or hypoglycemia, provide first aid according to the appropriate protocol and call 112 immediately.

Vulnerable groups more susceptible to heatstroke and related complications include patients with chronic conditions (e.g., heart failure, vascular diseases, hypertension, diabetes, cancer, kidney diseases, cystic fibrosis, asthma, COPD); pregnant women; individuals aged 65 and over; obese or asthenic individuals; individuals with insufficient fluid intake; those on diets or with nutritional deficiencies; migrant workers (internal and external migrants); undocumented agricultural workers; and child laborers.

Preventive and protective measures in emergency situations

a. Engineering Measures

Recommendation:

Installing local or general ventilation systems (HVAC), insulating heat sources, using radiation barriers to reduce radiant heat, implementing shading solutions (white/reflective roofs,

awnings, mobile awnings), and installing adiabatic cooling and misting systems.

b. Administrative Measures

Recommendations:

1. Work-rest periods should be regulated (e.g., 15 minutes of rest in the shade after 45 minutes of work).

2. Implementing shift rotation by scheduling work during cooler hours is another option.

3. Implementing a heat acclimatization program that gradually increases working hours over 10–14 days can help new employees.

4. Providing fluid and electrolyte support (ensuring consumption of 200–250 mL of water or ayran every 15–20 minutes) is of great importance.

5. Heat-stress training should be organized.

6. Implementing a "buddy system" among employees is important for early recognition of heat-related illness.

7. WBGT should be measured regularly, with the date, time, and environmental conditions recorded appropriately.

8. The number of first aid certified personnel be increased in accordance with regulations.

9. In line with the Presidential Directive dated 27.04.2024, unregistered agricultural workers should be registered through the E-Metip system. Supervision and monitoring should be provided by the governorships and the Ministry of Agriculture. The working hours of high-risk occupational groups should be regulated during periods of extreme heat.

c. PPE

While PPE plays an important role in protecting workers in extreme heat conditions, it is the last step in the prevention hierarchy and cannot replace engineering and administrative measures. Clothing selection is of great importance at this point: whereas normal work clothes do not affect the heat correction factor, thin cotton smocks can increase body temperature by approximately 2 °C, and vapor-barrier clothing can cause an increase of up to 11 °C.

Recommendations:

1. Cooling vests and vapor-permeable lightweight protectors should be preferred.

2. Clothing made of light-colored, sweat-absorbing, ultraviolet-protective fabrics should be used.

3. Wide-brimmed hats and neck protectors are also effective for sun protection.

d. Technical and Innovative Approaches

Since it is often impossible to completely eliminate the sources of danger in industrial processes, collective protection measures should be prioritized, especially in high-temperature enclosed systems such as metal-melting furnaces or in open-field work, such as agriculture and construction.

Recommendations:

1. Shade, automation, and remote-control systems can be considered in this context.

PPE applications should be continued to support these collective measures. Studies have shown that cooling vests reduce body temperature by up to 1.3 °C in employees, and water and sodium supplementation is effective against heatstroke.[9,10]

2. Building on conventional monitoring and preventive strategies as described above, advanced technological solutions may further enhance heat stress management. Integrating WBGT measurements with thermal imaging systems and artificial intelligence–supported algorithms enables real-time risk prediction based on workers' body temperature and environmental conditions, allowing dynamic adjustment of rest periods.

Fluid intake can be monitored through smart water dispensers, enabling automated warnings for insufficient hydration.

3. In workplaces with a high risk of extreme heat exposure, it is essential to have technological cooling devices and emergency response equipment readily available and to ensure access to first aid tools and communication systems.

Since each workplace involves different risks depending on the type of activity, environmental conditions, and job descriptions, it is crucial to prepare and regularly update customized emergency plans.

