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Project/Article Title:

Increasing the Resilience to the Health Impacts of Extreme Weather on Elderly People under Future Climate Change

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Background

Under future climate change, extreme weather events are expected to occur more frequently and with greater intensity. This impact is exacerbated due to the increasing urbanisation and compact urban living in Hong Kong. Older adults are particularly vulnerable to the impacts of extreme hot weather due to declining physiological functions and behaviour. To develop effective mitigation and adaptation plans to address the challenges, high-resolution spatial and temporal data is urgently needed to assess exposure and vulnerability to extreme hot weather. An understanding of the impacts of extreme hot weather on the living environment and the health impacts of extreme hot weather on older adults is also important.

Introduction of the Project

This four-year project, supported by the Research Impact Fund (R4046-18) from the Research Grants Council of Hong Kong, aims to contribute by providing local data for understanding extreme hot weather in Hong Kong and incorporating the scientific knowledge of extreme heat and its associated impacts on the senior health and well-being into a comprehensive plan for response actions. Three main research tasks to translate the urban climate knowledge into practice are: (1) Understanding the future local climate for advancing local weather information services; (2) Developing guidance for the building sector based on building performance modelling and microclimate simulation under extreme heat; and (3) Highlighting the heat health risks to raise public awareness and enhancement of supporting services for older adults (Fig. 1).

Research Tasks and Findings

Climate Data

Local climate datasets on an hourly basis for typical summer conditions and extreme hot summer conditions under different greenhouse gas emissions scenarios in the 2040s and 2090s have been established using downscaled projection data.

Built Environment

Regarding the indoor environment, building performance simulations were conducted to evaluate the changes in the living environment under different greenhouse gas emissions scenarios as compared to the current situation. The potential benefits of ten indoor design strategies were evaluated accordingly.

As for the outdoor environment, different heat mitigation strategies and their combinations in the landscape were evaluated to improve thermal comfort. The study also found that tree view factor was more suitable than green coverage ratio for thermal comfort assessments and urban green infrastructure design in complex urban settings.

Heat Health and Support Services

Numerous studies were conducted to assess the health impacts of extreme hot weather. From historical trends in Hong Kong, the extreme hot weather pattern of two very hot days and three hot nights had the strongest association with mortality and there was a significant lag effect for five days. In addition, consecutive hot nights imposed even higher risk than very hot weather in the daytime, of which five or more consecutive hot nights were the most dangerous.

The urban heat island effect-related mortality under extreme heat scenarios in Hong Kong from 2010 to 2019 was also studied. Under extreme heat scenarios, areas of moderate and high urban heat island effects (UHI) posed a significant increase in mortality risk; and the risk of high urban heat island effect areas demonstrated almost double the risk of moderate urban heat island effect areas.

A spatiotemporal hazard-exposure-vulnerability assessment of the extreme heat risk in Hong Kong was developed. It integrated cumulative very hot day hours and hot night hours in summer, population density and principal component analysis (PCA) of demo-socio-economic characteristics. The heat risk was found spatially variant and high risk mainly occurred in the core urban areas in both daytime and nighttime (Fig. 2).

Apart from mortality and physical health issues, hot weather also negatively correlated with the mental well-being of older adults. Based on the analyses of 320 in-home assessments in the experience sampling study, older adults with lower socioeconomic status were the most psychologically vulnerable to hot weather. Engaging in meaningful activities buffered against the negative effect of extreme hot weather and this buffering effect was more significant among lower-SES older adults.

As the baseline scenario of current perceptions, there is generally a lack of public education and support services in the community regarding the heat-health issue, reflected in the questionnaires and semi-structured focus group interviews. Some older adults perceived that hot weather did not have any impact and adaptation was not necessary. Even when they feel hot at home, they would rather tolerate the heat than turn on air-conditioning, mainly due to financial considerations, as reported by both service providers and older adults. Most importantly, there was a gap between the self-reported thermal sensation by older adults and the threshold of hospitalisation and mortality rate, i.e. when older adults felt hot, the best time to protect them from extreme heat might have already been missed. As such, taking precautionary actions and cooling interventions play an extremely crucial role in preventing and reducing the adverse health outcomes of extreme heat among older adults.

Impacts and Implications

This project provides a holistic understanding of urban heat issues in Hong Kong from different perspectives. This allows the applications and implementations of mitigations and adaptation by different sectors.

