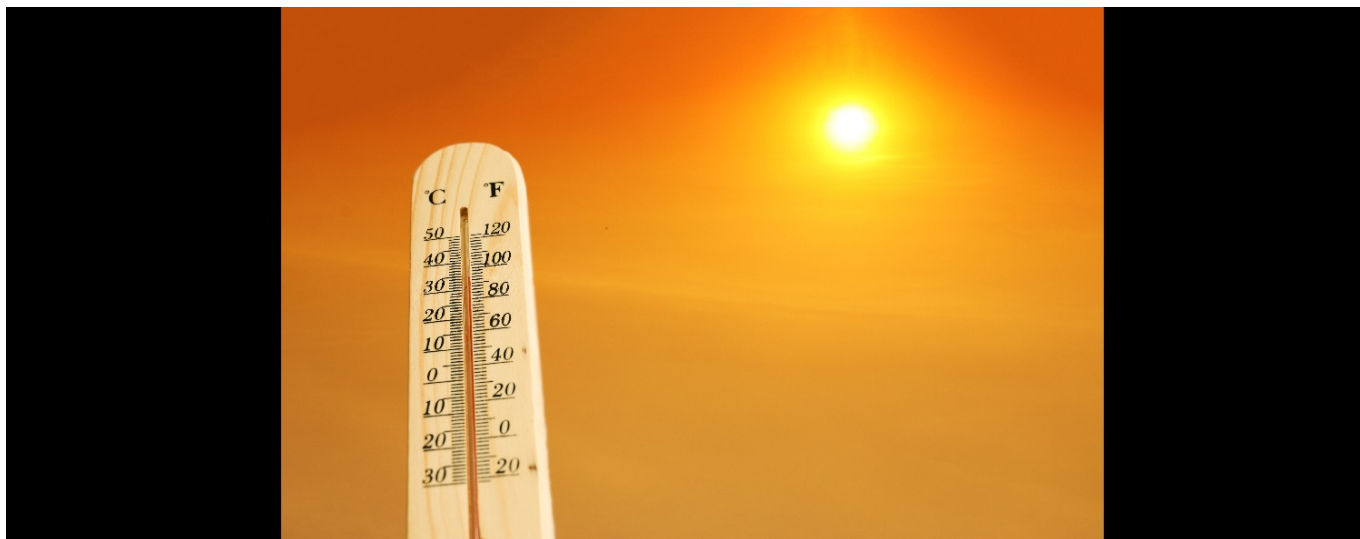


Heat & mental health

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Climate change poses a serious threat to human health, including mental health. A recent meta-analysis published in *Environmental International* demonstrates a positive association between heatwaves and the risk of mental health disorders, particularly in vulnerable populations ([1]).

Mental health disorders are a significant public health challenge, with more than one in ten people globally (792 million or 10.7% of the global population) living with a mental health disorder which accounts for approximately 5% of the global disease burden ([2]). Therefore, the impact of weather on mental health is gaining attention in public health research, particularly in connection with the potential consequences that climate change may have on the mental health of vulnerable populations.

The current systematic review and meta-analysis included 53 epidemiological studies exploring the effects of high temperatures/heatwaves on mental health-related mortality and morbidity. In total, these studies accounted for over 1.7 million mental health-related mortality and 1.9 million morbidity cases over a 30-year period.

The meta-analysis indicated a positive association between elevated ambient temperatures (and heatwaves) and adverse mental health outcomes. Every 1°C increase in temperature was significantly associated with a 2.2% increase in overall mental health-related mortality and a 0.9% increase in morbidity. The greatest mortality risk was attributed to substance-related mental disorders followed by organic mental disorders, and suicides and self-harm. A 1°C temperature rise was also associated with a significant increase in morbidity such as mood disorders, organic mental disorders, schizophrenia, neurotic and anxiety disorders.

Findings suggest that specific populations are more vulnerable to the mental effects of extreme heat, including those living in tropical and subtropical climate zones, aged 65 years and over, and in areas with lower national income levels.

The current study is the first meta-analysis to investigate the effect of high ambient temperatures and heatwaves on mental health-related mortality and morbidity. However, several previous studies have shown an association between increased ambient temperatures and aggression and conflict ([3]) and a higher risk for mental health outcomes such as emergency room visits, hospitalisations, and suicides ([4],[5]). Furthermore, previous evidence indicates that pre-existing mental illness alone raises mortality risk during extreme heat events 2- to 3-fold ([6]).

Several plausible mechanisms have been proposed to explain how ambient temperatures can affect mental health. Heat stress can alter levels of neurotransmitters, including dopamine and serotonin, which have roles in thermoregulation, mood, behaviour, and cognitive function ([7],[8]). Individuals who commit suicide are reported to have lower plasma levels of L-tryptophan, a serotonin precursor which is decreased by higher temperatures ([9]). Heat exposure can lead to an elevated production of stress hormones, including cortisol, epinephrine, and norepinephrine, and impair cognitive performance ([10]).

In addition, heat-induced neuroinflammation may play a role in mental disorders such as depression and cognitive impairment, with animal studies demonstrating significant neuroinflammatory responses and neuronal cell death in the hippocampus due to heat exposure ([11],[12]).

Several studies demonstrate an association between high night temperatures and sleep disturbances and deprivation, particularly in the elderly. Given the bidirectional relationship of sleep and mental health, heat-induced sleep deprivation could influence both the onset and trajectory of mental health disorders ([13],[14]).

Furthermore, psychiatric medications such as antipsychotics, anticholinergics, and antidepressants can impair the body's thermoregulatory mechanisms. Sweating and dehydration can increase lithium levels, increasing the risk for toxicity during heatwaves ([15]).

Limitations

Although most of the included studies controlled for relevant confounders, other environmental exposures correlated with high temperatures, including humidity, solar radiation, and high ozone concentrations, may affect mental health and should be considered in future research. Humidity, for example, may have a particular effect, with one study demonstrating that the impact of heat on distress more than doubled when humidity rose to the 99th percentile ([16]). Furthermore, some studies relied on temperature estimates from adjacent weather stations or interpolated using geographic information techniques, leading to an underestimation of the spatial differences in temperature.

Conclusion

Extreme heat can have significant effects on mental health and behaviour. Urban heat exposure has increased by nearly 200%, affecting 1.7 billion people, over the last 30 years ([17]), and will continue to increase with a warming climate, so further high-quality studies are urgently needed to identify modifying factors of heat impacts. These studies can be used to support policymakers

in developing public health interventions to mitigate the mental health impacts of climate change, particularly in vulnerable populations.

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