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THE IMPACT OF CLIMATE CHANGE ON THAILAND'S OCCUPATIONAL HEALTH-RELATED ISSUES

Kultida Bunjongsiri*

[1] School of Health Science, Sukhothai Thammathirat Open University, Nonthaburi, Thailand
Kultida.Bun@g.stou.ac.th
[1] https://orcid.org/0000-0002-0780-7574
*Corresponding Author: Kultida.Bun@g.stou.ac.th

Abstract— *Environmental change, including climate change, is one of the most urgent problems facing our time. Thailand is especially susceptible to climate change because of its position and reliance on industries that are sensitive to the changing climate. It is anticipated that climate change would increase occupational exposures to chemicals, ozone, high temperatures, and polycyclic aromatic hydrocarbons. In addition to increased workplace violence, climate change has been connected to an increase in the spread of wildfires, pathogenic microorganisms, and vector-borne infectious agents. A challenge to the productivity, social well-being, and health and safety of the diverse workforce worldwide is occupational exposure brought on by climate change and rising temperatures. Climate change is predicted to impact both indoor and outdoor workers. Common occupational health problems include heatstroke, headache, exhaustion, insomnia, skin, respiratory, renal, and heart disorders, immunological dysfunction, infections, injuries, cancer, and (in extreme cases) fatality. A range of strategies must be put in place by politicians, governments, and employers to protect workers against the long-term health implications of climate change. Any steps that could be made to lessen the negative health effects of climate change should also be communicated to employees.*

Keywords— climate change, climate-related, health impacts, heat-related illnesses, occupational health.

I. INTRODUCTION

Potential increases in the frequency and severity of severe weather—defined as any catastrophic weather, including floods, blizzards (heavy snow), tornadoes, and violent thunderstorms—could change the ecosystem services and, consequently, the quality of life for those who depend on them. The threat of climate change may have an impact on many nations worldwide in many spheres of development [1]. Globally, workers' health and safety are already being significantly impacted by climate change. Despite being among the groups most at risk from climate change, workers are sometimes forced to stay on the job, even under hazardous situations. Worker mortality and morbidity have resulted from global occupational safety and health (OSH) safeguards' inability to keep up with the changing hazards posed by climate change [2]. As a result of climate change brought on by global warming, natural disasters—such as melting polar ice caps, sea and ocean volatility, sea level rise, floods, wildfires, droughts, heat waves, storms, volcanic eruptions, tsunamis, etc.—become more frequent and severe, resulting in the collapse or submersion of entire cities and a significant number of fatalities [3, 4]. In Thailand, the sea level will rise by 5 mm annually, and the average annual temperature will climb by 1 degree Celsius (in 2019, the average annual temperature was 28.1 degrees Celsius, 1 degree Celsius more than in the previous 20 years) [5]. This includes the severe drought of 2010, the floods of 2011 and 2017, and the annual floods in numerous areas. Thus, work and global warming are inextricably intertwined. Affected by global

warming are the earnings of agricultural labourers who grow rice, corn, and sugarcane [6]. Damage to rice from floods or drought, like the 2011 floods, might result in employment losses for workers. Hot weather also increases the risk of illness, disease, and lost wages for workers. Employees have a harder time working, put in less, and are less productive [7]. Meanwhile, the unpredictable weather puts fishing boats at risk. Coastal erosion and rising water levels can cause disruptions to farms and jobs. In Thailand, the wet-bulb globe temperature (WBGT) index, which measures air temperature, natural wet temperature, globe temperature, relative humidity, and air velocity, was used to assess environmental temperature. A comprehensive, cooperative strategy involving legislators, regulatory bodies, public health organizations, companies, and employees is needed to address the serious public health issue of occupational heat disease. The initial steps in reducing occupational heat-related disease will be to prioritize workplace safety rules and educate workers and healthcare providers. By involving employees in the development and execution of heat stress interventions and giving priority to solutions that do not worsen already-existing socioeconomic disparities, these tactics should emphasize workers' rights and environmental justice. Finally, in order to prevent and lessen the effects of excessive heat on workers, efforts to limit greenhouse gas emissions must address the fundamental causes of climate change. The current analysis shows that, as predicted, the WBGT level peaked in the summer. In addition to high temperatures, the rainy season also brings high humidity, which increases the risk of heat stress by decreasing sweat's capacity to remove excess metabolic heat. This paper aims to explore the effects of climate change on occupational health and find the recommendation to policy maker in Thailand.

