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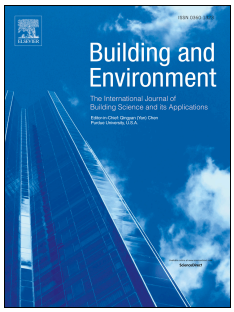

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Human metabolic rate and thermal comfort in buildings: the problem and challenge

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ABSTRACT

Of the six fundamental parameters in the classic heat balance model of human thermal comfort, metabolic rate is probably the most important and yet it is the most crudely assessed in both research and practice. Most studies in thermal comfort domain to date have relied on simple activity diaries to estimate metabolic rate. To better understand the pros and cons of this convenient approach, a literature review of cognate disciplines was conducted with the aim of transferring developments in human metabolic science to the built environmental context. This review leads to the conclusion that the dairy methods prevalent in thermal comfort research and practice are probably not accurate enough to sustain common thermal comfort modeling with any semblance of precision. Additional research effort is needed to develop better metabolic rate estimation methods for building occupants, especially accommodating individual differences in BMI, sex, age, pregnancy and menopause status, and non-steady state scenarios. In particular, three avenues of future research topics hold promise for improving practical metabolic estimation and thermal comfort in buildings were disscussed:1) development and validation of new metabolic rate instrumentation, 2) field measurement of human metabolic rate characteristics, 3) determine comfort zones for buildings with specific metabolic rate features.

KEYWORDS

Thermal comfort; metabolic rate; building environment; human body heat load

1 INTRODUCTION

Human thermal comfort in the built environment is directly relevant to major contemporary issues of anthropogenic climate change and rising standards of living in developing countries [1,2]. Considering the scale of energy applied to HVAC services in developed countries such as in the United States [3], Europe [4], and in the recently developing countries such as China [5], it is timely to review building occupants' thermal comfort requirements for indoor space conditioning and to better understand the physiological and perceptual processes underpinning those requirements.