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Evaluation of commercial activity monitors for quantification of high- and low-impact exercise

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Physical activity incorporating impact loading increases bone mineral density, so objective quantification of such activity is needed to quantify adherence to interventions[1]. Accelerometry is a practical method for monitoring daily physical activity that incorporates walking and running[2] but the most-widely-used devices have not been evaluated for their ability to quantify other types of exercise. The purpose of the present study was to determine whether commercially-available accelerometers could be used to quantify impact exercise.

Ten healthy moderately-active (1–3 h/week) male and female participants (age 24 (SD 4) years, stature 1.70 (SD 0.09) m, mass 66.8 (SD 7.9) kg) wore three accelerometers: the Actigraph (GT1M, ActiGraph, Pensacola, FL, USA), ActivPAL™ (PAL Technologies Ltd, Glasgow, UK) and the RT3 (Stayhealthy Inc., Monrovia, CA, USA), recording in 15 s and 1 min epochs, as necessary to allow a total recording duration of >24 h. Each participant walked or ran at five speeds (2.4, 3.2, 4, 4.8, 5.6 and 8 km/h) for 3 min on a motorised treadmill before completing a series of exercises (multidirectional hops, walking and two-footed countermovement jumps (CMJ)) for 1 min each on a force platform. Exercise was interspersed with 1 min rest periods and the order of activities was randomly assigned. Video recordings were used throughout for determination of step counts. Step counts were recorded from Actigraph and ActivPAL monitors, activity counts from Actigraph and RT3 monitors and these were compared with observed values or between activities using repeated measures ANOVA with Bonferroni *post hoc* tests.

Walking and running step counts measured by the Actigraph and ActivPAL did not differ significantly from observed values (differences −1.7 (SD 8.1) and −1.6 (SD 6.8) steps per min respectively; $P>0.05$). Actigraph step counts did not differ from observed step counts during multidirectional hop or CMJ (difference 1.4 (SD 19.6) steps per min), but the ActivPAL significantly overestimated steps during these activities, by 46.8 (SD 40.6) steps per min. Actigraph activity counts and RT3 vector magnitude activity counts were significantly higher during running than all walking speeds ($P<0.0001$). RT3 mediolateral activity counts were 66% higher during mediolateral hops than walking ($P<0.05$), but monitored activity counts during other impact activities were not significantly higher than those during walking. Mean peak force during impact activities was not significantly correlated with activity counts by Actigraph or RT3.

The monitors used in the present study were less accurate in assessing step counts during impact activities than during walking or running and one monitor consistently overestimated the step counts. Monitor activity counts distinguished running, but not high-impact activities, from walking. Using epochs necessary to record for a sufficient duration to make monitors practical for free-living activity assessment it was not possible to distinguish impact activities from walking.

1. Bailey CA & Brooke-Wavell K (2008) *Proc Nutr Soc* **66**, 9–18.
2. Rowlands AV, Stone MR & Eston RG (2007) *Med Sci Sports Exerc* **39**, 716–727.