International Journal of Environmental Epidemiology

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Editorial

Climate change and human health: the critical role of anthropogenic heat in health impact assessment

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Received 13 May 2026; Revised 30 May 2026; Accepted 1 June 2026; Published 29 June 2026

https://doi.org/10.55092/ijee20260010

Climate change is one of the most critical public health challenges of the 21st century, affecting human health through both direct and indirect pathways. While it is well known for increasing the frequency and intensity of natural disasters such as hurricanes, droughts, and rising sea levels, its health impacts go far beyond these immediate events. Increasing global temperatures lead to more heatwaves, change the spread of disease-carrying insects, and worsen air quality, all of which increase the risk of cardiovascular, respiratory, and metabolic diseases. However, many health impact assessments (HIAs) still focus on individual weather factors like ambient temperature, overlooking the combined effects of urbanization, energy consumption, and social inequalities. To address this limitation, anthropogenic heat (AH), the heat produced by human activities, has gained attention as a valuable indicator. It helps capture the complex links between climate, infrastructure, human behavior, and health outcomes.

Unlike ambient temperature alone, AH measures the heat produced by human activities such as industrial processes, buildings, transportation, and even human metabolism. This makes it a more comprehensive indicator of energy use and urban structure. AH is closely linked to the intensity of urban heat islands (UHIs), which are known to increase heat-related illnesses, energy poverty (due to higher air conditioning use), and even crime during extreme heat events. Additionally, the spatial distribution of AH highlights important environmental justice issues, as marginalized communities often face higher exposure because of limited access to green spaces and inadequate infrastructure. Including AH in environmental health risk assessments offers a valuable tool for better understanding and addressing the complex and unequal effects of climate change.

AH is typically estimated using an inventory-based method, where fuel consumption data from various sectors are assigned to specific administrative regions and combined with satellite-based nighttime light data (e.g., VIIRS) to generate high-resolution (500 m) heat maps [1]. Studies show that AH not only amplifies urban heat island (UHI) effects but also interacts with greenhouse gas emissions and air pollutants, further enhancing regional warming [2–7]. These results highlight AH as a vital factor in climate-health modeling, with important implications for urban planning, energy efficiency, and public health policies. Numerous population-based studies conducted by international researchers have increasingly examined the health impacts of AH. For example, in Northeast China, a 10 W/m² increase in AH was associated with a 5.82% higher risk of childhood adiposity [8]. Likewise, a one-standard-deviation rise in AH exposure was linked to greater odds of sleep disorders (OR = 1.90 [9]), asthma (OR = 1.15 [10]), and ADHD (OR = 3.60 [11]) among children. In adults, moving from the 25th to the 75th percentile of AH exposure correlated with a 0.23 mmol/L increase in total cholesterol and an 8% higher risk of dyslipidemia [12]. The same exposure range was also associated with increased odds of hypertension (OR = 1.17 [13]) and metabolic syndrome (OR = 1.29 [14]). These relationships suggest that thermoregulatory stress, systemic inflammation, and sleep-related endocrine disruption may be central pathways through which AH affects health outcomes.

AH goes beyond traditional climate indicators by emphasizing human-made sources of warming and their immediate health impacts. Including AH in HIAs provides a practical pathway toward precision public health, helping to identify vulnerable groups, evaluate policy co-benefits, and reduce health disparities. In the era of the Anthropocene, ignoring AH risks continues existing cycles of environmental and health vulnerability. Conversely, recognizing AH as a key

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metric can support the creation of more resilient, health-focused urban environments.

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