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Objective and subjective evaluation of a sleeping environment test chamber with a thermoelectric air cooling system

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Abstract

Currently, comfort analyses of buildings equipped with thermoelectric air cooling or heating systems mainly focus on when occupants are in a wakeful state. In this study, both objective and subjective analyses of the sleeping behavior for fifteen (15) healthy occupants were conducted by exposing the occupants to two sleeping environments (i.e., test room equipped with the thermoelectric air duct cooling system (TE-AD) and naturally ventilated test room (NH)). The result shows that there were significant variations in the sleep satisfaction level in the test room with TE-AD and NH. Occupants felt more comfortable (5) and a slightly cooler thermal environment (3) while sleeping in the test room equipped with the TE-AD system. Their body movements, heart rate and sleeping stages shift from non-rapid eye movement (NREM) to rapid eye movement (REM) and then to the waking stage (WS), was less in test room with the TE-AD system as compared to NH. The occupants gave slightly hot (5) for indoor climatic ratings in NH room and felt a slightly uncomfortable (3) while sleeping. The PMV and PPD analyses showed that occupants were very sensitive to climatic conditions around bed and with slightly change in temperature (1.2 ± 0.4 °C) results in the shifting of sleeping stages. For the TE-AD room, the average occupant sleep onset latency was 19 ± 0.5 min, which is 20 ± 0.4 min lesser than NH room.

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