DISCUSSION

The primary outcome of this workshop is a clear, consensus-based framework which highlights the need for urgent adaptation of current OHS mechanisms in Türkiye to manage the escalating threat of extreme heat. The key messages derived from the working groups emphasize four critical action areas: 1) the explicit integration of extreme weather risks into primary legislation (OHS Law No. 6331); 2) the establishment of secondary regulations mandating WBGT-driven work-rest schedules and acclimatization protocols; 3) the prioritization of structural engineering and administrative controls over PPE; and 4) the implementation of targeted protection mechanisms for informal, seasonal, and migrant workers.

This workshop report demonstrates that extreme heat is no longer an "exceptional weather event" but a permanent, predictable occupational hazard for working life. The WHO European Regional Office reports that between 2000 and 2019, more than 175,000 deaths each year in the European Region were related to extreme heat, which accounts for approximately one-third of global heat-related deaths.[1] This shows that the effects of climate change on health are no longer marginal, but rather a fundamental public health issue. Joint WHO and World Meteorological Organization reports published in recent years highlight that approximately 2.4 billion workers, or more

than 70% of the global workforce, are exposed to heat stress at work; and that occupational heat-related incidents occur every year, resulting in millions of injuries and thousands of deaths.[11] These findings reveal that the TTS's initiative to address working conditions during extreme heat as a distinct policy area is highly appropriate. The ILO report entitled "Working on a Warmer Planet" predicts that by 2030, more than 2% of total global working hours will be lost solely due to temperature.[12] This loss will be concentrated in labor-intensive sectors such as agriculture, construction, and other outdoor work. Considering both Türkiye's climate projections and employment structure, it is clear that similar losses are likely in our country as well.

Studies in industrialized countries show that the risk of traumatic occupational accidents increases significantly with rising temperatures. In their systematic review, Spector et al.[13] revealed that the common finding of numerous studies conducted in different sectors is that working in hot environments increases the incidence of events such as falls, loss of equipment control, and vehicle accidents. Park et al.[14], who analyzed 11.6 million worker compensation files in California between 2001 and 2018, showed that the risk of occupational accidents increased by approximately 10–15% on days when the daily maximum temperature rose to the 32–37 °C range, and this rate increased even further on extremely hot days. Reports from the California Environmental Health Agency also show that occupational heat-related illness and death rates doubled between 2000 and 2017.[15] These findings support the observation, as emphasized during the workshop, that "heat stress is a risk factor that increases occupational accidents not only in outdoor work but also in indoor environments". The lack of a national coding system for monitoring heat-related occupational injuries in Türkiye reduces the visibility of the problem; however, it does not imply that the risk is absent. Systematic studies of heat stress-related accidents are necessary, especially in sectors with long working hours, low wages, and widespread informal employment.

The literature has increasingly focused on heat stress, which predisposes not only to acute events but also to long-term consequences such as chronic kidney disease. Pioneering studies on sugarcane workers in El Salvador found a significant deterioration in end-of-shift kidney function, associated with intense physical workload, high ambient temperature, and inadequate fluid intake; this condition was linked to a condition called "Mesoamerican nephropathy".[16] Wesseling et al.[17], in their studies involving different occupational groups, reported a strong association between high heat, dehydration, and increased serum uric acid levels and kidney dysfunction in workers in fields such as agriculture, ports, and construction. In a more recent review, Elinder[18] emphasized that heat-related kidney damage is not limited to Central America; similar clinical patterns have been reported in groups performing heavy physical work in hot climates, and this should be considered a new type of "occupational nephropathy". These data represent a potential warning for workers in Türkiye, particularly those in the agriculture, construction, mining, and logistics sectors. Since current databases do not specifically track heat-induced renal dysfunction, this area should be a priority for future epidemiological studies.

Analyses by the ILO show that heat-related work hours lost in the agricultural and construction sectors in low- and middle-income countries have significant impacts on economic productivity.[12,19] These losses are important not only macroeconomic indicators but also income inequality and social justice; the highest losses are seen in those already working in precarious and low-wage jobs. Review studies on Mesoamerican nephropathy reveal that kidney damage is most common in low-wage, non-unionized, and socially unprotected male workers; the disease is a "climate justice" issue arising at the intersection of climate change and social inequality.[18] These findings explain why the dimensions of "informal labor, migrant labor, and child labor," which were frequently emphasized at the workshop, should be central.

