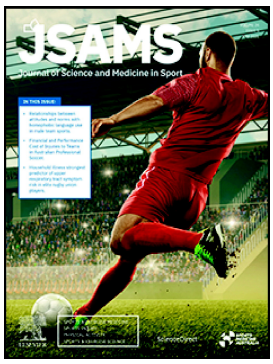

Validity of low-cost measures for global surveillance of physical activity in pre-school children: the SUNRISE validation study

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Title:

Validity of low-cost measures for global surveillance of physical activity in pre-school children: the SUNRISE validation study

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TM-V, XJ, and JJR contributed to the conceptualisation, data analysis and interpretation, drafting, review, and final approval of the manuscript. ADO, MST, CED, AAF, CT, DK, GH, HKT, KHC, ML, MSH, PC, and PWPC contributed to data acquisition as well as reviewed and approved the manuscript.

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Abstract

Objective

To validate parent-reported child's habitual total physical activity (TPA) against accelerometry and three existing step-count thresholds for classifying 3 hours/day of TPA in pre-schoolers from 13 culturally and geographically diverse countries.

Design

Cross-sectional validation study.

Methods

We used data involving 3- and 4-year-olds from 13 middle- and high-income countries who participated in the SUNRISE study. We used Spearman's rank-order correlation, Bland-Altman plots, and Kappa statistics to assess correlation and classification ability of parent-reported child's habitual TPA against *activ*PAL^{TM}-measured TPA over 3 days. Additionally, we used Receiver Operating Characteristic Area Under the Curve (ROC-AUC) analysis to validate three existing step-count thresholds (Gabel, Vale, and De Craemer) for accurately classifying achievement of the WHO guideline of at least 3 hours/day TPA using step-counts derived from *activ*PAL^{TM}.

Results

Of the 352 pre-schoolers, 49.1% were girls. There was a very weak but significant positive correlation and slight agreement between parent-reported and accelerometer-measured TPA (*r*: 0.140; p=0.009; Kappa: 0.030). Parents over-estimated their child's TPA compared to accelerometer data (mean bias: 69 min/day; standard deviation: 126; 95% limits of agreement: -179, 316). Of the three step-count thresholds tested, the De Craemer step-count threshold of 11,500 steps/day provided excellent classification of meeting the TPA guideline as measured by accelerometry (AUC: 0.945; 95% CI: 0.928, 0.961; Sensitivity: 100.0%; Specificity: 88.9%).

Conclusions

Parent reports may have limited validity for assessing pre-schooler's level of TPA. Step-counting is a promising alternative – low-cost global surveillance initiatives could potentially use pedometers for assessing compliance with the physical activity guideline in early childhood.

Keywords: Measurement, Physical activity, Accelerometry, Parent reports, Pedometer, Child

Introduction

In 2016, the World Health Organization (WHO) recommended promotion of physical activity in early childhood as a critical component of the global obesity prevention agenda.[1] Consequently in 2019, the WHO developed the first global guidelines for physical activity, sedentary behaviours and sleep for under 5s to tackle the obesity pandemic and improve children's health and development.[2] Among pre-schoolers (3-4 years), the WHO recommends daily total physical activity (TPA) of at least 180 minutes including 60 minutes of moderate- to vigorous-intensity physical activity (MVPA). Despite the publication of these guidelines in 2019,[2] there is currently no systematic global surveillance of physical activity at this age group across the globe[3] partly due to practical issues like budget limitations and uncertainty over the validity and cultural appropriateness of physical activity surveillance measurements globally. As such, there is a need for a relatively simple, low-cost and sustainable method of surveillance which has criterion validity (against accelerometry) to assess compliance with the guidelines and allow comparisons across studies, cultures, populations, and countries. One obvious option on cost grounds is proxy reports from parents,[4–6] but there is no geographically and culturally validated questionnaire for global surveillance of physical activity in the early years (under 5s) to date.[3]

