TO EVALUATE THE WALKING AND RUNNING SPEED BY ACCELEROMETERS

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INTRODUCTION

To evaluate the walking and running speed allows quantifying the motor capabilities of physical activity. Optical motion capture systems and force platforms are the reference instruments, used to evaluate the walking and running speed, but they require equipped laboratory and cannot be employed in playing fields. An accelerometer is used to measure accelerations and decelerations of movement. It is low-cost and can be worn on the ankle, wrist, or trunk. However, trunk placement (usually the hip) is the most common site for placement (1). Forward speed changes and vertical displacements of the centre of mass of the body inevitably accompany human locomotion, even when the average speed of progression is constant and the track horizontal (2). In addition, the flight time, measured by acceleration and GRF (ground reaction force), presents a good correlation (3).

The purpose of this study was to evaluate the walking and running speed in short term on treadmill by the peak vertical acceleration of accelerometers. The hypothesis was that the walking and running speed influenced the peak vertical acceleration, and had high correlation.

METHODS

Six male trained runners (age= 23.8±3.1 yrs; heights= 176.2±5.3 cm; mass= 67.7±7.4 kg) were recruited as subjects. The institutional ethics committee granted approval, and all participants were gave written informed consent. All participants were asked to complete two trials and to wear three accelerometers (Crossbow, 25G). One was positioned on the dorsal area, at the level of L4-L5 vertebra; another was positioned on the left ankle; the other was positioned on the left wrist. All accelerometers were oriented to assess accelerations in the vertical plane. Each participant walked (constant ground contact) on a motor-driven treadmill (SensorMedics 2000) for 60 seconds at 4, 6 km/h, and run for 60 seconds at 8, 10, 12, 14, 16 km/h. Speeds were presented in a sequential order, with 1-5 min of rest between speeds as required.

Three vertical accelerations on back (AB), ankle (AA) and hand (AH) were collected in 10 seconds by Dasylab software while stationary, respectively, and were scaled to 1 G (Gravity). The sample rate was 200 Hz and low pass filter was 6 Hz. Descriptive statistics were calculated for all trials. No significant side-to-side differences were evident for either trial ($P > 0.05$), so the mean of two trials was used in all analyses. SPSS was used for all statistical analyses. Alpha was set at 0.05 unless otherwise indicated. Pearson product moment correlation was used to compare the linear relationship between speed and peak vertical acceleration.

RESULTS AND DISCUSSION

Table 1 showed the means, standard deviations of peak vertical accelerations on back (AB), ankle (AA) and hand (AH) in every speed. There were high linear correlations between speed and peak AB (r= 0.920), speed and peak AA (r= 0.990), speed and peak AH (r= 0.994), respectively. Figure 1 showed the graphical representation of the results of peak AB, AA, AH and speed. The figure also showed the equation of the regression line and the Pearson correlation coefficient. It was obvious that the regressive equation of peak vertical acceleration could calculate the walking and running speed in short term on treadmill.

Table 1: the means and standard deviations of peak vertical accelerations on back, ankle and hand in every speed

Speed (km/h)	AB_{peak} (G)	AA_{peak} (G)	AH_{peak} (G)
4	1.26±0.27	0.82±0.27	1.83±0.26
6	1.65±0.19	1.10±0.31	2.32±0.54
8	1.95±0.11	1.50±0.34	2.60±0.60
10	2.07±0.14	1.98±0.44	2.73±0.67
12	2.15±0.12	2.50±0.70	3.14±0.69
14	2.24±0.15	3.16±0.96	3.48±0.49
16	2.25±0.21	3.85±1.22	3.77±0.59

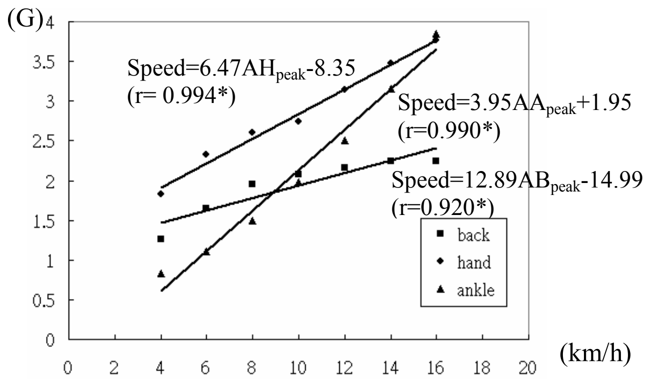

Figure 1: graphical representation of the results of peak AB, AA, AH and speed

CONCLUSIONS

From this study we provided an effective method to evaluate the walking and running speed in short term on treadmill by the peak vertical acceleration of accelerometers which were worn on the ankle, wrist, or trunk. The better position to wear the accelerometer should depend on the type of movement. On treadmill, hand and ankle were both the better position to wear the accelerometer to evaluate the speed. In the future we hope to obtain more quantitative agreement by including both on treadmill and in play fields to affect more realistic potential.

REFERENCES

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