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Using thermal walks to examine pedestrians' thermal (dis)comfort across indoor, outdoor and semi-outdoor environments in the equatorial climate of Singapore.

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Thermal comfort assessments utilising field survey methods are usually confined within distinct thermal environments (i.e. indoors, outdoors and semi-outdoors) because (i) non-steady state thermal comfort indices for the field are less established and (ii) such spatial-situatedness enables researchers to identify the exact spaces for thermal improvements. Such assessments benefit space-users, but neglect the pedestrians who transit across the ubiquitous indoors, outdoors and semi-outdoors in an urban environment.

In this study, we present results from a field campaign examining variations in the microclimate conditions and pedestrians' objective and subjective thermal comfort after their transit across distinct thermal environments. Subsequently, we analyse these variations according to the direction of transit (thermal step-up or step-down) across the distinct environments. We also investigate how magnitudes of thermal step changes may potentially influence pedestrians' thermal comfort. The campaign is conducted in a mixed land-use urban development within the National University of Singapore, and consisted of eight thermal walk sessions over the same route, with 20 transitions across distinct environments. A total of 18 students acclimatised to the equatorial climate, aged 21-35, participated in the daytime campaign conducted from 1030-1130 hr. Microclimate conditions were documented via a portable instrumental set-up of fast response sensors. The pedestrians' subjective thermal comfort is assessed through questionnaires surveying their perceptions of the microclimate in every environment they had just transitioned into. Objective thermal comfort is assessed using the modified Physiological Equivalent Temperature (mPET) index, derived from the microclimate and physiological conditions experienced upon the transitions. Using the outdoor microclimate data observed during the thermal walks, three clusters of outdoor weather-type are observed. Initial results for subjective thermal comfort show that no votes at the extreme ends of the thermal sensation spectrum ("Hot" and "Cold"), is casted for a thermal step-up and step-down respectively. No votes at the positive end of the wind and sun sensation spectrum ("Too much wind" and "Too sunny") is also observed during a thermal step-down. Significant differences in the microclimate conditions are experienced (i) after transitions into indoors and into outdoors and (ii) during both thermal step-up and step-down. Lastly, mPET for transitions into outdoors is higher than that for indoors, but no statistically significant difference in mPET is observed between thermal step-up and step-down.