Among the follow-up actions identified, a heat alert system is of the utmost importance to both supporting services and preventive measures by the individuals. The project team has communicated with the Hong Kong Observatory (HKO) regarding the heat-health findings, especially regarding the prolonged heat and the health risks to older adults. Service enhancement of the HKO weather forecasting for heat alerts has been eventually implemented in these two years. First, upgraded precautionary actions and warnings for older adults associated with the very hot weather warning. Second, employed a new alert on prolonged heat alert through the mobile app and official website. Third, issued the new "extremely hot" weather warning when the actual or predicted temperatures commonly reach 35°C in the HKO Headquarters or New Territories, i.e. core urban area or residential areas in the new towns.

For the built environment, the future climate datasets are made available online for free for the building industry to carry out building performance simulations and thermal comfort evaluations in future urban development, taking into account the impacts of extreme heat under climate change. An easy-to-understand design guidebook for architectural practice is in preparation to encourage optimisation of the built environment in future development through adopting evidence-based heat mitigation strategies.

For the development of cooling interventions and community services, the heat risk maps for daytime and nighttime visualized and identified areas of higher heat risk to prioritise design/planning mitigations and community adaptation programmes at district and community levels, e.g. long-term planning for cool spots, cooling facilities and heat shelters.

To raise public awareness and preparedness for heat-related health impacts, a series of knowledge transfer activities including health talks, video series and a press conference were conducted. Educational materials were distributed to community senior centres and stakeholders of the support services. Wide media coverage also helps disseminate heat-health knowledge and research findings.

This project is set to be completed in June 2023. Renewal funding has been awarded for extreme cold weather to further the work for a year-round understanding.

More project details could be found at: https://www.cuhk.edu.hk/proj/rif

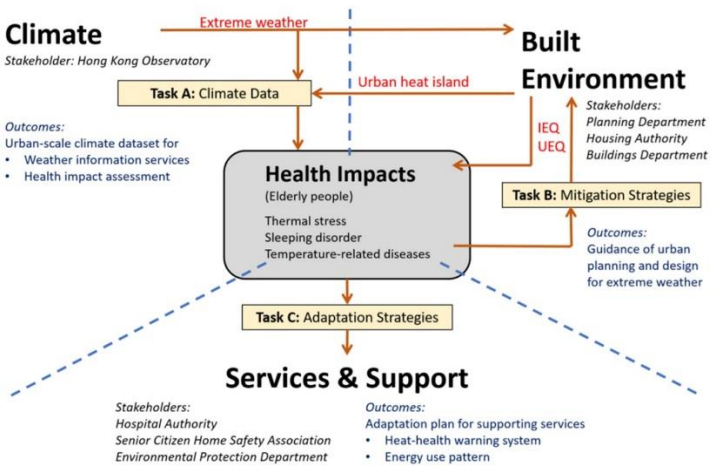

Figure 1. The research methodology and the interaction of the three disciplines.

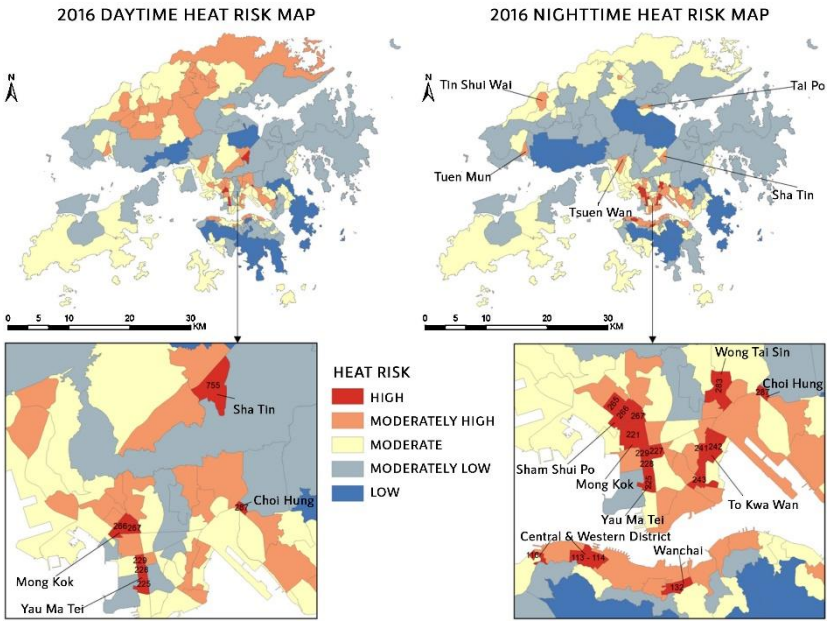

Figure 2. The heat risk maps for daytime and nighttime in 2016.