So far, only four studies[6–9] have validated parent-reported physical activity against the commonly used criterion measure of accelerometry in children under 5 years: Bacardi-Gascón et al.[8] used light physical activity (LPA), moderate physical activity (MPA), and MVPA; Bingham et al.[9] used MVPA; and the remaining two studies evaluated parent-reported TPA against accelerometer-measured TPA (LPA+MVPA) among 3-5 years old Australian[7] and 4-70 months old Canadian[6] children. However, all of these validation studies[6–9] are limited to a single geographical location and in high income countries (HICs). To the best of our knowledge, there have been no attempts to validate parent-reported TPA against *activ*PAL™ measured TPA (the criterion method) in 3- to 4-year-olds across various countries. The *activ*PAL™ is one of the most commonly used research-grade accelerometers

for objective measurement of physical activity, and has been validated for measurement of TPA against direct observation in this age group.[10]

Another simple low-cost global alternative to parent reports for global public health surveillance of TPA is step-counting. Over the last decade several studies have developed step-counting thresholds to classify 3 hours of TPA in pre-schoolers.[11–13] However, previous studies proposed widely varying step-count thresholds derived from the ActiGraph accelerometers which were equivalent to 3 hours daily TPA[11–13]: Gabel et al.[11] recommended a step-count threshold of 6,000 steps/day; Vale et al.[12] suggested 9,000 steps/day; and De Craemer at al.[13] suggested 11,500 steps/day. To date, it remains unclear which of these step-count thresholds provides the most accurate measure which might be suitable to use for global surveillance of TPA in pre-school-aged children and whether these thresholds are valid when using different step-count devices and placements.

Therefore, in order to help develop relatively simple methods of physical activity assessment suitable for global public health surveillance in pre-schoolers in future, the aims of our study were to (a) validate parent-reported habitual TPA against *activ*PAL™ measured habitual TPA (calculated as total time spent stepping min/day) in pre-schoolers from geographically and culturally diverse countries, and (b) cross-validate existing step-count thresholds for determining habitual TPA against *activ*PAL™ measured TPA. Given the diversity of our sample, we also explored differences in validation outcomes between parent-reported and accelerometer-measured TPA across the socio-demographic characteristics of study participants.

Methods

This study was a secondary analysis of *activ*PAL™ (PAL Technologies Ltd, Glasgow, UK) data collected as part of the first and second pilot phases of the SUNRISE Study (https://sunrise-study.com/), an international cross-sectional study of movement behaviours in the early years.[4] The SUNRISE study is being conducted in 43 high-, middle- and low-income countries. Over 2,500

children aged 2-6 years from 23 countries have completed the pilot phase of the study, with *activ*PAL™ data available for 955 children from 17 countries. Data are de-identified and available on request from the SUNRISE Coordinating Centre based at the University of Wollongong (UOW), Australia. The SUNRISE study protocol was reviewed and approved by Human Research Ethics Committee at the UOW (2018/044) and ethics committees in each participating country; all parents of participating children gave informed consent.

A total of 352 pre-schoolers aged 3-4 years from 13 countries who participated in the pilot phases 1 and 2 of the SUNRISE Study comprised the sample for our validation study. Participants were included in the current study if: (i) they had both *activ*PAL™ and parent-reported habitual TPA data; (ii) they had three valid days of *activ*PAL™ measurement (i.e., a valid day was defined as having 24-hours of data), which is appropriate to measure usual level of TPA[14]; and (iii) they were aged 3.0 to <5.0 years. One participant was excluded because the parent-reported level of child physical activity was recorded as zero.

No significant differences in participant characteristics were found between those included and excluded in our study, except for a higher percentage of urban children that have been included in this validation study (59% vs 44%). Since future global surveillance of physical activity in children will need to take place in diverse settings, a range of countries (Australia, Bangladesh, Brazil, China, Hong Kong, Indonesia, Japan, Malaysia, South Africa, South Korea, Sri Lanka, Sweden, and Vietnam) and income levels (lower-middle, upper-middle, and high-income countries) were represented in our study.

