Research on the evaluation of indoor thermal environment based on the sleep and thermoregulation

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To determine indoor environmental parameters for healthy living, this study focused on sleep because people spend about one third of their lives sleeping. High sleep quality is essential for restoring energy and maintaining bodily functions. To investigate the effects of various combinations of environmental conditions on sleep quality and quantity, thermoregulation, and thermal comfort, we conducted experiments in a climatic chamber as well as field surveys in actual living premises of young and elderly healthy participants. High temperature in combination with high humidity increased heat stress on human body during sleeping in summer and, the sleep efficiency index (SEI) decreased. The effect of isothermal airflow on the sleeping subjects was investigated in hot humid conditions. It was found that even isothermal airflow reduces heat stress on human body and improves the SEI. The effect on sleep of varying air velocities was also investigated from two air conditioners set to 26°C. The cool airflow form air conditioner influences the number of waking events and body movements, as well as the increase in heart rate although the SEI did not differ significantly (92.1% vs. 92.6%). Finally, we investigated whether low temperatures (5°C) influenced sleep quality and physiological responses in a shelter-like setting (a gymnasium) in winter. Three cases were compared - when using disaster relief blankets or normal futon in the gymnasium and, when using normal bedding in the participants’ home. The sleep quality was worse when using disaster relief blankets (SEI :86%) in comparison with the normal futon (91%) in the gym and, the ordinary bedding in the participants’ home (96%). It is necessary to be prepared, so that even in cases of emergency to ensure high sleep quality.