



Caution must be advised when using wearable technology data due to inaccuracies

By: Sulaiman Sajjad, Muhammad Aman Beg, Shahaab Shameem, Martinique Vella Baldacchino,

Introduction

Objectively measuring physical activity using wearable technology such as smartwatches or smartphones is increasing worldwide. However, its accuracy and relevance towards orthopaedic surgery remains unclear. A survey conducted by AO has shown that 21 % of surgeons employ wearable systems as part of their clinical work using a combination of smartphones and accelerometry in order to analyse patient's activity such as step count and kinematics.

Consumer wearable physical activity trackers are low cost devices when compared to £20,000 laboratory standard gait analysis treadmill. Despite the advantages, the validity of many consumer devices have not been evaluated and thus it is no surprise that 18% of the AO survey respondents are unsure what data to use.

Aims

The aim of this study was to determine if a wearable smartwatch such as the Fitbit Luxe is equivalent to the gait analysis treadmill (H/p/cosmos quasar). A second aim was to determine if there is a difference when wearing a wearable sensor on the dominant compared to the non-dominant hand.

Method

21 healthy adults were recruited to this study, their basic demographic profile was recorded. Participants were positioned on the gait analysis treadmill and provided with two Fitbit Luxe devices. The FitBit devices were worn on the subject's dominant and non-dominant hand. Data collection began for a total of 6 minutes when the treadmill reached a speed of 5km/h.

The number of steps from the gait lab treadmill were deduced from the computer-based treadmill software.

The number of steps from the Fitbit device which corresponded to the same minute intervals as the treadmill was recorded from Fitabase, a software platform which allows researchers to collect data from wearable technology. A non inferiority test was performed using statistical software statgraphics19.

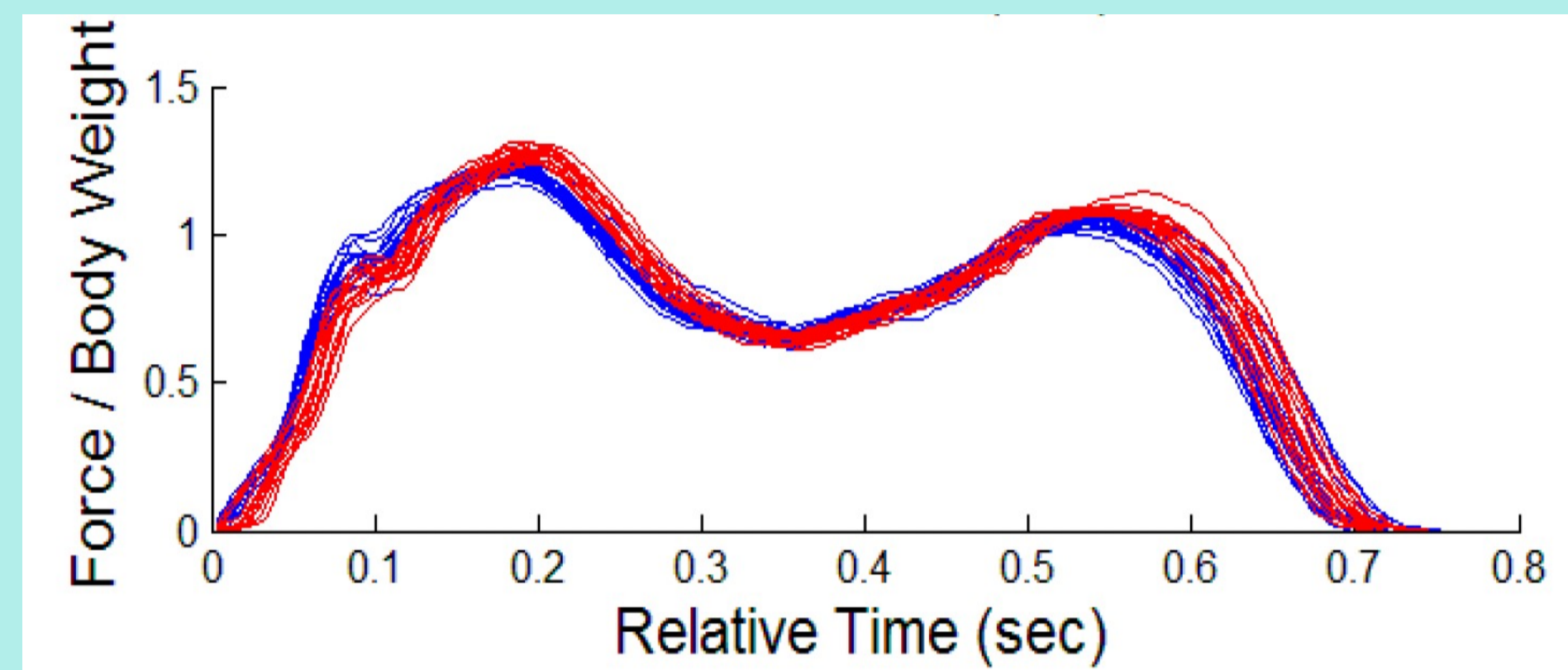


Figure 1: Ground reaction force graph for a single step

Results

The mean step count for fitbit was 679 steps (SD 38) during the same period on the gait treadmill was 648 (SD 41). Based from previous studies, 5% was taken into account as an acceptable equivalence margin from the gold standard determined as 31 steps. A two sided equivalence test was performed and the results did not demonstrate equivalence P= 0.45.