Habitual TPA by accelerometry was assessed using *activ*PAL™, an activity monitor worn on the thigh with an accelerometer to record time spent sitting/lying, moving/stepping and standing in 15-second epochs.[15] TPA was calculated as the total time spent stepping per day (min/day). The *activ*PAL™ has been validated against direct observation of physical activity for measurement of TPA in 3-4 year-olds, with high sensitivity and specificity for measurement of TPA relative to direct

observation and no significant bias in measurement of TPA.[10] Children were asked to continuously wear the device on the right anterior thigh, midway between the hip and the knee in the midline, for 3-5 five days.[4] This allowed collection of three full days of data (3 x 24-hour period) on TPA. Based on the 2019 WHO Global Guidelines for TPA in children aged 3-4 years,[2] participants were classified as meeting the guideline if they spent at least of 180 min/day in TPA.

Habitual TPA by parent reports was assessed using a parent questionnaire completed by self-administration, or interviewer-administered when necessary, for example, where literacy posed challenges.[4] Questions were developed based on available physical activity, sedentary behaviour, and sleep guidelines for the early years.[16] Parents were asked: "On a 24-hour period in the past week, how much time did the 3- to 4-year-old child who is participating in this study spend in a variety of physical activities, spread throughout the day? For example: active play, running, playing with balls, moving to music/dancing, swimming, riding a scooter/tricycle/bike." Parent reports were recorded in hours and minutes and were converted to min/day to calculate parent-reported habitual TPA. This was used to classify participants as meeting the physical activity guideline if they spent at least 180 min/day in TPA.

Habitual number of steps taken was assessed using *activ*PAL™ accelerometers. As noted earlier, the *activ*PAL™ records time spent sitting/lying, moving/stepping and standing in 15-second epochs,[15] and it has been validated for measurement of step-counting in older children aged 9-10 years.[17] Since children were asked to wear the device continuously for 3-5 days, its stepping function allowed collection of three full days of data (3 x 24-hour period) on total step-counts. These were used to classify participants as either meeting or not meeting the 180 min/day of TPA in three ways based on the three step-count thresholds in the literature[11–13]: ≥6,000 steps/day[11]; ≥9,000 steps/day[12]; and ≥11,500 steps/day.[13]

Socio-demographic information of participating children were recorded based on a modified version of the WHO STEPS Survey.[18] Parents reported their child's date of birth (or age in complete years if

date of birth was unknown) and this was used to determine the child's age in years and months. Parents reported their child's sex as either boy or girl. Highest level of education completed by the parent or other member of the household was recorded based on each participating country's educational classification and this was then grouped into two categories due to varying educational classifications between countries: low (secondary/high school or below) or high (tertiary education or above) education. Country income level was classified based on the World Bank classification (https://datahelpdesk.worldbank.org/knowledgebase/articles/906519-world-bank-country-and-lending-groups): lower-middle, upper-middle, and high-income country. However, we treated the two categories for middle-income country (MIC) as one category (i.e., MIC) in our analyses due to fewer children (n=47) from lower-middle income countries. Child's residential area was recorded as either urban or rural based on the location of the Early Childhood Education and Care (ECEC) centre or community where children were recruited to participate in the SUNRISE study.[4]

Descriptive analyses were performed to describe characteristics of participants and presented as means, standard deviations (SD), frequency, and percentage (%). We assessed the validity of the parent-reported level of child TPA in meeting the WHO TPA guideline for pre-schoolers in four ways. First, we used Spearman's rank-order correlation (*r*) to determine the ability of the questionnaire to correctly rank order children by time spent in TPA (min/day) measured by *activ*PAL™. The strength of the correlations were classed as: 0.00–0.19 'very weak'; 0.20–0.39 'weak'; 0.40–0.59 'moderate', 0.60–0.79 'strong'; 0.80–1.0 'very strong'.[19] Our sample was powered to detect a correlation of *r*: 0.1489 at 80% power and 0.05 significance level. Secondly, we used Kappa statistics to assess the ability of parent reports to place individuals in tertiles of habitual TPA measured by accelerometry: strength of agreement was classified using Landis and Koch: <0.00 'poor agreement'; 0.00–0.20 'slight agreement'; 0.21–0.40 'fair agreement'; 0.41–0.60 'moderate agreement'; 0.61–0.80 'substantial agreement'; and 0.81–1.00 'almost perfect agreement'.[20] We also assessed the ability of the questionnaire results to classify participants as meeting (sensitivity) or not meeting (specificity) the TPA guideline by reporting percentage agreement. Sub-group analyses were conducted by the various socio-demographic characteristics (i.e., sex, education class, residential area,