II. METHODOLOGY

The research paper is based on a narrative review of journal articles and other sources in the domains of health impacts of climate change on workers, health and safety impacts from climate change, chemical and physical particles, biological illnesses, and building research. The potential effects of climate change on the health and safety of industry personnel are examined in this narrative review. It also explores the importance of resilience in helping these workers adjust to and successfully handle the difficulties and barriers presented by climate-related factors in the line of work.

III. THE HEALTH IMPACTS OF CLIMATE CHANGE

A. The health impacts of climate change on workers

The productivity, social well-being, and health and safety of the diverse workforce around the world are now at risk due to occupational exposure linked to climate change and rising temperatures. Therefore, encouraging well-being, ensuring decent employment and work capability, ensuring healthy lifestyles, and preventing the consequences of climate change on all areas of development are the main objectives of the 2030 Sustainable Development Goals (SDGs) [8]. The World Economic Forum's Global Risks Report 2020 states that, over the next ten years, climate change will pose the biggest threats to human livelihoods due to its detrimental effects on health and well-being, decreased labour productivity, and increased forced migration [9]. According to a 2018 report, environmental deterioration threatened 1.2 billion employment, or 40 percent of the global workforce [10]. Indigenous peoples, the poor, rural labourers, workers in developing nations, and other marginalized groups are the ones most impacted by climate change, biodiversity loss, and environmental degradation. Uncontrolled labour migration results from this, opening doors for exploitation and forced labour. Different regions have different percentages of employment that depend on ecosystem services; Africa and Asia and the Pacific have the largest percentages, at 59

and 47 percent, respectively. Ecosystem services directly support 17% of all jobs in Europe and the Americas, and 15% in the Arab States. Agriculture accounts for 80% of these jobs worldwide, followed by forestry and fisheries (5%), food, drink, and tobacco (6%), wood and paper, renewable energy, water, textiles, chemicals, and tourism related to the environment (9%). Only jobs that directly depend on the delivery of ecosystem services are taken into account in these estimations. Through other industries that rely on or supply inputs for these activities, ecosystem services also indirectly sustain jobs (for instance, these figures account for farmers but not salesmen selling seeds or truckers delivering produce) [10].

B. Health and safety impacts from climate change

Climate change threatens human health, especially mental health, as well as access to wholesome food, clean air, safe drinking water, and shelter. Everyone is impacted by climate change at some point in their lives. Some people are more impacted by climate change than others due to factors like where they reside, their age, health, income, and job, as well as how they conduct their everyday life. Outdoor occupations are not the only ones affected by climate change. Workers in hot interior environments (such as steel mills, dry cleaners, manufacturing facilities, warehouses, and other areas without air conditioning) are particularly susceptible to the negative effects of climate change, such as indoor air pollution or excessive heat exposure [11, 12]. In addition to these, there are a number of additional variables that combine to constitute risk factors (individual, institutional, and environmental factors) that increase workers' susceptibility to occupational hazards associated with climate change. Employee sensitivity to the environmental effects of climate change has received less attention from academics in recent years than vulnerability to those effects. Using the available empirical data, the current review discusses the various occupational exposures that are predicted to contribute to climate change, identifies the areas that would be most affected, and highlights the various preventive measures that are required to protect workers from the health risks associated with climate change.

The Thai rule on administration and management of workplace safety, health, and environment with regard to heat specified the following requirements: i) a light workload is defined as an environmental temperature of less than 34°C WBGT and metabolization of less than 200 Kcal/h; ii) a medium workload is defined as an environmental temperature of less than 32°C WBGT and metabolization of between 200 and 350 Kcal/h; and iii) a heavy workload is defined as an environmental temperature of less than 30°C WBGT and metabolization of more than 350 Kcal/h. When metabolization was compared to environmental temperature (°C WBGT), it was discovered that all of them functioned in extremely hot settings above the summer and rainy season regulations. For example, farmworkers' workloads were therefore classified as heavy in the summer and medium in the winter and rainy season. Furthermore, under heat stress circumstances, the WBGT was determined to be the most accurate method for associating physiological data. Human health and climate change have a direct, systemic, and complex relationship. The human body must adjust to a few increasing stressors that threaten its homeostatic internal equilibrium as the world's external conditions change. These changes to the environment do more than just change the scenery; they also set off biological reactions that show up as physical trauma, chronic degeneration, or acute sickness. The following high-level effect categories have been identified as the main risks to human health:

1.The Intersection of Climate and Biology: Health status, dietary patterns, food systems, and the physical environment are some of the factors that cross to create the complex links between health, disease, and nutrition. The environment in which these interactions exist is ever-changing.

