TACSM Abstract

Validation of Wearable Activity Monitors for Real-Time Cadence

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ABSTRACT

The recent advent of wearable activity monitors to provide physical activity intensity in real time (e.g., real-time cadence), enables researchers and practitioners to measure and prescribe physical activity targeting specific intensity in real time. The validity of real-time estimates from the devices, however, remains unclear. **PURPOSE**: To evaluate the validity of wearable activity monitors providing the values of real-time cadence against a criterion measure (i.e., hand-tally count). **METHODS**: Thirty-six healthy adult individuals (age 18-65 years) participated in the study. Participants wore Garmin Forerunner 235 (GM) and Polar M430 (PL) on their wrist of the non-dominant arm while placing the other two activity monitors paired with a cadence sensor GM + Garmin Foot Pod (GM&FP) and PL + Polar Stride Sensor (PL&SS) on their dominant wrist. Each participant completed the study protocol consisting of two distinct components: (1) treadmill protocol and (2) over-ground protocol. To establish evidence of validity, Pearson correlation and mean absolute percentage error (MAPE) for each monitor were calculated between the criterion measure and the measure from the monitors. Bland-Altman analysis was performed to determine the mean bias and 95% limits of agreement between the criterion and the measures of activity monitors. **RESULTS**: In the treadmill protocol, PL&SS had-the highest correlation ($r = 1.000$), followed by GM&FP ($r = 0.999$), GM ($r = 0.937$), and PL ($r = 0.932$) ($p < .01$). The correlations ranged from 0.243 (GM) to 0.999 (PL&SS) ($p < .01$) across the different treadmill speeds. In general, lower correlations were observed at slow walking speeds, i.e., 3.2 and 4.0 km/h, when solely using the activity monitor (both GM and PL). In the over-ground protocol, the correlations ranged from 0.264 (GM) to 0.998 (GM&FP and PL&SS) ($p < .01$) and were lower at the self-determined slow walking speed compared to normal and fast walking speeds for both GM and PL. Consistent and strong correlations were observed with both cadence sensors (overall, 0.999 for GM&FP and 0.997 for PL&SS; $p < .01$) in all walking speeds. Average MAPE score was 3.7% and 3.8% for GM and PL, respectively, in the treadmill protocol whereas a higher average MAPE score (7.6% vs. 6.4% for GM and PL, respectively) was observed in the over-ground protocol. Less than 1% of MAPE scores occurred with the measures of both cadence sensors (GM&FP and PL&SS) throughout the entire protocol. In Bland-Altman plots, the difference of 95% limits agreement was calculated for GM&FP (mean = 0.5; ±1.96 SD = 1.9, -1.0), GM (3.9; 21.4, -13.6), PL&SS (0.2; 1.7, -1.3) and PL (-3.1; 16.6, -22.7). **CONCLUSION**: The results of this study suggest that the wearable activity monitors are an acceptable measure of real-time cadence and provide the potential to improve intensity-focused prescription of physical activity using the device.