In Türkiye, a large proportion of agricultural workers are seasonal or migrant and work informally. The steps proposed in the workshop, such as registration via E-Metip, OHS training in the native language, and integration with the family physician system, are consistent with the "temperature-sensitive social protection systems" approach advocated by the ILO and WHO.[11,12,19] In our country, there is no specific law or regulation regarding working conditions in extreme heat. However, the climate crisis, with increasing temperatures and extreme weather events necessitates legal measures regarding OHS. In countries with higher temperatures, such as the United Arab Emirates and Qatar, legislation includes quite comprehensive

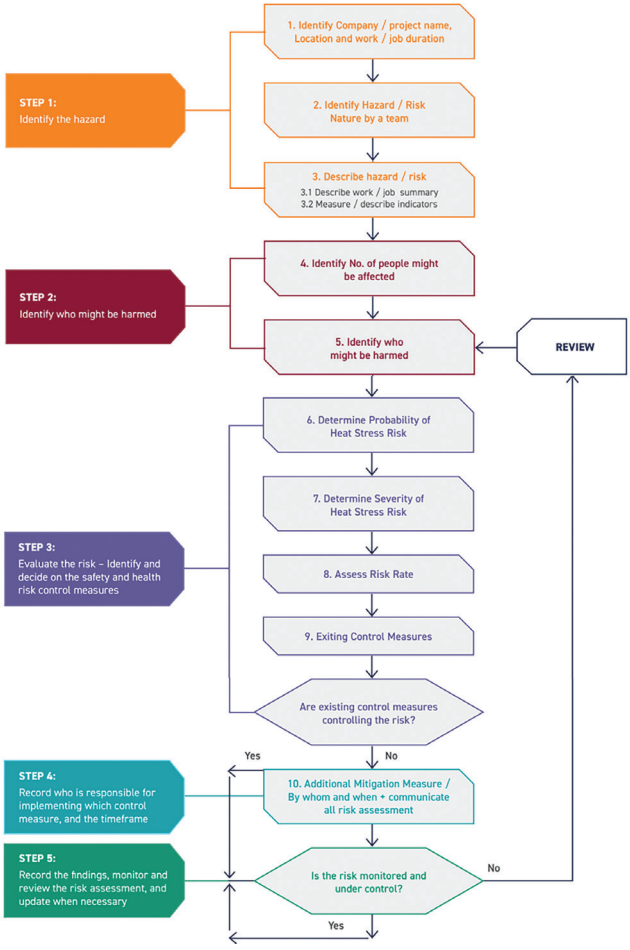

Figure 1. Risk assessment flowchart used in Qatar[20]

(Reproduced from ILO publication with permission)

regulations regarding working conditions in terms of OHS. Figure 1 illustrates the risk assessment flowchart used in Qatar.[20] A risk assessment flowchart can also be prepared in our country, taking regional conditions into account.

Similarly, in Dubai, the temperature index is calculated by taking the humidity level into account, and a risk assessment is carried out accordingly (Figure 2).[21]

In Qatar, work-rest schedules based on WBGT measurement results, work intensity and whether the employee is acclimatized, (starting with short working hours for new employees or those returning from a long break and gradually increasing the duration-approximately 15 days) are shown in Figure 3.[20]

A study of 307 workers in Australia[22] highlighted the association between rising temperatures and several types of injuries, including lifting injuries, hand injuries, and loss of control of electrical tools. Climate change causes far more workplace accidents than official records indicate, and research shows that the effects of climate change are concentrated among workers in open areas and among low-income workers living in housing without air conditioning. Studies show that heat impairs concentration, increases workplace accidents, and leads to an additional 20,000 such accidents every year in California alone.[14]

Heat islands in cities also contribute to extreme temperatures. In our country, unplanned urbanization exacerbates this effect. Heat island formation can increase temperatures by up to 10 °C at night.

