The relationship between psychological well-being and physical activity: The impact of measurement

Submitted by Lisa Rachel Stephanie Phillips to the University of Exeter
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I certify that all material in this thesis which is not my own work has been identified and that no material has previously been submitted and approved for the award of a degree by this or any other University.

Signature: ..............................................................................................................
Abstract

Psychological well-being occurs when there is an absence of mental disorders and presence of positive states. Given the increasing prevalence of mental disorders, which are thought to have their roots in childhood, improving psychological well-being in children is currently an important area of research. Physical activity has been proposed as a method by which negative states can be reduced and positive states increased, thereby increasing children’s overall psychological well-being and in turn helping to protect against a decline into clinical disorders. Research focusing on physical activity and psychological well-being has mainly used self-reported measurements to assess physical activity, a method which leads to considerable non-differential misclassification that in turn will attenuate associations between physical activity and psychological wellbeing. Few studies have employed more precise, objective measures such as accelerometry. Despite providing a more precise measure of physical activity, a number of limitations are present with the use of accelerometry, specifically concerning the data reduction processes. Various decisions made when handling accelerometer data can result in misclassification of time spent in different intensities of physical activity and can introduce selection bias. The present thesis aims to address how the decisions made during data reduction can affect estimates of physical activity prevalence and alter the observed relationships between physical activity and psychological well-being in children.

The first study of this thesis assessed the misclassification of activity intensities occurring as a result of the use of various accelerometer cut-points and the resulting variation in relationships between physical activity and psychological well-being that occurs. Results showed that the use of different cut-points to determine physical activity intensity alters the magnitude of the relationship between physical activity and psychological well-being; relationships were attenuated, with some becoming non-significant. The second study addressed the issue of children’s compliance with wear time requirements over multiple time points; compliance with wear time decreased over time, whilst inclusion and exclusion rules based on minimum wear times introduced selection bias. The use of more lenient wear time criteria, to reduce selection
bias, introduced misclassification of physical activity intensities. Further, longitudinal relationships between physical activity and psychological well-being differed depending upon the wear time criteria employed. The third study aimed to address whether compliance, and in turn selection bias would systematically differ between groups of a trial of a physical activity intervention, and whether this would alter the results of the intervention itself. Results showed that compliance varied across trial condition, that selection bias with groups was different for each condition and that non-compliance hindered the exploration of the mediating effect of physical activity on psychological well-being. Study four involved the validation and calibration of a new wrist worn, waterproof physical activity monitor more compatible with 24 hour wear, thus potentially overcoming the compliance problems noted in the earlier studies. Results showed good concurrent and criterion validity, with high classification accuracy for the cut-points created. The final study assessed the acceptability and compliance with 24 hour wear in children and allowed a detailed examination of the underestimation of time spent in PA intensities that occurs from capturing shorter and different periods of the day. Results showed large misclassification with 10 hour capture periods relative to complete observation, with time in activity intensities varying across different periods of the day.

The results of this thesis demonstrate that substantial selection bias and misclassification of time in activity intensities can be introduced through the decisions made during the processing of raw accelerometry data. Furthermore, this error alters the relationships between physical activity and psychological well-being. The results indicate that the true relationship between physical activity and psychological well-being in children may still be unknown, with researchers reporting relationships and effects only relevant to the measurement methods and data reduction processes they have employed. A method of overcoming selection bias and reducing misclassification is through 24 hour wear, which through the design of new accelerometers is now possible. Future studies should use monitors compatible with and acceptable for complete observation. This would result in more precise estimates of time spent in physical activity intensities and less selection bias. Both of these improvements would greatly increase our understanding of the relationship between physical activity and psychological well-being in children.
Acknowledgments

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I hope I've made you proud!
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Definitions

Physical activity:
Throughout this thesis physical activity is defined as ‘any bodily movement produced by skeletal muscle that results in energy expenditure above resting level’ (Caspersen et al., 1985, p. 128).

Significant / significance:
The term significant is used throughout this thesis to indicate statistical significance, determined as $p < 0.05$.

Abbreviations

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<td>LTPA</td>
<td>Leisure time physical activity</td>
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<td>PWB</td>
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<td>Global self-worth</td>
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