1.1 Severe Heat: The human body's thermoregulatory system is directly and severely stressed by excessive heat, frequently exceeding its ability to sustain a steady core temperature of about 37°C. This stress can put life-threatening strain on the heart, kidneys, and other organ systems. It shows itself as a strong, coordinated effort by the autonomic nervous system to dissipate heat through increased skin blood flow and massive sweating.

1.2 Degradation of Air Quality: The respiratory and cardiovascular systems are the main targets of the severe, systemic effects of air quality degradation, which is mostly caused by the burning of fossil fuels and industrial pollution. Because they cause oxidative stress, chronic inflammation, and direct organ damage, fine particulate matter ($PM_{2.5}$), ground-level ozone (O_3), and nitrogen dioxide (NO_2) cause millions of premature deaths each year.

1.3 Severe weather events: Climate change is causing severe weather events, such as tropical cyclones, floods, wildfires, and excessive heat, to occur more frequently and with greater intensity. The yearly global direct damage from these occurrences have increased since the early 2000s, posing interrelated and compounding risks to infrastructure, human life, and physiological health.

1.4 Infectious Diseases: By extending the seasonal activity windows and geographic ranges of infections and their vectors (mosquitoes, ticks, etc.), global warming has significantly changed the patterns of infectious disease transmission. Tropical disease-carrying vectors are migrating into temperate regions as temperatures increase and extreme weather events become more common, while warmer winters and hotter summers enable parasites to thrive and proliferate in formerly too-cold locales.

1.5 Water and food insecurity: A systematic, interrelated, and frequently self-reinforcing disruption of nutritional intake brought on by both the lack and pollution of vital, life-sustaining resources, water and food insecurity constitute a compound disaster. There is a twin burden of malnutrition—simultaneous undernutrition and obesity—as well as an increased burden of chronic illness due to the failure of systems to supply clean, consistent water and nutrition.

1.6 Mental Health Strains: A substantial contributor to psychological morbidity worldwide is trauma resulting from natural disasters, technical disasters, and persistent instability in living settings; around one-third of those exposed suffer serious mental health consequences. These incidents frequently have long-lasting, persistent effects on mental health that go well beyond the immediate aftermath.

A thorough examination of the precise physiological processes triggered by rising thermal baselines is necessary to comprehend these broad categories.

2. Thermal Stress: Reasons for Severe Heat. The human body must perform intense metabolic labour in order to maintain a steady core temperature when it is overheated. Several crucial biological circumstances arise when the body's ability to dissipate heat and cool itself through evaporation is exceeded by the ambient temperature. Table 1 showed heat-related conditions and their primary symptoms.

TABLE I

HEAT-RELATED CONDITIONS AND THEIR PRIMARY SYMPTOMS

Environmental Factor	**Biological Response/ Condition**	**Primary Symptom**
Extreme Ambient Temperature	Heatstroke	Altered mental state, confusion, or loss of

		consciousness; life-threatening systemic failure
Prolonged Heat Exposure	Heat Exhaustion	Excessive diaphoresis (sweating), rapid pulse, and profound fatigue
Thermal Fluid Loss	Dehydration	Extreme thirst, dizziness, and decreased renal output
Muscle Overexertion in Heat	Heat Cramps	Acute, painful muscle spasms and involuntary contractions

