Concurrent Validity of running performance parameter – Step frequency

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Introduction:

Step frequency is a factor of running performance, and its increase causes an increase in running speed (Delecluse, Ponnet, & Diels, 1998). This makes it a commonly noted parameter for running analysis. Video footage is used to determine the step frequency and is considered the gold standard. Newer technologies in the form of OptoJump provides step frequency data without much manual intervention in the data collection process. A study is conducted to prove the concurrent validity of step frequency calculated by OptoJump. The null hypothesis for the study is that there is no difference in the measurements of step frequency by High Speed Video footage and OptoJump.

Methodology:

6 participants (mean ± standard deviation: age: 22.33 ± 0.745 years, stature: 182.5 ± 2.378 cm, mass: 77.24 ± 1.705 kg) were recruited and the procedures conducted in the study followed the Ethics procedures of Sheffield Hallam University. Personalised running speeds for the participants were arrived at based on the speed at which the participant reached the Respiratory Compensation Point (RCP). The running speeds of 4 participants were 11km/hr and 13 and 14km/hr for the other two.

The laboratory set-up included a high-speed video camera (frame rate:1000 frames per second) and a calibrated OptoJump on the sides of the treadmill. Post a warm-up each participant ran 2trials each 30seconds in duration. The high-speed video camera was focused to capture the foot of the participant in its view.

Difference between consecutive heel strike's frame number from the video gives step time. The stride frequency is given by the formula:

$$Step\ freququency = \frac{1}{time\ between\ consecutive\ heel\ strikes}$$

Root mean square error (RMSE) analysis is used to show the deviation between the data collected using the two methods. An inter class correlation (ICC) gives the strength of the resemblance of the two groups of data. A Bland Altman (BA) plot (95% confidence intervals) quantifies the agreement of the two groups of data (Myles & Cui, 2007).

Results:

Method	Mean	Standard Deviation
OptoJump	2.730951780	. 1163550374
HighSpeedVideo	2.730703208	.1146902662

Table 1: Descriptive statistics of the two groups of data

An RMSE value of 0.085673 is obtained from all the data points. ICC coefficient of 0.724 shows high correlation.

Inter-Item Correlation Matrix

	Opto	HSV
Opto	1.000	.724
HSV	.724	1.000

(a)

Intraclass Correlation Coefficient

	Intraclass Correlation[b]	95% Confidence Interval		F Test with True Value 0		
		Lower Bound	Upper Bound	Value	df1	df2
Single Measures	.724[a]	.667	.773	6.250	309	309
Average Measures	.840[c]	.800	.872	6.250	309	309

(b)

Figure1: (a &b) Interclass correlation outputs from SPSS showing a strong correlation.

The BA plot shows heteroscedasticity.

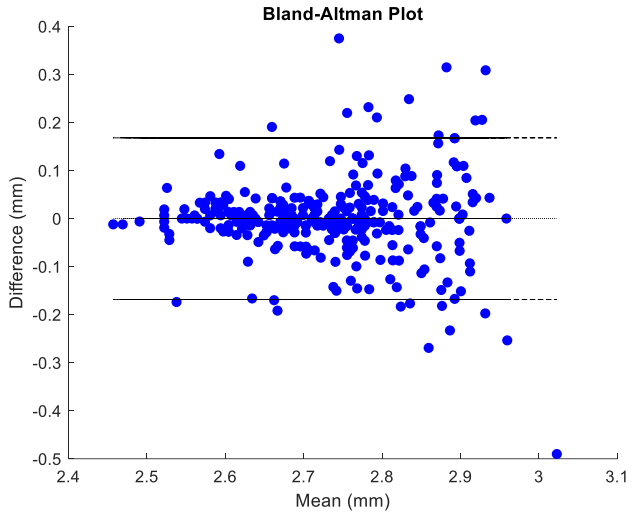

Figure 2: BA Plot

Discussions:

It can be said that the two methods are similar due to the strong inter class correlation (Correlation coefficient=0.724) and small RMSE Value (0.085673).

BA plot has increased variance with higher average values which could indicate a flaw in experimental design due to unaccounted factors.

The experiment could be improved by including more participants with varying speeds and considering landing patterns. The experiment considered heel strike for video analysis whereas the OptoJump system could record a different measurement for a person with a forefoot landing. The participants heel strike could have been better recorded given better lighting conditions or contrasting shoe colour to the treadmills belt.

In conclusion from the study it can be said that OptoJump measurement has similarity to the gold standard but cannot replace it.

References

Delecluse, C., Ponnet, H., & Diels, R. (1998). Stride characteristics related to running velocity in maximal sprint running. *[w:] Riehle HJ, Vieten MM. (red) Proceedings II of XVI International Symposium on Biomechanics in Sports, ISBS*, (pp. 146-148).

Myles, P. S., & Cui, J. (2007). *I Using the Bland–Altman method to measure agreement with repeated measures.*