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# RaY

Research at the University of York St John

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## 1. Rationale and study aims

- High levels of inactivity are reported for adult hospital ward patients recovering from critical illness.<sup>1-2</sup>
- Immobility in hospital contributes to irreversible functional decline in older populations.<sup>3</sup>
- Conventional methods of activity monitoring (self report, observation) are prone to methodological or operational weaknesses.<sup>4</sup>
- Wearable motion-sensors (accelerometers) offer an objective and unobtrusive alternative to monitoring the type and regularity of activity undertaken by hospitalised patients.
- To be considered a viable alternative, the data they capture must be valid and clinically meaningful.
- This study aimed to investigate if the Actigraph GT3X accelerometer (Figure 1) could identify body position and quantify step count during typical activities undertaken on a hospital ward by simulated patients recovering from critical illness.

**Figure 1. The Actigraph GT3X accelerometer**



## 2. Method

- Observational and prospective in design.
- Ethical approval from NHS Research Ethics Committee (14/NI/1023) and York St John University (UC/25/2/14/JA)
- 30 healthy volunteers enrolled, age matched to a Hull and East Yorkshire Hospitals NHS Trust (HEYHT) critical care population admitted during 2012.
- Research undertaken within a closed hospital ward at HEYHT.
- Participants undertook a movement protocol consisting of postural transitions on a bed (e.g. lying to sitting/ sitting to standing) and ten metre distance walks with walking aids.
- Video recordings formed the criterion measure against which accelerometer data was compared.
- Agreement between accelerometer data and activity observed from the video recordings was analysed using Bland Altman analysis for continuous data (step count) and Kappa ( $\kappa$ ) for categorical data (body position).