The biggest risk that climate change poses to workers may be heat, which is predicted to increase over time and endanger both indoor and outdoor workers. These conditions are typically found at ferrous foundries, nonferrous brick-firing sites, ceramic factories, glass factories, rubber plants, electrical industries, bakeries, confectioneries, commercial kitchens, laundromats, food canneries, chemical plants, mining sites, smelters, and steam tunnels. Inadequate or non-existent air conditioning and limited access to sufficient ventilation might increase the risk of heat-related illnesses for indoor workers. The outdoor jobs most vulnerable to heat-related illnesses include construction, hazardous waste site operations, asbestos removal, farm labour, oil and gas well operations, landscaping, and emergency response. Occupational heat-related illnesses are underreported, nonetheless, because heat-related occupational fatalities and morbidities are not consistently identified. Agricultural workers, Thailand's largest industry, are especially vulnerable to heat-related ailments. The task usually requires vigorous physical exertion in an outdoor setting with high temperatures and humidity, exposing them to the acute health effects of heat, which can include anything from cramps to potentially fatal conditions like heatstroke. As temperatures rise due to climate change, agricultural labourers will be more susceptible to heat-related illnesses and mortality if physical exertion stays the same. Extreme heat is a systemic catalyst that aggravates pre-existing vulnerabilities in addition to these acute reactions. The cardiovascular system is severely taxed by high temperatures because the heart must work harder to promote peripheral vasodilation for cooling. Increased breathing rates put the respiratory system under stress at the same time, which often leads to a jump in hospital admissions and mortality among vulnerable groups. The chemical makeup of the air is also changed as the physical atmosphere warms, which has an immediate effect on the quality of each breath.

3. Atmospheric Triggers: Respiratory Health and Air Quality. The concentration of chemical and particulate triggers that enter the pulmonary and circulatory systems is increased by climate change, which acts as a force multiplier for air pollution. Dust, wildfire smoke, and Ozone (O_3) are the three main contaminants causing these health effects. Through the following physiological routes, these contaminants damage health by exacerbating particular chronic conditions:

3.1 Asthma The bronchial lining is irritated by particulates and ground-level ozone, which causes inflammation and acute bronchospasms.

3.2 Chronic Obstructive Pulmonary Disease (COPD): Prolonged exposure to dust and smoke-derived particles worsens chronic airway blockage and speeds up the deterioration of lung function.

3.3 Heart Conditions: When fine particulate matter ($PM_{2.5}$) from wildfire smoke enters the bloodstream from the lungs, it can cause systemic inflammation and raise the risk of acute cardiovascular events.

3.4 Lung Cancer: Long-term exposure to contaminated air that contains oxidative triggers and carcinogenic particles raises the chance of cellular mutation and cancer.

But in addition to chemical and physical particles, biological illnesses that thrive in a warmer climate are also regarded as environmental threats. As rising temperatures provide more favourable habitats for disease-carrying mosquitoes, ticks, and rodents, these climate-sensitive diseases—including vector-borne (malaria, dengue, Zika), waterborne (cholera), and zoonotic pathogens—are expanding their geographic ranges and extending their transmission seasons.

4. Biological Catalysts: Living things or the compounds they create are known as biological pollutants, and they are now important, self-propagating catalysts in the deterioration of natural resources and the acceleration of infectious disease outbreaks. These agents, which include bacteria, viruses, and fungi, function as "pathogen pollution" and flourish in settings that have been altered by humans. They frequently produce feedback loops that lead to the spread of antibiotic-resistant strains and cross-species transmission.

A rise in vector-borne and resource-based illnesses results from the upward shift in global temperatures, which broadens the geographic range and seasonal duration of different pathogens. Vector-borne disease transmission and the ensuing health consequences were displayed in Table 2.

TABLE III
VECTOR-BORNE DISEASE TRANSMISSION

Mechanism	**Resulting Health Outcome**
Vector-borne (Mosquitos and Ticks)	Malaria, Dengue Fever, Lyme Disease, and Zoonoses (diseases transmitted from animals to humans).
Water/Food Contamination	Gastrointestinal illnesses (Cholera, Salmonella) and acute Diarrhea, and increased risk of harmful algal bloom toxins in seafood).
Disrupted Food Systems	Malnutrition, acute undernutrition, stunting (45M+ children), and macro/micronutrient deficiencies.
Heat-related Impacts	Heatstroke, cardiovascular stress, dehydration, increased mortality in elderly populations.
Air Quality/Wildfires	Respiratory illnesses (asthma, COPD), cardiovascular disease, and increased allergy symptoms.

These biological risks are exacerbated by additional climate-related factors in addition to the direct effects of temperature:

Expanded Vector Habitats: Warmer winters and more rainfall enable vectors to live in higher latitudes and elevations, resulting in the emergence of dengue cases in Europe and the spread of diseases like malaria to formerly untouched regions of Africa. Insects like mosquitoes and ticks move into higher latitudes and altitudes when temperatures rise, bringing infectious diseases to populations that are immunologically naive.