and country income level) to explore differences in correlation and classification accuracy between parent-reported and accelerometer-measured TPA. Finally, we used Bland–Altman plots to evaluate bias between parent-reported habitual TPA measure and accelerometry by plotting the difference between the two methods against accelerometry (the criterion method).[21] We also used Bland–Altman plots to calculate 'limits of agreement' (LOA, i.e., mean bias ±1.96 SD). Additionally, we used Pearson's correlation to test for systematic bias between the difference and the criterion method.

We validated the three proposed step-count thresholds by calculating sensitivity, specificity, and area under the receiver operating characteristic curve (ROC-AUC) for Gabel, Vale & De Craemer step-count thresholds using steps derived from *activ*PAL™.[11–13] The ROC-AUC provides a measure of classification accuracy by graphically plotting the *y*-axis as true positive rate (sensitivity) and *x*-axis as false positive rate (1 – specificity). ROC-AUC values were defined as excellent (0.9–1.0), good (0.8–0.9), fair (0.7–0.8), or poor (<0.7).[22] Statistical significance was determined at 5%. All analyses were performed in Stata/IC v.16.1 for Mac (StataCorp, College Station, Texas, USA) except for ROC-AUC which was performed using SPSS v.27 for Mac (IBM Corp, Armonk, NY, USA).

Results

We included 352 pre-schoolers aged 3.0-4.9 years from 13 countries: 3 lower-middle, 5 upper-middle, 5 high-income countries (Supplementary Table A online). Descriptive characteristics of participants are presented in Table 1. The proportions of boys and girls included in the current study were similar. A slight majority (59.1%) lived in urban areas and over two-thirds (67.0%) were from lower- and upper-MICs. The mean age was 4.4 (SD: 0.3) years. Children accumulated an average of 119 (SD: 32) min/day of TPA and accumulated an average of 8,784 steps (SD: 2,548) as measured by the *activ*PAL™. Using the parent reports, children achieved an average of 188 (SD: 127) min/day of TPA.

Table 2 shows rank-order correlations between parent-reported against accelerometer-measured TPA across various demographic characteristics of participants. There was a very weak but statistically significant positive correlation between parent-reported and accelerometer-measured TPA (*r*: 0.140; p=0.009). When stratified by various demographic characteristics, correlations ranged from very weak to weak (*r*: 0.034–0.233). Correlations were statistically significant for boys, participants from highly educated families, and those from MICs.

Overall, there was slight agreement between accelerometer-measured and parent-reported TPA (κ: 0.030) (Table 2). With the various demographic characteristics considered, there remained slight agreement between accelerometer-measured and parent-reported TPA, except among girls where there was disagreement between the two methods (κ: -0.012). Parent reports showed an overall sensitivity of 75.0% and specificity of 55.2% for meeting 180 minutes of TPA guideline per day. When stratified by the various demographic groups, parent reports showed sensitivity of 0.0%–100.0% and specificity of 49.6%–67.3% for meeting the TPA guideline.

The Bland-Altman plots (Figure 1) demonstrated an over-estimation of habitual child TPA time from parent reports compared to the actiPAL™ measurement (mean bias: 69 min/day; SD: 126; 95% limits of agreement [LOA]: -179, 316). As shown in Figure 1, most parents with less active children over-reported their child's habitual TPA. There was also systematic bias in the measurement of child TPA by parent reports compared to accelerometer data, as parents tended to over-report their child's habitual TPA to a larger extent in less active children (*r*: -0.106; p=0.047).

