Validation of the Hexoskin wearable body metrics vest to predict activities of daily living

Rodrigo Villar¹, Thomas Beltrame¹,2, Rosemary Ku¹ and Richard L. Hughson¹
¹Faculty of Applied Health Sciences, University of Waterloo, Waterloo, ON Canada; ²Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq), Brasilia, DF, Brazil

RATIONALE

• The role of physical activity for a healthy lifestyle is well known, but quantification of energy expenditure during activities of daily living is challenging due to the lack of practical tools to measure them.

• The Hexoskin wearable vest is a multi-parameter physiological recording system designed to monitor levels of physical activity and energy expenditure combining heart rate (HR), breathing rate (BR) and activity (AC) data.

• This new device has not been tested in laboratory conditions during activities similar to those of daily living. Therefore, we tested the validity of HR, BR and AC data of the Hexoskin with laboratory standard devices to quantify such activities.

METHODS

• 20 healthy participants (9 men and 11 women): age (26.3 ± 5.9 years), height 171.6 ± 11.5 cm, weights (71.2 ± 12.6 kg) and body mass index (24.0 ± 1.9).

• 2 days of testing (2 phases)

Figure 1 – Illustration of the protocols used in the first phase and second phase of testing. (A) walking 1.0 km/h, (B) walking 3.0 km/h, (C) walking 4.5 km/h followed by incremental walking until 80% of the predicted maximal heart rate (80% HRmax), (D) postural change (lying-sitting-standing) and (E) walking at 80% ventilatory threshold (80% VT).

Figure 3 – Heart rate comparison between standard laboratory ECG and Hexoskin and Bland-Altman plots during lying-sitting- standing (A and D), 1.0 km/h (B and E), 3.0 km/h (C and F), 80% ventilatory threshold (G and I) and 4.5 km/h followed by incremental (H and J) walking tests. The symbols are offset for clarity.

Figure 4 – Breathing rate comparison between the breath by breath system (Amis 2000) and Hexoskin and Bland-Altman plots during lying-sitting-standing (A and D), 1.0 km/h (B and E), 3.0 km/h (C and F), 80% ventilatory threshold (G and I) and 4.5 km/h followed by incremental (H and J) walking tests. The symbols are offset for clarity.

CONCLUSION

HR, BR and AC from the Hexoskin compared to laboratory standard devices demonstrated: (1) low variability, (2) good agreement, and (3) consistency. The results support the utilization of the Hexoskin to quantify activities of daily living during postural changes and walking tasks.

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Figure 2 – Illustration of the Hexoskin vest with the activity, heart and respiration sensors (A). Example of the experimental set up used to collect data (B).