Water scarcity and contamination: Droughts concentrate germs in scarce, stagnant water supplies, while increased floods overwhelm sanitation facilities and cause waterborne illnesses. Additionally, the integrity of food and water supplies is jeopardized by climate volatility, which also makes it easier for enteric diseases to spread and undermines food security.

Accelerated Pathogen Growth: Pathogens like Vibrio bacteria, which cause serious wound infections and sepsis, replicate and become more virulent at higher temperatures.

Health System Strain: When biological threats are coupled with extreme weather, human immunity is weakened by increased stress and starvation, which makes it harder for people to deal with disease epidemics.

The body's structural integrity is challenged by macro-scale physical stressors brought on by the changing climate, which go beyond the microscopic dangers of infections and contaminants.

5. External Physical Stressors: External physical stressors, particularly extreme weather and UV radiation, are important, interconnected environmental risks that have a substantial effect on material integrity, occupational safety, and human health. By making extreme events more frequent and UV exposure more intense, climate change is raising these risks.

Both large-scale physical disasters and high-frequency radiation can exert external strain on the human body. Extreme weather events pose acute, catastrophic risks, whereas UV radiation gradually damages cells.

5.1 UV Radiation: Chronic UV exposure raises the risk of skin malignancies, such as melanoma, basal cell carcinoma, and squamous cell carcinoma, and causes photoaging (deep wrinkles, loss of elasticity). Immune Suppression by causing DNA damage and inducing the release of immunosuppressive cytokines, UV radiation suppresses the immune system. Ocular damage, macular degeneration and cataracts are caused by high UV exposure. Material degradation, plastics, rubber, and wood coatings undergo photodegradation because of UV radiation breaking down chemical bonds in materials, frequently in conjunction with high temperatures.

5.2 Extreme Weather (Floods, Storms, Wildfires): Climate change has increased the frequency and intensity of extreme weather events, particularly floods, storms, and wildfires, turning them from sporadic crises into persistent hazards to infrastructure and public health worldwide. These incidents result in severe physical injury and were linked to tens of thousands of deaths in 2025 alone. In addition, these catastrophes cause widespread relocation, disrupt the chronic patient care chain, and destroy vital medical infrastructure.

A comprehensive overview of the interrelated dangers to human health is required due to the confluence of these biological and environmental elements.

IV. RECOMMENDATIONS

Making sure that future greenhouse gas emissions from the biggest emitters are limited beyond the existing national plans is a key tactic to lower the risk of health consequences and productivity losses in the WHO South-East Asia Region. Countries released their intended nationally determined contributions (INDCs), or post-2020 climate plans, before the United Nations Framework Convention on Climate Change summit in Paris in December 2015 [13]. The average GTC would still rise to 2.7 °C if the INDCs were followed, which is more than the maximum increase in GTC of 2.0 °C that the assembled governments had decided upon. Therefore, to lessen the effects mentioned above and safeguard working people in the countries in the region, more efforts are required to limit greenhouse gas emissions. To determine the degree of health danger, many businesses in hot tropical nations need heat monitoring at some point. Businesses must comprehend the potential effects of climate change on the health and safety of their workforce. Administrative controls, such as workload assessment, heat acclimation, taking breaks in shady locations, giving

cool water, and wearing heat-resistant gear, are particularly necessary to reduce high heat exposure in occupational settings. Offering shade covers to those who must work outside can help reduce heat discomfort at work. Because there would be less internal heat production, using mechanical devices to minimize task intensity would also lessen heat stress. Fans that improve air flow are frequently the most straightforward first line of defense for indoor workspaces, which can be air conditioned or cooled in other ways. Starting today, employers should incorporate climate change considerations into their present health and safety training. Existing tools and strategies for defending against climate change-related hazards, such as temperature extremes and the harmful health impacts of pesticide use, may be helpful to workers currently suffering the health effects of climate change. Workers can be shielded from the dangers of excessive heat by comprehensive workplace regulations including employer mandates, improved inspections, and sufficient resources devoted to enforcement. These techniques and strategies can also be applied to get ready for the future prevention of negative health consequences on vulnerable occupational groups.

