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Tropical cyclones and mortality risk

A global call for preparedness

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Tropical cyclones, commonly known as hurricanes, typhoons, or tropical storms depending on geographical location, rank among the most destructive and costly climate extreme events worldwide.[1] As climate change accelerates, the proportion of very intense tropical cyclones (categories 4 and 5) is projected to rise by 13% globally.[2] With ongoing shifts in weather patterns, along with ageing populations and the rapid growth of coastal communities, tackling the risks posed by tropical cyclones is crucial for building resilient and sustainable communities. The urgency of this challenge has never been more pressing.

Exposure to tropical cyclones can lead to direct physical harm, such as drowning and injury, as well as indirect adverse effects, often stemming from interrupted healthcare services, contaminated floodwater, psychological distress, and infection outbreaks.[3] A growing body of epidemiological studies suggest that tropical cyclones are associated with a range of health outcomes,[3] including mortality,[4 5] hospital admissions,[6 7] adverse birth outcomes,[8] and mental health disorders.[9] Two key challenges have, however, limited previous research in this area. Firstly, most studies have focused on the health impacts of a single cyclone within a restricted geographical area and timeframe, limiting the generalisability of their findings. Secondly, exposure assessment methods and modelling strategies have varied considerably among studies, making it difficult to compare results or draw robust conclusions.

To address these gaps, the linked study by Huang and colleagues (doi:10.1136/bmj-2025-084906) examined the association between exposure to tropical cyclones and cause specific mortality across nine countries and territories, covering tropical, subtropical, and extra-tropical regions with diverse sociodemographic, infrastructure, and health service conditions.[10] Analysing data from 14.8 million deaths and 217 tropical cyclone events, the authors used well validated models to estimate wind speeds and cumulative rainfall associated with tropical cyclones, and applied a standardised two stage, time series analytical framework.

The study found that mortality risks were most pronounced for renal diseases and injuries, followed by diabetes, neuropsychiatric disorders, infectious diseases, digestive diseases, respiratory diseases, cardiovascular diseases, and neoplasms.[10] Tropical cyclone related rainfall, which typically leads to more indirect health impacts, was more strongly associated with mortality risk than tropical cyclone associated windspeeds. These findings highlight the critical importance of the indirect health effects of tropical cyclones, as many of the highest risk conditions arise not from immediate trauma but from disrupted healthcare systems, environmental contamination, and prolonged stress.

Importantly, Huang and colleagues identified substantially higher mortality risks in communities with greater deprivation, which highlights the need for targeted public health strategies that prioritise the most vulnerable populations. Socioeconomically disadvantaged communities often face multiple barriers to preparedness, response, and recovery, including limited healthcare access, inadequate housing, poor basic amenities, and lower levels of disaster awareness.[11]

Huang and colleagues study further found that areas with less frequent cyclone exposure experienced higher mortality risks during such events.[10] Limited experience with tropical cyclones can lead to a lack of preparedness and adaptive response capabilities. This challenges the assumption that only regions frequently affected by tropical cyclones need to invest in tropical cyclone preparedness, highlighting the importance of universal readiness and adaptive capacity building, even in regions with historically low cyclone activity. One of the key limitations of this study is that tropical cyclone exposure was assessed at the community level, with all individuals in a given community assigned the same exposure level despite differences in their actual experiences. This approach can introduce exposure measurement error, potentially biasing the results towards the null and underestimating the true association.

Policy imperatives

The health impacts of tropical cyclones are predictable, disproportionate, and preventable with proper preparation. Effective adaptation planning could prioritise several key areas.

Firstly, strengthening health surveillance systems by integrating climate monitoring with public health data can provide timely and accurate warnings about tropical cyclones. This proactive approach will empower governments and communities, especially in low income and high risk areas, to prepare in advance and allocate medical resources swiftly and effectively. For example, the National Weather Service in the US has developed early warning systems that could serve as models for other regions seeking to strengthen their disaster preparedness.[12]

Secondly, investment in resilient infrastructures against tropical cyclones is essential, with a particular focus on electrical grids, hospitals, clinics, and shelters. Strengthening the resilience and continued operation of critical facilities during and after cyclones is vital for protecting community health.[13] Some regions, such as Japan and parts of the US, have

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implemented building codes and backup power systems that have proven effective during recent extreme weather events.

Thirdly, public education about health risks after tropical cyclones needs to be enhanced, especially in regions with low income or limited historical exposure to tropical cyclones. Disseminating information on health risk management after cyclones can empower individuals and communities to respond more effectively to flooding, contamination, and mental health challenges, thereby reducing indirect impacts. Initiatives such as communities based disaster preparedness training have shown positive outcomes in improving local resilience.[14]

Fourthly, policies must explicitly deal with the needs of the most vulnerable populations. Targeted interventions, such as prioritising these groups for evacuation, healthcare access, and recovery assistance, can help minimise the adverse health impacts of tropical cyclones. Existing programmes, such as the US Federal Emergency Management Agency (FEMA) disaster assistance for medically vulnerable populations, offer useful examples.

As the intensity and frequency of tropical cyclones continue to increase, we must translate these research insights into developing cyclone specific health policies that protect the most vulnerable, building resilience against the direct and indirect health impacts of these devastating events.

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