The ROC analyses showed excellent classification accuracy for the De Craemer et al.[13] step-count cut-point with an AUC of 0.945 (95% CI: 0.928, 0.961), 100.0% sensitivity and 88.9% specificity (Supplementary Figure A online). The Vale et al.[12] cut-point showed a fair classification accuracy (AUC: 0.773; 95% CI: 0.747, 0.799, Sensitivity: 100.0%; Specificity: 54.6%), and Gabel et al.[11] step-count cut-point showed a poor classification accuracy (AUC: 0.577; 95% CI: 0.557, 0.595; Sensitivity: 100.0%; Specificity: 15.1%).

Discussion

Our findings suggest that simple parent-reporting of child TPA is not likely to be adequate for global surveillance of the WHO physical activity guideline for pre-schoolers. However, we found that step-counting, using the De Craemer et al.[13] step-count threshold of 11,500 steps/day, provided an accurate way of assessing compliance with the guideline in this diverse group of pre-schoolers.

Only two studies have evaluated parent-reported TPA against accelerometry in young children.[6,7] Dwyer et al.[7] found very weak correlations ranging between 0.05 and 0.16 which were not statistically significant (p>0.05). Additionally, Dwyer et al.[7] reported mean biases of parent-reported TPA against accelerometry of 45 min/day (LOA: -104, 194) and 21 min/day (LOA: 122, 164) based on Sirard et al.[23] and Reilly et al.[24] accelerometry cut-points, respectively. Unlike our study, findings from Dwyer et al[7] were limited by a small sample size (n=67). Sarker et al.[6] found a weak correlation of 0.39 (95% CI: 0.19, 0.56) between parent-reported and accelerometer-measured child habitual TPA, which is higher than the correlation in our study (*r*: 0.14; p=0.009). Unlike Sarker et al.[6] which used Actical accelerometers, our study used *activ*PAL™ accelerometers which have been validated for measurement of TPA against direct observation in this age group.[10] Sarker et al.[6] had a mixed sample, involving infants, toddlers, pre-school and schoolchildren aged 4-70 months and did not report correlation/agreement specifically for each age group. The present study only included pre-schoolers aged 3-4 years that may have different activity patterns as well as spend less time with their parents compared to younger children in the Sarker et al.[6] study. Additionally, participants in both previous studies were from HICs[6,7]; whereas our study included participants from lower- and upper- middle-income countries and with diverse culture and lifestyles. Nevertheless, the results of the current study are consistent with a previous review of validation studies of physical activity measures in children, even though most validation studies included in the review involved children older than those participating in our study.[25] The poor/weak correlation in validation studies of parent-reported physical activity could be caused by parents over-reporting their child's physical activity due to social

desirability[26] or because they do not know how much activity their child participate in during weekdays when they are at an ECEC centre for example.

Despite the importance of TPA in early childhood for current child health and development, and future health according to the WHO Ending Childhood Obesity (ECHO) Report[1] and WHO 2019 Guidelines,[2] there is currently no systematic global surveillance.[3] There is global surveillance of adherence to WHO physical activity guidelines in adolescents[27] and adults.[28] While proxy reports from parents are simple and cheap for monitoring physical activity in young children, our results suggest that they are not likely to be valid for global public health surveillance of physical activity in early childhood. Consequently, parent questionnaires may not be suitable for monitoring compliance with the WHO physical activity guidelines in early years. Given the need to for a globally validated physical activity measurement for surveillance purposes to monitor progress towards the global targets, and based on our results, step-counting may be a more accurate alternative to parent reports. At the moment, there is currently no consensus on culturally and geographically valid step-count targets for classifying 3 hours of TPA in pre-schoolers.[11–13] The present study suggests that a step-count threshold of at least 11,500 steps/day may be used for assessing compliance with meeting the TPA guideline in early years because it is geographically and culturally valid against TPA measured by the *activ*PAL™. There are barriers to using accelerometers in population-based studies as they are intrusive, require complicated data reduction and analysis, produce huge data sets, and are expensive,[5,9] at about a minimum of $254 USD per device up to > $1000 USD, depending on the device. As such, surveillance studies and national surveys in future could potentially use much simpler, cheaper devices like pedometers to assess the prevalence of compliance with WHO guidelines. Pedometers are highly correlated to accelerometer step-counts in young children[17,29] and adults[30]; however, exact step-count thresholds should be established as being accurate in the population they are being used before being included as surveillance measures due to potential differences between methods of measuring step-counts (including differences due to the placement of the device, e.g. with the *activ*PAL™ worn on the thigh and pedometers usually worn on the hip).