According to ILO data, agricultural and construction workers, numbering 940 million, are the most affected groups, with particularly elevated risks among informal workers. Risk has also increased among workers in environmental services, fishing, waste collection, cargo distribution, tourism, sports, road maintenance and repair, and power-line workers, firefighters, search-and-rescue and emergency-response workers, those employed in mining and manufacturing, and individuals engaged in military activities.

Some countries have begun to recognize heat stress as an occupational risk and to explicitly reflect it in their legislation. In Qatar, a 2021 Ministerial Decree required a risk assessment based on WBGT and stipulated that work be stopped when WBGT exceeds 32.1 °C.[20] In addition, an outdoor work ban was imposed between 10:00 and 15:30 from June 1 to

Relative Humidity

Temperature, °C	25%	30%	35%	40%	45%	50%	55%	60%	65%	70%	75%	80%	85%	90%	95%	100%
42°	48	50	52	55	57	59	62	64	66	68	71	73	75	77	80	82
41°	46	48	51	53	55	57	59	61	64	66	68	70	72	74	76	79
40°	45	47	49	51	53	55	57	59	61	63	65	67	69	71	73	75
39°	43	45	47	49	51	53	55	57	59	61	63	65	66	68	70	72
38°	42	44	45	47	49	51	53	55	56	59	60	62	64	66	67	69
37°	40	42	44	45	47	49	51	52	54	56	58	59	61	63	65	66
36°	39	40	42	44	45	47	49	50	52	54	55	57	59	60	62	63
35°	37	39	40	42	44	45	47	48	50	51	53	54	56	58	59	61
34°	36	37	39	40	42	43	45	46	48	49	51	52	54	55	57	58
33°	34	36	37	39	40	41	43	44	46	47	48	50	51	53	54	55
32°	33	34	36	37	38	40	41	42	44	45	46	48	49	50	52	53
31°	32	33	34	35	37	38	39	40	42	43	44	45	47	48	49	50
30°	30	32	33	34	35	36	37	39	40	41	42	43	45	46	47	48
29°	29	30	31	32	33	35	36	37	38	39	40	41	42	43	45	46
28°	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43
27°	27	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41
26°	26	26	27	28	29	30	31	32	33	34	34	35	36	37	38	39
25°	25	25	26	27	27	28	29	30	31	32	33	34	34	35	35	37
24°	24	24	24	25	26	27	28	28	29	30	31	32	33	33	34	35
23°	23	23	23	24	25	25	26	27	28	28	29	30	31	32	32	33
22°	22	22	22	22	23	24	25	25	26	27	27	28	29	30	30	31

Legend:

Up to 29°C	No discomfort
From 30 to 34°C	Slight discomfort sensation
From 35 to 39°C	Strong discomfort. Caution: limit the heaviest physical activities
From 40 to 45°C	Strong indisposition sensation. Danger: Avoid efforts
From 46 to 53°C	Serious danger: stop all physical activities
Over 54°C	Death danger: imminent heat stroke

Figure 2. Temperature index calculated, taking humidity into account, reproduced with permission from Technical Guideline DM-HSD-GU38-MHSW2, Safety Section, Health and Safety Department, Dubai Municipality, Dubai, United Arab Emirates

(Reproduced from ILO publication with permission)

Minutes of break within an hour of work shift	WBGT for type of work load (°C)			
	Light work	Moderate-intensity work	High-intensity work	Very high-intensity work
Acclimatized workers				
0 – 15	≤ 30.8	≤ 28.2	---	---
15 – 30	30.9 - 31.2	28.3 - 29.0	26.7 - 27.6	---
30 – 45	31.3 - 31.8	29.1 - 30.1	27.7 - 28.8	26.6 - 27.9
45 - 60	> 31.8	> 30.1	> 28.8	> 27.9
Non-acclimatized workers				
0 - 15	≤ 28.1	≤ 25.0	---	---
15 - 30	28.2 - 28.7	25.1 - 26.0	23.1 - 24.2	---
30 - 45	28.8 - 29.3	26.1 - 27.2	24.3 - 25.7	23.0 - 24.6
45 - 60	> 29.3	> 27.2	> 25.7	> 24.6

--- : No Threshold Limit Values provided. Detailed analysis and/or physiological monitoring should be used.