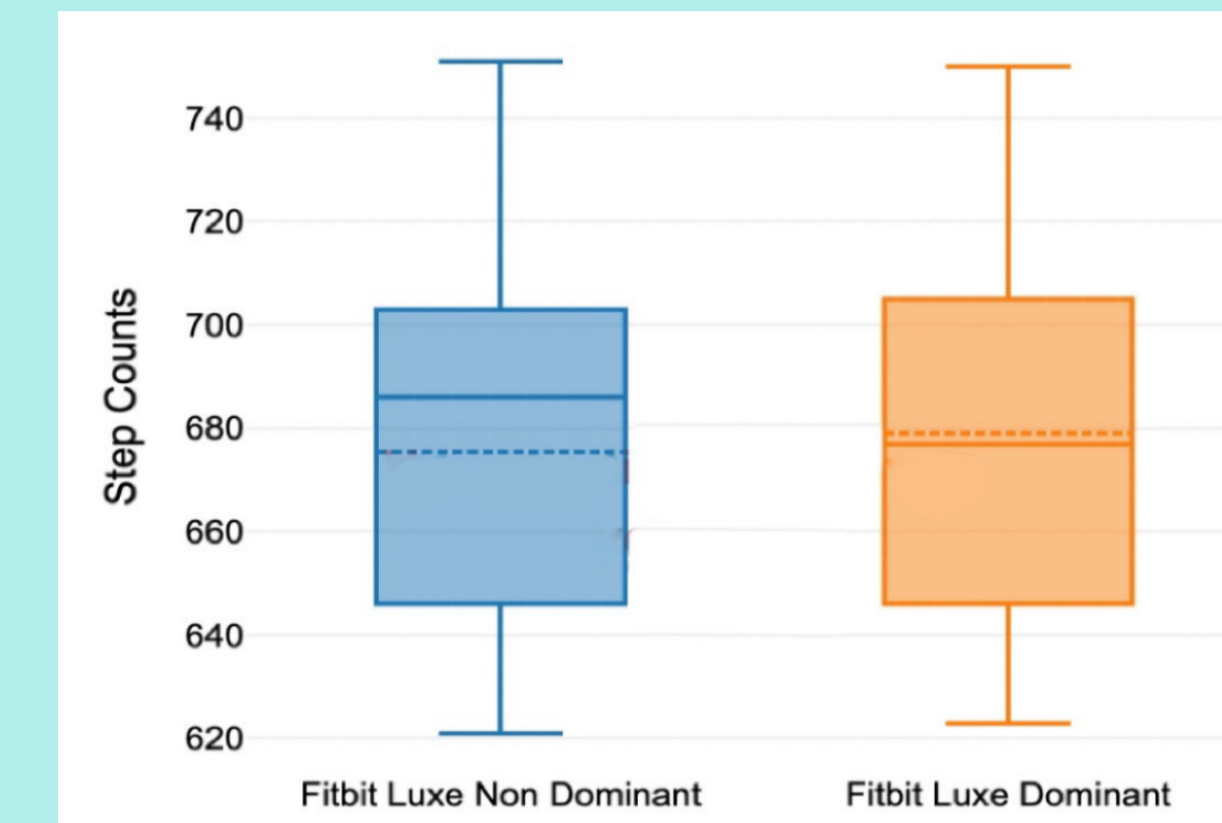
Figure 2.1: Box and whisker plot comparing mean aggregate step counts recorded from the FitBit and treadmill

Figure 2.1: Table of results comparing mean aggregated step counts recorded from the FitBit and treadmill

	FitBit Luxe Dominant	Treadmill
Mean	679	648
Standard deviation	38	41
Difference of Means	31	
P Value	0.45	

A two tailed T test was conducted which showed there was no difference when wearing the sensor on the dominant vs non dominant hand (p=0.225).

Figure 3.1: Box and whisker plot comparing mean aggregated step counts recorded from the FitBit on dominant vs non-dominant hands



Conclusions

With the help of technological giants our ability to collect large amounts of data continues to improve. Despite the excitement of being able to analyse large swathes of data in terms of clinical care, such as in the post-operative phase following trauma or arthroplasty, caution should be observed in terms of accuracy of the data. It is worrying that only 10% of AO survey respondents were worried about validity. In the future, perhaps a more accurate way of objectively measuring recovery would be energy expenditure.

References

- [1] Daskivich, T.J., Houman, J., Lopez, M., Luu, M., Fleshner, P., Zaghiyan, K., Cunneen, S., Burch, M., Walsh, C., Paiement, G., Kremen, T., Soukiasian, H., Spitzer, A., Jackson, T., Kim, H.L., Li, A. and Spiegel, B. (2019). Association of Wearable Activity Monitors With Assessment of Daily Ambulation and Length of Stay Among Patients Undergoing Major Surgery. JAMA Network Open, 2(2), p.e187673. doi:10.1001/jamanetworkopen.2018.7673.
- [2] Adam Noah, J., Spierer, D.K., Gu, J. and Bronner, S. (2013). Comparison of steps and energy expenditure assessment in adults of Fitbit Tracker and Ultra to the Actual and indirect calorimetry. Journal of Medical Engineering & Technology, 37(7), pp.456-462. doi:10.3109/03091902.2013.831135.
- [3] Feehan, L.M., Geldman, J., Sayre, E.C., Park, C., Ezzat, A.M., Yoo, J.Y., Hamilton, C.B. and Li, L.C. (2018). Accuracy of Fitbit Devices: Systematic Review and Narrative Syntheses of Quantitative Data. JMIR mHealth and uHealth, [online] 6(8), p.e10527. doi:10.2196/10527.