V. POLICYMAKERS AND THE GOVERNMENT'S ROLE TO PLAY

A skills gap between the workforces of different nations will be the outcome. To develop a workforce that can support industries that are changing their production patterns, governments must concentrate on the development of skills in emerging occupations for their workforce. This will help to create employment opportunities and make changes in the labour market sustainable. As of right now, the Thai government has neither labour plans nor policies for the shift to a green economy. The Green Growth Strategy for Sustainable Development, which defines eight development alternatives, is a climate change strategy included in national plans like the 13th National Economic and Social Development Plan (2023–2027). These methods have nothing to do with labour. Practically speaking, the Department of Labour Protection and Welfare supervises protection measures, and the Ministry of Labour has released a few policy statements, but neither of these explicitly address global warming. The Ministry of Agriculture has been striving to reduce global warming; the Ministry of Tourism has a plan for hotels and tourism; and the Ministry of Energy has a mission to improve staff. It is advised that each nation create a local occupational health impact analysis and prevention plan to safeguard its workers because climate change would exacerbate the situation. Workers can be shielded from the dangers of excessive heat by comprehensive workplace regulations including employer mandates, improved inspections, and sufficient resources devoted to enforcement. A comprehensive, cooperative strategy involving legislators, regulatory bodies, public health organizations, companies, and employees is needed to address the serious public health issue of occupational heat disease. Prioritizing workplace safety laws in addition to educating employees and healthcare professionals will be essential initial measures in minimizing occupational heat-related illnesses (HRI). By involving employees in the development and execution of heat stress interventions and giving priority to solutions that do not worsen already-existing socioeconomic disparities, these tactics should emphasize workers' rights and environmental justice. Finally, to prevent and lessen the effects of excessive heat on workers, efforts to limit greenhouse gas emissions must address the fundamental causes of climate change. These activities ought to include

1. Determining which health outcomes are impacted by climate change and estimating the existing costs associated with them.
2. Calculating the correlations between the chosen health outcomes and climate and non-climate variables.
3. Creating scenarios for the future based on the climate and other factors.

4. Estimating the burden of disease that is anticipated to be caused by both climate and non-climate risk factors in the future by connecting these links.

5. Monitoring the frequency of heat-related illnesses at work using hospital and physician reports, administrative data (such workers' compensation claims and disability payments), and syndromic surveillance;

6. Examining heat-related illness cases and outbreaks to determine risk factors and inform employers and employees about preventative and intervention measures;

7. Teaching medical professionals how to identify HRI, report it, and work with regulatory and public health authorities;

8. Creating and disseminating industry/occupation-specific and community-level health information on heat disease, particularly during heat waves when mitigation and prevention measures are crucial;

9. Establishing and upholding workplace regulations for heat-related illness that include water, shade, rest periods, and training employees to identify the early warning signs and symptoms of heat-related illness; and

10. Funding research to enhance global data on the prevalence and severity of heat-related illness, to improve understanding of the relative workload among occupational groups, and to assess successful interventions to mitigate HRI.

VI. DISCUSSION

There are several limitations to the current study that should be discussed. The first is that the effect of heat on population health is evaluated using mortality data, which are frequently the foundation of health surveillance programs. However, the influence on health in the working population goes much beyond the elevated mortality risk. The second drawback is that significant health outcomes, like mental health issues, were either not evaluated or merely addressed in passing. Lastly, the subject of productivity loss was not fully addressed; the effects were quantified in terms of lost working hours, but the lower production output and product quality were not evaluated. Extreme heat's physiological effects on human health have been extensively studied. Numerous experiments have demonstrated that working in hot conditions might raise one's risk of harm [14]. Although those studies focus on individuals, there is insufficient evidence of heat-related injuries at the population level, where most of the research has been ecological and observational. We can verify the link between heat and injury after evaluating the data from research conducted at the individual and population levels. The different characteristics of the data sources and the heat exposure indicators used in the research under consideration make it challenging to further synthesize the results. The available research confirms the connection between high working temperatures and negative health effects for workers, even among younger age groups. Most of the research employed subpar designs, such as cross-sectional or case series, which prevented definitive conclusions. Workers' compensation claims, emergency department data, or hospital discharge records are the most popular data sources for conducting extensive, reliable studies on heat-related illness and injury. Heat indicators, such as the daily maximum temperature, are frequently used in studies based on these data sources to evaluate the effect on workers' health [15]. Exposure is typically measured at group level rather than the individual level in these ecological investigations. Conversely, the most often measured indicator used in ad hoc research is the WBGT. The effects of heatwaves, elevated temperatures on the day of the injury, and/or the climate conditions in the preceding days, accounting for the lag effect, were taken into consideration in studies that evaluated the relationship between heat exposure and acute injuries. While the impacts of heat waves seem to be the most overlooked now, those of high temperatures are typically evaluated. Guidelines for

