THE RELATIONSHIP BETWEEN THE RAW ACCELERATION SIGNAL FROM A COMMERCIALLY AVAILABLE ACCELEROMETER AND GROUND REACTION FORCE

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INTRODUCTION

Accelerometers are increasingly employed to assess relationships between physical activity and health. Output is in proprietary counts, hindering between model comparisons, and translated into time spent at activity intensities based on energy expenditure [1]. Bone mineral density (BMD) is improved by mechanical overload. Thus, in order to use accelerometers to assess activity beneficial to bone, accelerometer output needs to be calibrated against mechanical loading, e.g. ground reaction force (GRF). The purpose of this study was to examine the relationship between the raw acceleration signal (vertical and resultant over three axes) from a new commercially available accelerometer and mechanical loading.

METHODS

Ten participants (age: 29.4±8.2 y; mass: 74.3±10.3 kg) wore a triaxial GENEA accelerometer (80 Hz, ActivInsights Ltd, UK) on the hip. A force plate set flush within the floor (960 Hz, Advanced Mechanical Technology Inc., Massachussetts) was used to collect GRF data. Each participant performed eight trials of slow walking, brisk walking, jogging and running with GRF data collected for one step per trial. Low jumps and higher jumps (one per second) were each performed for 20 s on the force plate. Finally participants dropped from a 20 cm high box onto the force plate eight times. Force plate and accelerometer data were analysed for one step from each trial and eight jumps of each type with the mean of eight steps/jumps used for all analyses.

RESULTS

Mean vertical accelerations (g, acceleration of gravity (1g) subtracted) measured by the GENEA for each activity (slow walking: 0.76±0.20; brisk walking 1.34±0.39; jogging 4.69±0.72; fast running 4.76±0.69; low jumps 3.45±1.06; high jumps 4.32±1.01; box jumps 4.93±0.78) compared well to previous research [2]. Resultant and vertical accelerations correlated similarly with force plate outputs. Peak accelerations were positively correlated with resultant force ($r>0.74$, $p<0.01$), peak active force ($r>0.65$, $p<0.01$) and peak impact force ($r>0.59$, $p>0.01$). Slopes from the acceleration curves were positively correlated with loading rates (peak loading rate and peak slope: $r>0.55$, $p<0.01$; average loading rate and average slope $r>0.68$, $p<0.01$).

DISCUSSION AND CONCLUSION

The acceleration level of activities and slope of the acceleration curve, as measured by the GENEA, are related to GRF. This data can be used to identify acceleration thresholds that relate to levels of loading beneficial to bone.

The GENEA is a small, commercially available accelerometer that provides raw acceleration data. Accelerations associated with physical activity reflect mechanical loading and appear promising for assessment of activity beneficial to bone.

REFERENCES

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