Figure 3. Work break recommendations according to WBGT[20]

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WBGT: Wet-Bulb Globe Temperature

September 15 each year, and rest areas and cooling stations were mandated. Similarly, in the United Arab Emirates, a "lunch break work ban" is implemented between 12:30 and 15:00 during the summer, and the compliance rate is reported to reach 99%.[23]

These examples show that the recommendations in the workshop report, such as "not working between 10:30 and 15:30 for vulnerable groups at 32 °C and above" and "incorporating WBGT-based work-rest schedules into legislation," are not merely theoretical demands but are consistent with good practices already implemented in some countries.

When the reviewed literature and the workshop findings are evaluated together, the following conclusions can be drawn:

- Extreme heat is one of the most important climate-related causes of death and workforce loss, according to WHO and ILO data.
- Heat stress increases both acute traumatic injuries and long-term health problems such as chronic kidney disease.
- The highest risk is concentrated in sectors with open spaces and heavy workloads, such as agriculture, construction, mining, logistics, and environmental services, and among informal and migrant workers.
- Examples from some countries show that work bans based on WBGT protocols, acclimatization protocols, and mandatory rest and cooling areas are feasible in practice.

Therefore, in Türkiye, as suggested in the workshop report:

- Adding a clear provision specific to extreme weather conditions to Law No. 6331,
- Arranging work-rest periods in accordance with temperature and WBGT thresholds in the Working Hours Regulation related to the Labour Law,
- Establishing special protection and monitoring mechanisms for unregistered and migrant workers,
- All these recommendations should be regarded as scientifically-based policy steps consistent with national health data and the international literature.

Study Limitations

While this workshop report provides a comprehensive and interdisciplinary framework, several limitations should be noted. First, participant selection was based on purposive sampling. Although it aimed for broad representation across the health, labor, and legal sectors, representatives of some specific industrial sectors or local employer associations may have been underrepresented. Second, the consensus process relied on open qualitative discussions rather than a formal, mathematically structured consensus method (such as the Delphi technique). While the final recommendations reflect a strong agreement among attendees, the outputs were shaped by the dynamics of open group discussions. The proposed WBGT thresholds and work-rest schedules are currently based on international standards (e.g., ISO 7243) and on practices in other countries. Future empirical studies are needed to validate these specific thresholds within Türkiye's local climatic and demographic context.

CONCLUSION

The climate crisis is one of the most important issues threatening our health worldwide. Besides measures to prevent the crisis from deepening, adaptation and mitigation are crucial. Workers' health is threatened by the climate crisis, rising temperatures, and extreme weather events. To address this issue, our country needs legal regulations, training for workers and employers, and structural adjustments. In the workshop we held, which included representatives from all relevant fields of expertise, we discussed the issue in all its aspects and developed recommendations. We believe that the topics discussed and

the recommendations made at our workshop will guide future steps in this field within our country.

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Footnotes

Authorship Contributions

Concept: S.G., S.Ç.K., S.S.O., Design: S.G., S.S.O., Data Collection or Processing: S.G., S.Ç.K., S.S.O., M.K., İ.C.D.Ü., Analysis or Interpretation: S.G., S.Ç.K., S.S.O., M.K., İ.C.D.Ü., Literature Search: S.G., S.Ç.K., M.K., Writing: S.G., S.Ç.K., S.S.O.

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Appendix 1: https://d2v96fxpocvxx.cloudfront.net/bd1986e1-0bc1-4f4d-af66-3a184850a065/content-images/7335677d-6d13-4975-b682-c7f7c04cf9d9.pdf

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