managing heat stress are in place in almost every nation. The effects of intense heat on occupational health are currently the primary focus of heat prevention initiatives [16]. However, heat seems to be a quiet killer. Research indicates that the association between heat and injuries is an inverted U-shaped curve: when temperatures are still not excessively high, work-related injuries begin to rise as the maximum temperature rises [17]. Furthermore, some workers may still be at high risk of injury even in modest heat stress situations since heat stress is influenced by both internal heat (physical activity) and clothing, as well as external heat (weather-related heat and machine-generated heat). Surprisingly little research has been done on the health effects on construction workers, and studies focusing on vulnerable workers—such as those with chronic respiratory or cardiovascular diseases—who are most vulnerable to the worst outcomes have not been found [18].

Since there is currently very little information about how climate change affects vector-borne infectious diseases in the working population, it was decided to concentrate the analysis on the overall increased risk of infections and to consider the potential impact of climate change on vector distribution. In this instance, deductive reasoning was used to conclude that, given the current and future growth of vectors' habitats, outdoor workers will have a higher chance of experiencing these kinds of health effects. According to a recent study, the microbial communities of our soils are being drastically altered by climate change and the increased frequency of extreme events like desert dust storms [19-20]. This includes the movement of entire microbial communities (bacteria and fungi), including organisms that are incredibly resilient and able to survive in different environments far from their origins [21]. According to a recent review of current research on infectious diseases and climate change, results may be underestimated due to the inability to take into consideration co-factors, such as the impacts of chemotherapy and human-induced snail clearance in the case of schistosomiasis [22-23].

VII. CONCLUSION

There is clear evidence of climate change, and extreme weather occurrences are occurring worldwide. The population's occupational distribution is now more susceptible to health risks associated with climate change due to these significant changes. To create a vulnerability comparison at the national and regional levels, a global policy is necessary. Since the risk of climate change differs from nation to nation and from region to region, each nation will need its own policies and funding. To foster advocacy, legalization, and cooperation across the labour, environmental, and health sectors, a profile of the national or regional vulnerability must be established. Maintaining a record of the negative impacts of climate change on occupational health is equally crucial. Since 1988, the body of research on the connection between OSH risks and climate change has grown. But there are still a lot of gaps, especially when it comes to how worker exposure to air pollution, UV radiation, hazards in the built environment, and injustices affect their physical and mental health. More interventions should be created to avoid and regulate the risks associated with vector-borne illnesses, as well as scenarios for identifying hazards in geoengineering. Programs that target business and worker behaviors will be crucial because employers are not used to handling climate-related risks. The monitoring data is insufficient to address equity problems associated to worker exposures and bad outcomes with relation to race/ethnicity, nativity, immigrant status, and language, despite the rising body of literature on health equity and climate change. Setting an agenda for occupational health research that takes these climatic projections into consideration is necessary. The number of workers at risk for the consequences of climate change in various industries, as well as the type and context of their employment in various geographical areas, still need to be adequately described. This data will help with comprehensive exposure assessments that quantify the effects

of occupational climate change. Researchers need to keep evaluating the financial consequences of climate-related risks to businesses and employees, as well as how these risks affect indoor workers. They also need to develop novel risk management and hazard control strategies that employers can implement to safeguard employees. In order to meet the demands of workers exposed to climate-related hazards, a more aggressive front for research and surveillance must be formed.

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REFERENCES

[1] Unfccc, U., Kyoto protocol reference manual on accounting of emissions and assigned amount., eSocialSciences, 2009.

[2] Ansah, E.W., Ankomah-Appiah, E., Amoadu, M., and Sarfo,J.O., "Climate change, health and safety of workers in developing economies: A scoping review." The journal of climate change and health, vol. 3: 100034, August 2021.

[3] Sukumaran, K., "Impact of human activities inducing and triggering of natural disasters, in A System Engineering Approach to Disaster Resilience: Select Proceedings of VCDRR 2021.", Springer. p., pp. 17-31, March 2022.

[4] Nukusheva, A., Ilyassova, G., Rustembekova, D., Zhamiyeva, R., and Arenova, L., "Global warming problem faced by the international community: international legal aspect." International Environmental Agreements: Politics, Law and Economics, vol. 21, no. 2, pp. 219-233, August 2020.

