

Beyond the Heat: Revealing Socio-Spatial Inequities Patterns in Milan during Heatwaves

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Abstract As climate extremes intensify-particularly heatwaves, the spatial distribution of human vulnerability in urban environments becomes increasingly critical. The study starts from the hypothesis that heat stress does not affect the city equally. The condition in which individuals or communities lack adequate access to affordable and effective cooling solutions to protect their health and well-being during extreme heat was recently identified as cooling poverty. In this context, we investigate the role of urban form (primarily building density and presence of greenery) and socio-demographic variables in shaping differentiated exposure to heat-related health risks across neighbourhoods.

Specifically, this study uncovers socio-environmental inequities linked to heat-related health risks in Milan, Italy. Emergency calls for cardiovascular and respiratory diseases recorded during summer periods, were analysed in relation to urban morphological indicators, and socio-demographic variables. The meso-scale mapping is based on a hexagonal grid to take into account and emphasise the level of communities.

The analysis reveals a correlation between call volumes and both population density and built density. However, significant outliers indicate that vulnerability cannot be explained by density alone. In particular, reporting values on quadrant plots comparing call density to population and urban density, expose distinct risk patterns, underscoring the need for tailored interventions. The results suggest that emergency service planning, social outreach, and urban retrofit strategies should move beyond temperature or density metrics to include indicators of social vulnerability.

This study highlights the value of meso-scale spatial analysis at the scale of neighbourhoods in uncovering 'invisible' urban heat inequities and supports data-informed decision-making in urban planning and public health. These findings can guide both short and long term action for the planning, design and management of heat-resilient cities. To achieve equitable urban adaptation, public authorities must address the multiple dimensions of human fragility, including urban morphology and green infrastructure, in addition to welfare provision and access to services.