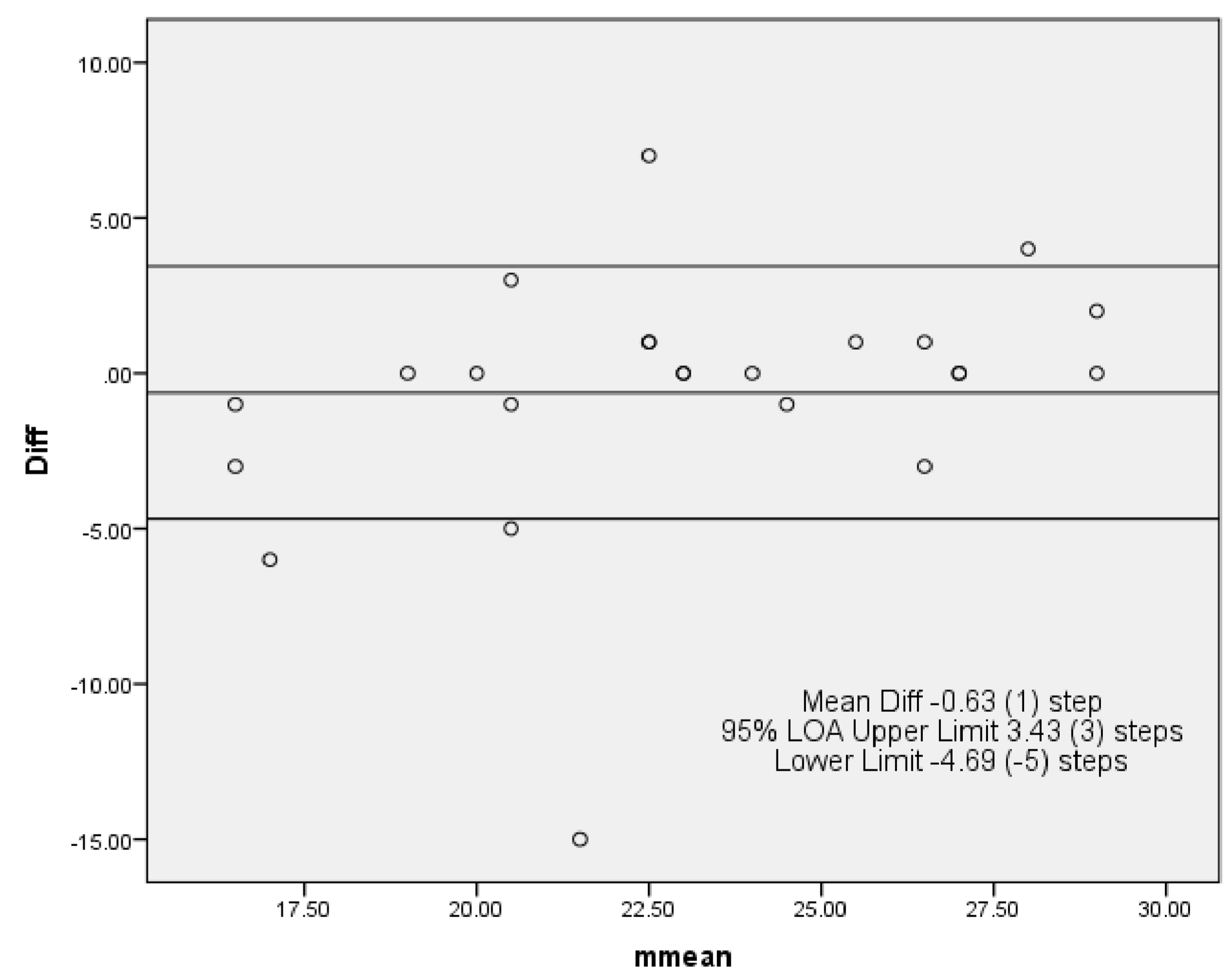
## 3. Results

- Fair agreement between waist accelerometer data and video recordings for recognition of lying, sitting and standing postures ( $\kappa = 0.21$  :  $p < 0.001$ )
- Moderate agreement between ankle accelerometer data and video recordings ( $\kappa = 0.43$  :  $p < 0.001$ )
- Ankle accelerometer correctly identified lying position on 91% of occasions, standing 99%, sitting 32%)
- Mean differences in step count recorded by the ankle accelerometer compared to observed step count when using a stick or walking frame were smaller than the waist placement (Table 1)
- Figure 2 presents the Bland Altman plot constructed for agreement between step count quantified by the ankle accelerometer and observed step count for the ten metre walk using a stick.

**Table 1: Mean differences in step count recorded by accelerometry and direct observation (speed  $\geq 0.3$ m/s).**

Walk type	n	Mean difference (95% limits of agreement - LOA) WAIST PLACEMENT	Mean difference (95% LOA) ANKLE PLACEMENT
Frame	18	-6.72 steps (-24.83 to 11.39 steps)	- 0.28 steps (- 5.98 to 5.42 steps)
Stick	24	-6.58 steps (-22.63 to 9.47 steps)	- 0.63 steps (- 4.69 to 3.43 steps)

**Figure 2. Bland Altman plot for ankle accelerometer and stick**



## 4. Conclusions

- The Actigraph GT3X accelerometer exhibited a delay in recognition of a postural change of  $\leq$  nine seconds compared to observation
- Ankle placement was superior to waist placement for identification of body position and step count when undertaking activities typically undertaken by patients recovering from critical illness within a hospital ward environment.
- Whilst the ankle placement accurately identified both lying and standing postures, it often misclassified the sitting position as standing.
- Future studies investigating the validity of this model to capture purposeful activity should enrol hospitalised patients recovering from critical illness.
- Combinations of accelerometer placement sites may improve identification of the sitting position with this model, using data from multiple placement sites to construct an algorithm.

## 5. Acknowledgements

Special thanks is given to Hull and East Yorkshire Hospitals NHS Trust for their permission to undertake the study within a closed ward and to Dr Victoria Allgar (Hull York Medical School) for statistical advice.

## References

- <sup>1</sup> Borges RC., Carvalho CR., Colombo AS., da Silva Borges MP. & Soriano FG. Physical activity, muscle strength, and exercise capacity 3 months after severe sepsis and septic shock. *Intensive Care Medicine*. 2015; 41(8):1433-44.
- <sup>2</sup> Hopkins RO., Miller III RR., Rodriguez, L., Spuhler, V. & Thomsen, GE. Physical therapy on the wards after early physical activity and mobility in the Intensive Care Unit. *Physical Therapy*. 2012; 92: 1518-1523.
- <sup>3</sup> Graf C. Functional decline in hospitalized older adults. *The American Journal of Nursing*. 2006;106(1):58-67.
- <sup>4</sup> Cheung, VH., Gray, L. & Karunanithi, M. Review article (meta-analysis): Review of Accelerometry for determining daily activity among elderly patients. *Archives of Physical Medicine and Rehabilitation*. 2011; 92: 998-1014.