A strength of our study was the relatively large sample of young children compared to previous validation studies among this age group.[6–9] Moreover, to our knowledge, this is the first study to assess validity of parent reports of their children's physical activity based on a sample from vastly differing contexts, including lower- and upper-MICs as well as HICs. This is also the first study to cross-validate existing step-count thresholds in such a varied sample of pre-schoolers.

Our study had some limitations. Recruitment of participants in the SUNRISE study was determined independently in each country due to the varying contexts in which the study was conducted, including use of convenience cluster sampling.[4] The sample was not representative. However for a methodological study the main requirements are adequate sample size, wide range of settings, and a range of levels of TPA from low to high, and all these requirements were met in our study. We did not have any low-income countries (LIC) study participants as classified by the World Bank. However, our study included participants from Bangladesh which is classified as a LIC according to the Organisation for Economic Co-operation and Development's (OECD) Development Assistant Committee (DAC; https://www.oecd.org/dac/financing-sustainable-development/development-finance-standards/daclist.htm) and also included three lower-MICs. The parent-reported questions in our study were based on available physical activity, sedentary behaviour, and sleep guidelines for the early years,[16] and alternative questions might have higher validity. In addition, it is possible that the observed bias in over-reporting of child's TPA by parents varied between countries due to cultural differences; however, with our sample size we were not adequately powered to explore differences in biases by country of origin. As such, a further study focusing on potential differences in the biases in physical activity reporting by parents across countries may be useful. We identified a gender difference in accuracy of parent reporting of TPA (more accurate in the boys than girls) – the reasons for this are not clear and may be worth investigating further in future. However, correlations between parent-reported TPA and accelerometer-measured TPA, though statistically significant, were very low in the boys in the present study and so the practical significance of this gender difference is probably quite limited – validity of parent reporting was low in both boys and girls. Further, we used research-grade accelerometer to test the three existing step-count thresholds and therefore cheaper pedometers

need to be validated before use. Lastly, there was a suggestion of a possible gender difference in the classification accuracy as there was disagreement between the two methods in measurement of habitual TPA among girls which also requires further research.

Conclusions

Despite the importance of TPA in early childhood for current child health and development, and future health according to the WHO ECHO Report[1] and WHO 2019 Guidelines,[2] there is currently no global surveillance of TPA in early childhood, and one major barrier to a surveillance system is cost and complexity of the measurement method. The present study provides evidence that parent reports may have limited validity for this purpose as parents cannot recall their child's physical activity adequately, at least not using fairly simple questions. However, our study also shows that step-counts may be an accurate and relatively simple, potentially low-cost, alternative to assessment of progress towards meeting the global physical activity targets in this age group.

Practical implications

- Parent reports of their child's level of physical activity are not accurate.
- An alternative simple objective monitoring method is required, especially for low-and-middle--income countries.
- Step-counting (e.g., using pedometers) provides an accurate low-cost option and may be suitable internationally for population monitoring of physical activity in early childhood to improve children's health and prevent obesity and related diseases, such as diabetes, high blood pressure and some cancers.

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Tables

Table 1: Characteristics of study participants (as frequency and percentage unless specified).

