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Indirect calorimetry on the metabolic rate of sitting, standing and walking office activities

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Abstract: Metabolic rate was measured on 60 college students (30 women and 30 men) while reclining at rest (Re), sitting (quiet-SQ, typing-ST and filing-SF), standing (quiet-STQ, typing-STT and filing-STF), and walking on a treadmill at 1.0, 2.0, 3.0, 4.0, 5.0 and 6.0 km/h. Each activity was measured for 10 min using a wearable high-precision metabolic system (COSMD K5) that samples the oxygen consumption rate ($\dot{V}O_2$) and carbon dioxide generation rate ($\dot{V}CO_2$). Metabolic rate was then calculated per the ISO 8996 method. The average metabolic rates were 0.8 (SD = 0.2) met for reclining, 0.9 (SD = 0.2), 1.0 (SD = 0.2), and 1.2 (SD = 0.2) met for SQ, ST, and SF, 1.0 (SD = 0.2), 1.1 (SD = 0.2), and 1.3 (SD = 0.3) met for STQ, STT, and STF, and were 1.8 (SD = 0.3), 2.1 (SD = 0.3), 2.5 (SD = 0.3), 3.0 (SD = 0.4), 3.8 (SD = 0.5), and 4.9 (SD = 0.6) met for walking at 1 to 6 km/h. Differences were found between these measured metabolic rates and those presented in existing international comfort standards. ISO and ASHRAE standards overestimate metabolic rate for sitting and standing activities by 10-20%, and underestimate metabolic rate for walking activities by 5-9% in ISO, and by more than 20% in ASHRAE. No gender differences were found in metabolic rates of all the activities tested. We encourage further development of a database of metabolic rates for offices activities for people of different age, race, and geographical locations.

Keywords: Metabolic rate; Thermal comfort; Comfort standard; Indirect calorimetry; Gender difference

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