Rafal Marszalek, PhD

Chief Editor

Scientific Reports

June 20, 2023

Dear Dr. Marszalek and the *Scientific Reports* editorial board:

On behalf of my co-authors, Thomas Parkinson, Hui Zhang, and Stefano Schiavon, I would like to submit the attached manuscript entitled “**Passive and low-energy strategies can improve thermal comfort and resilience during sleep**” for consideration as a Research Article in *Scientific Reports*. This manuscript has not been published previously (in whole or in part) nor is it currently under consideration for publication in any other journal. All authors know and approve of its submission.

This manuscript presents a laboratory study to rank the effectiveness of different passive and low-energy heating and cooling strategies during sleep, ranging from changing clothing and posture to heated blankets and ceiling fans. Some of these strategies have been studied previously, but usually in the context of commercial office spaces. The sleeping context is particularly important because of the implications on human health and well-being and the energy intensity of operating heating, ventilation, and air-conditioning (HVAC) systems continuously. Other issues challenging the suitability of HVAC systems in this context include energy poverty, grid instability, and climate change.

Our experimental results show that many passive and low-energy strategies have significant heating or cooling effects and can therefore be considered as alternatives or supplements to HVAC systems. Even though the low-energy strategies require electric power, they consume one to two orders of magnitude less energy than conventional HVAC systems. Some low-energy strategies have low enough power input to be battery powered. Our experimental results also showed that the cooling effect from fans can be amplified by up to 3x when combined with passive strategies that increase skin exposure.

To further contextualize our results, we applied our laboratory findings to two case studies: the 2015 Karachi heat wave and the 2021 Texas power crisis. In both cases, conventional HVAC systems were not available either due to lack of access or a multi-day power outage. We found that passive and low-energy strategies can reduce potentially unhealthy heat and cold exposure by as much as 90%.

This research is well-aligned with the aims and scope of *Scientific Reports*, particularly the engineering discipline. HVAC systems are already a significant end use for residential building energy consumption and their demand, particularly that of air-conditioning, is rising with increasing economic prosperity in low and middle-income countries. This puts an enormous strain on utility grids and drives up global greenhouse gas emissions, accelerating climate change. This study provides an effective alternative or supplement to HVAC systems during sleep while maintaining human health and well-being. This study can contribute towards evidence-based public health guidelines and emergency response during extreme temperature events.

We would like to suggest three possible reviewers:

1. Li Lan, Professor, Shanghai Jiao Tong University, [lanli2006@sjtu.edu.cn](mailto:lanli2006@sjtu.edu.cn)
2. Holly Samuelson, Associate Professor, Harvard University, [hsamuelson@gsd.harvard.edu](mailto:hsamuelson@gsd.harvard.edu)
3. Mikhail Chester, Professor, Arizona State University, [mchester@asu.edu](mailto:mchester@asu.edu)

Thank you for your consideration.

Sincerely,

Arfa Aijazi

PhD Candidate, University of California, Berkeley