Characteristics	**Frequency**	**Percent**
Sex		
Boys	179	50.9
Girls	173	49.1
Education class		
High	183	52.0
Low	165	46.9
Missing	*4*	*1.1*
Residential area		
Urban	208	59.1
Rural	144	40.9
Country income level [a]		
HICs	116	33.0
MICs	236	67.0
		Mean (SD)
Age, years	352	4.4 (0.3)
Accelerometer total physical activity, min/day	352	118.9 (31.7)
Parent-reported total physical activity, min/day	352	187.6 (126.9)
Total step-count, steps/day	352	8,783.6 (2,548.2)

Note: HIC = High-income countries; MICs = Middle-income countries

[a] denotes derived variable based on World Bank classification

Table 2: Spearman's correlation and classification accuracy between parent-reported and accelerometer-measured levels of TPA.

	Spearman's correlation		**Classification accuracy**			
	Coefficient (r)	p-value	Agreement (%)	Sensitivity (%)	Specificity (%)	Kappa (κ)
All	0.140	0.009	56.0	75.0	55.5	0.030
Sex						
Boys	0.171	0.022	53.6	85.7	52.3	0.058
Girls	0.088	0.249	58.4	0.0	58.7	-0.012
Education class [a]						
High	0.233	0.002	57.9	66.7	57.6	0.035
Low	0.034	0.665	54.0	100.0	54.0	0.028
Residential area						
Urban	0.108	0.120	59.6	60.0	59.6	0.022
Rural	0.157	0.060	50.7	100.0	49.6	0.039
Country income level [b]						
HIC	0.112	0.233	67.2	66.7	67.3	0.050
MIC	0.156	0.016	50.4	80.0	49.8	0.024

Note: HIC = High-income countries; MICs = Middle-income countries

[a] denotes 4 participants with missing data; [b] denotes derived variable based on World Bank classification

Agreement means the proportion of children who were accurately classified by both the parent reports and accelerometry (the criterion method) as meeting or not meeting the TPA guidelines

Sensitivity means proportion of children who are accurately classified as meeting the TPA guidelines by parent reports

Sensitivity means proportion of children who are accurately classified as not meeting the TPA guidelines by parent reports

Kappa statistics by Landis and Koch[20]: <0.00 'poor agreement'; 0.00–0.20 'slight agreement'; 0.21–0.40

'fair agreement'; 0.41–0.60 'moderate agreement'; 0.61–0.80 'substantial agreement'; and 0.81–1.00 'almost perfect agreement'.

Figure legends

Figure 1. A 'modified' Bland-Altman Plot between accelerometer-measured and parent-reported child's habitual TPA. The figure shows mean bias (middle solid line) of 69 min/day in (over-) estimation of child's TPA by parent reports compared to accelerometer measurement and its associated lower and upper limits of agreement (below and above the mean bias line, respectively). The dots indicate that over-reporting of child's TPA by parent reports was higher among less active children.

Appendices

Supplementary Table A and Figure A

Abbreviations:

AUC = Area under the ROC curve

CI = Confidence interval

ECEC = Early Childhood Education and Care

ECHO = Ending Childhood Obesity

HIC = High-income country

LIC = Low-income country

LMVPA = light-moderate-vigorous physical activity

LPA = light physical activity

MIC = Middle-income country

MPA = moderate physical activity

MVPA = moderate-to-vigorous physical activity

REDCap = Research Electronic Data Capture

ROC = Receiver operating characteristic curve

SD = Standard Deviation

TPA = Total physical activity

UOW = University of Wollongong

USD = United States Dollar

WHO = World Health Organization

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Declarations of interest: none

Confirmation of Ethical Compliance

The SUNRISE study protocol was reviewed and approved by Human Research Ethics Committee at the UOW (2018/044) and ethics committees in each participating country; all parents of participating children gave informed consent.

