Protection from occupational heat stress amid rising global temperatures

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Prof Luana Main emphasises that as extreme heat events become more frequent due to rising global temperatures, immediate action is essential to protect workers through evidence-based and context-specific risk mitigation strategies and solutions

Climate change and the associated increases in the frequency and severity of extreme heat events have rapidly become one of the most significant challenges facing humanity's health. Fuelled by rising global temperatures, occupational heat stress will pose a critical threat to the health and safety of workers worldwide, with projected estimations suggesting a 12- to 18-fold increase in global heat wave exposures by 2050. (1)

Already, 71% of the global working population is exposed to excessive work-related heat. (2) As a result, 18,970 lives and 2.1 million disability-adjusted life years are lost annually due to 22.9 million occupational injuries, directly attributable to excessive heat. (3) This does not include the 26.2 million people worldwide living with chronic kidney disease linked to workplace heat stress (2020 figures). (3) By 2050, the economic impact due to heat waves is projected to be US$7.11 trillion due to productivity loss, with a commensurate US$7.1 trillion burden on healthcare systems worldwide from heat-related diseases. (1)

Extreme heat poses serious health risks

Extreme heat poses serious health risks for both outdoor workers and those working in enclosed indoor spaces with inadequate ventilation. Workers in occupations such as agriculture, construction, mining, defence, and fire and rescue services will be among the most adversely impacted by global warming due to the physically demanding nature of their professions and exposure to radiant heat sources (e.g., solar radiation, hot machinery). In many of these occupations, heavily insulated and encapsulating protective clothing further compounds this heat stress.

These arduous work conditions can overwhelm the body's physiological capacity to dissipate heat, resulting in progressive elevations in body temperature that compromise health and reduce productivity. Across the course of a single work shift (~8-12 hours), it is well established that heat-exposed workers experience fluid depletion, cardiovascular strain, and impairments in cognitive functioning. These effects can impair work performance (4) and significantly increase the risk of occupational injuries and deadly pathophysiological conditions (i.e., heat stroke, Acute Kidney Injury (AKI), and adverse cardiovascular events). (5)

Growing evidence indicates that working in the heat on consecutive days, a common situation for many workers, will exacerbate these health issues. [5-8] This cumulative effect increases the physiological strain on the body and the commensurate risk of heat-related injuries. However, current heat management practices do not account for the impact of repeated heat exposures or the need for recovery between workdays. This is particularly concerning, given current global heatwave trends.

Heat stress research

While all workers are vulnerable to the adverse effects of heat stress on health and productivity, some population groups may be at higher risk. For example, a recent report showed that existing heat exposure limits may under-protect many workers, especially females [9,10] and older individuals [11,12] who, relative to young men, have a reduced capacity to dissipate heat and yet these individuals represent a growing proportion of our workforce. Despite this, current occupational heat stress management guidelines assume a one size fits all approach that does not consider individual variability in physiological tolerance to heat stress [9], leaving many workers vulnerable. As such, there is an urgent need to develop individualised heat guidance to protect the health of all workers.

Perhaps the most effective means to mitigate occupational heat strain is through the use of different cooling interventions (e.g., slushies, fans) which aim to enhance the body's physiological capacity to dissipate heat or extract heat stored within the body. While these interventions have been extensively investigated [13-15], critical gaps in our knowledge have made it challenging to develop a strong rationale for implementing them to protect the health of our workers.

Anecdotally, many industries do not utilise the available heat mitigation strategies because they are not feasible in their specific contexts. There are also significant challenges with implementing these interventions in some workplaces due to safety concerns or the remoteness of the worksite. [16,17] There are also questions regarding whether the effectiveness of these interventions is influenced by the various individual factors noted above, which can affect the body's capacity to dissipate heat. [13,18]

Logistically feasible cooling interventions

To address these knowledge gaps, we are currently working with industry partners to investigate the effects of logistically feasible cooling interventions, co-designed with industry end-users, on physiological, neurological, and cognitive functioning in young and older males and females during simulated physically demanding work in the heat. [19]

Importantly, these effects on worker health, safety, and resilience (i.e., the ability to sustain work) will be examined across multiple days to better reflect the realities of most occupations, where work over three consecutive days is commonplace. Leveraging these findings, we will develop contextually feasible, low-cost heat-mitigation strategies and evidence-based recommendations to enhance the safety of all workers during heatwave conditions. We want to encourage interested parties to reach out and connect with us.

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