[5] Lindsey, R. and L. Dahlman, "Climate change: Global temperature.", Climate. gov, vol. 16, pp. 1-5, January 2024.

[6] Ojo, T. and L. Baiyegunhi, "Climate change perception and its impact on net farm income of smallholder rice farmers in South-West, Nigeria.", Journal of cleaner production, vol. 310: 127373, August 2021.

[7] Morabito, M., Messeri, A., Crisci, A., Bao, J., Ma, R., Orlandini, S., ... and Kjellstrom, T., "Heat-related productivity loss: benefits derived by working in the shade or work-time shifting.", International Journal of Productivity and Performance Management, vol. 70, no. 3, pp. 507-525, February 2021.

[8] Wayne, S. and D.C. Frechtling, "Sustainable Development Goals (UN)", Encyclopedia of Tourism., pp. 1018-1020, January 2025.

[9] McLennan, M., The global risks report 2022 17th edition., World Economic Forum Cologny, Switzerland, 2022.

[10] Montt, G., F. Fraga, and M. Harsdorff, "The future of work in a changing natural environment: Climate change, degradation and sustainability.", International Labour Organization, 2018.

[11] Han, S. R., Wei, M., Wu, Z., Duan, S., Chen, X., Yang, J., ... & Xiang, J., "Perceptions of workplace heat exposure and adaption behaviors among Chinese construction workers in the context of climate change.", BMC Public Health, vol. 21, no. 1, 2160, November 2021.

[12] Board on Population Health, Public Health Practice, Committee on the Effect of Climate Change on Indoor Air Quality, & Public Health., Climate change, the indoor environment, and health. : National Academies Press, 2011.

[13] Cadman, T., “The United Nations framework convention on climate change.”, The Palgrave handbook of contemporary international political economy., London: Palgrave Macmillan UK.. pp. 359-375, December 2018.

[14] Ebi, K. L., Capon, A., Berry, P., Broderick, C., de Dear, R., Havenith, G., ... and Jay, O., “Hot weather and heat extremes: health risks.”, The lancet, vol. 398, no. 10301, pp. 698-708, August 2021.

[15] Murage, P., Hajat, S., Macintyre, H. L., Leonardi, G. S., Ratwatte, P., Wehling, H., ... and Kovats, S., “Indicators to support local public health to reduce the impacts of heat on health.”, Environment international, vol. 183, 108391, January 2024.

[16] Gibb, K., Beckman, S., Vergara, X. P., Heinzerling, A., and Harrison, R., “Extreme heat and occupational health risks.”, Annual review of public health, vol. 45. January 2024.

[17] Chen, S., Geng, J., Lan, M., He, S., and Weng, W., “Study on physiological features, subjective perception, and cognitive performance of individuals in prolonged high-temperature environments.”, Building and Environment, vol. 273, 112700, April 2025.

[18] Covert, H. H., Wahid, F. A., Wenzel, S. E., and Lichtveld, M. Y., “Climate change impacts on respiratory health: exposure, vulnerability, and risk.”, Physiological reviews, vol. 103, no. 4, June 2023.

[19] Coleine, C., Delgado-Baquerizo, M., DiRuggiero, J., Guirado, E., Harfouche, A. L., Perez-Fernandez, C., ... and Egidi, E., “Dryland microbiomes reveal community adaptations to desertification and climate change.”, The ISME journal, vol. 18, Issue 1, wrae056, January 2024.

[20] Liu, J., Wang, C., Guo, Z., Xu, A., Pan, K., and Pan, X., “The effects of climate on soil microbial diversity shift after intensive agriculture in arid and semiarid regions.”, Science of the Total Environment, vol. 821, 153075, May 2022.

[21] Weil, T., De Filippo, C., Albanese, D., Donati, C., Pindo, M., Pavarini, L., ... and Miglietta, F., “Legal immigrants: invasion of alien microbial communities during winter occurring desert dust storms.”, Microbiome, vol. 5, no. 1, 32, March 2017.

[22] Liang, L., and Gong, P., “Climate change and human infectious diseases: A synthesis of research findings from global and spatio-temporal perspectives.”, Environment international, vol. 103, pp. 99-108, June 2017.

[23] Rodó, X., and Anton, J., “Assessing the role of climate and the environment as co-factors for vasculitis diseases.”, Rheumatology, vol. 64 (Supplement_1): pp. i28-i32, March 2025.