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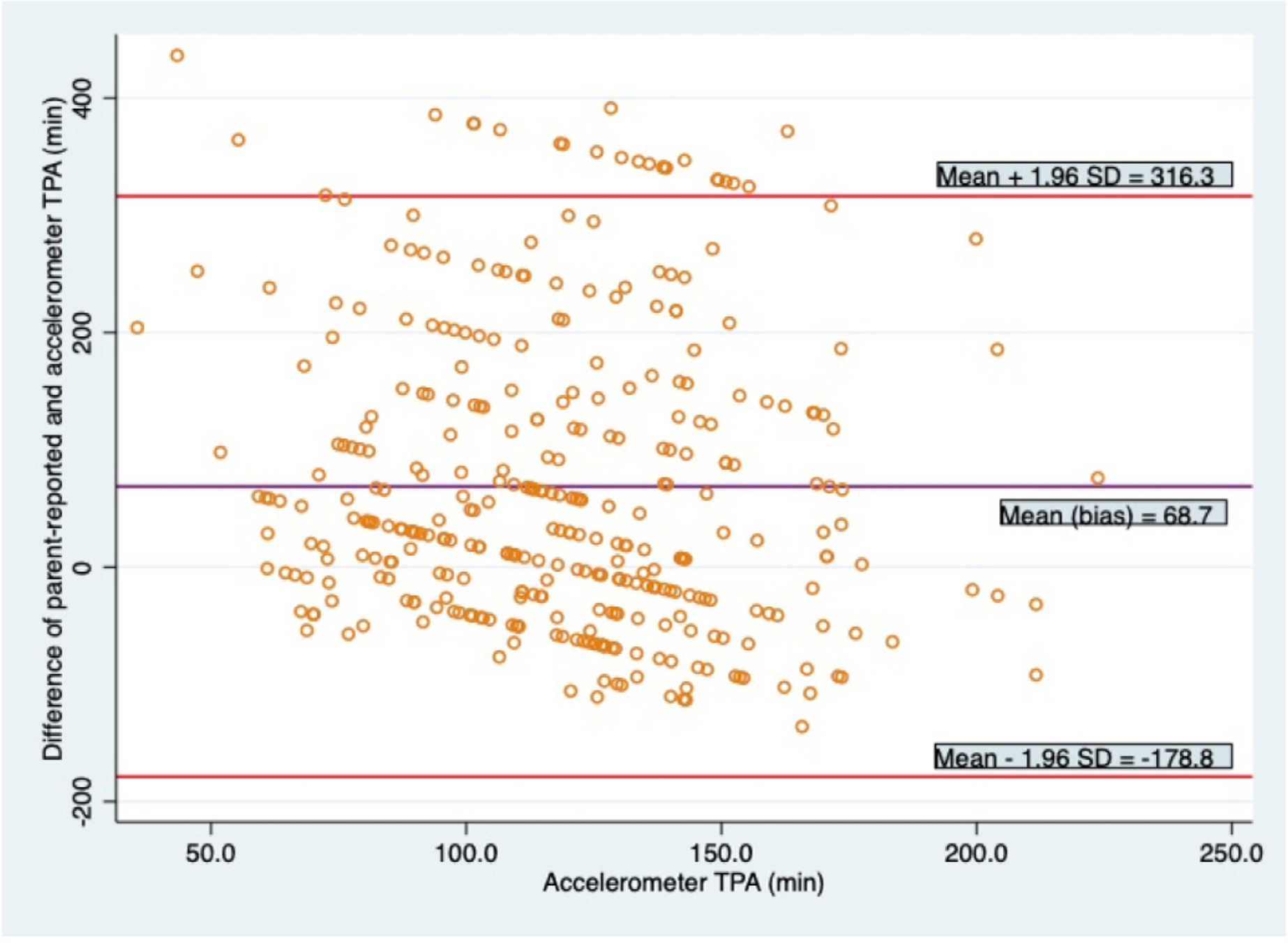
Difference of parent-reported and accelerometer TPA (min)
400
200
0
-200
Mean + 1.96 SD = 316.3
Mean (bias) = 68.7
Mean - 1.96 SD = -178.8
50.0
100.0
150.0
200.0
250.0
Accelerometer TPA (min)

Figure 1