RESEARCH ARTICLE

REVISED Description and comparison of physical activity from self-reports and accelerometry among primary school children in Kilimanjaro, Tanzania: a pilot study [version 2; peer review: 1 approved with reservations, 1 not approved]

Previously titled: Validation of self-reported physical activity by accelerometry among primary school children in Kilimanjaro, Tanzania: a pilot study

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Abstract

Background: Self-reports are commonly used to assess physical activity in children. Existing self-reports for physical activity have not been validated for use among primary school children in, Tanzania. In order to understand if primary school children can accurately report their physical activity, we examined the validity of self-reported physical activity against accelerometer measured physical activity.
Methods: A community based cross-sectional study was conducted from May to July, 2018. Four primary schools were conveniently selected in Moshi municipal and Moshi rural districts in Kilimanjaro, Tanzania and from these 51 children aged 9 – 11 years were randomly selected. Self-reported questionnaire was used to collect physical activity related variables. In addition, children wore accelerometers for seven consecutive days to capture physical activity movements. Spearman's rank test and Bland Altman plots were used for assessing validity and agreement between self-reports and accelerometer moderate to vigorous physical activity (MVPA).
Results: The mean age of the study participants was 10 (SD=0.8) years and 32 (63%) were girls. A positive significant correlation was found between self-reports and accelerometer MVPA (rho=0.36, p=0.009). Accelerometer had higher mean MVPA 408 (SD = 66) compared to self-reports 261 (SD = 179). Children who reported walking to school had higher MVPA for both accelerometer and self- reports compared to children who use other means of transport to school, e.g. school

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buses ($p < 0.001$).
Conclusions: This study found a positive significant correlation between self-reports and accelerometers. Self-reports are prone to errors due to recall bias, and this interferes their validity. More research is needed to develop better self-reported measures with specific activities which can easily be recalled by children. Also, researchers have to be aware of self-reports validity limitation.

Keywords
Children, self-reports, accelerometer, physical activity, validation, Tanzania

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REVISED **Amendments from Version 1**

We would like to acknowledge all comments raised by reviewers and would like to share the revised version of the manuscript. We have revised the title as suggested by reviewers and now it captures the clear message. We have revised the abstract appropriately, correct all typos and add a word Tanzania to the key words. Introduction is revised as suggested and study variables clearly written. We have included the set of final questions from self-reports questionnaire as suggested. In the statistical analysis we have included the results of the normality test "Shapiro Wilk". For accelerometer data reduction we have revised and include more details on scoring and filtering the accelerometry data. We have modified the tone of the section on variability between self-reports and accelerometer time blocks of activities as well as the section on associations between child level variables and accelerometer MVPA. In the results section, we have changed the information on the strength of correlation and it now states a positive significant correlation to make it clearer. Discussion section, strengths and limitations of the study have been modified as suggested. Figure 1 have been revised and have added more details on blocks of activities to improve clarity, and block numbers have been removed from the horizontal axis. Figure 2a and 2b have been separated and they are now Figure 2 and Figure 3. In Figure 3 we have removed the confidence intervals as suggested. For Figure 4 we have added the outliers as suggested and include some notes to improve clarity.

Any further responses from the reviewers can be found at the end of the article

Introduction

Physical activity in children is key to better health. Active children gain health benefits including cardiorespiratory, muscular fitness and bone health. Physical activity plays an important role in prevention of non-communicable diseases (NCDs) and avoidance of weight gain[1]. The World Health Organization (WHO) recommends an average of at least 60 minutes per day of moderate to vigorous activities (MVPA) for 5–17-year-olds, to gain benefits for their later life[2–4]. Studies in low- and middle-income countries (LMICs) reported low levels of physical activity and high levels of sedentary behaviours in children[5,6]. In Tanzania, 82.1% of school-going children are not meeting the recommended physical activity levels, according to self-reports[7].

Physical activity is a complex behaviour which includes day-to-day variations of activities which might not be easily remembered by children[8]. Tools for measuring physical activity include subjective measures such as self-reports, proxy reports by parents and teachers, activity diaries and recalls. Selection of a suitable assessment questionnaire for physical activity and instruments is based on the target population under study, respondent burden, cost effectiveness and type of information to be collected. In population studies, objective measures may be too expensive to be feasible, so self-reports are often used to assess physical activity. However, self-reports are prone to errors due to large day-to-day variations and inaccurate estimation of physical activity levels[9,10].

Over the years, accelerometers have been used increasingly in high-income countries for assessment of physical activity in children[11,12]. However, in LMICs there is limited number of physical activity studies which uses accelerometers to assess physical activity. Objective measures include motion sensors such as heart rate monitors, accelerometers and pedometers. Heart rate monitors are cheap to use but they have shown a weak relationship with energy expenditure while pedometers only capture steps taken to provide estimates of activity levels. Accelerometers are more valid than self-reports in estimating physical activity[8,9]. The doubly labelled water method is a gold standard to measure energy expenditure but is expensive and requires specialist techniques[13]

The validity of self-reports for assessing physical activity in primary school children have not been fully explored in Tanzania. It is unclear if children from Tanzania can accurately report their physical activity, or estimate minutes spent in physical activity. Therefore, this study aimed at describing physical activity, compare and determine the validity of a self-reported questionnaire to measure physical activity in Tanzanian primary school children, using an accelerometer as a reference method.

Methods

Study design and setting

This was a community-based cross-sectional study conducted in two districts purposely selected, Moshi municipal and Moshi rural district, of Kilimanjaro region in the Northern part of Tanzania. Two primary schools (one private and one government-funded) from each district were conveniently selected.

Study participants

School children were recruited through a simple random technique between May to July, 2018. A convenience sample of 80 children aged 9–11 years were randomly selected from the school attendance registers, i.e. 20 from each school, and their parents were contacted for a detailed explanation of the study aims and procedures. Thereafter children were sent home with the information sheet and consent form for parents to sign after agreeing to take part in the study. Only day schoolers children were eligible to be involved in the study.

Study variables

Our main study variable was minutes per day spent in MVPA which was obtained from self-reports and accelerometry.

Data collection methods and tools

For this study, questionnaires from the International Study on Childhood Obesity, Lifestyle and Environment (ISCOLE) were adapted and modified[14]. The ISCOLE physical activity questions were reviewed to check for the appropriateness of the cultural context and applicability for use with primary school children in Tanzania. These questionnaires had been used in several high-income countries, and in one African country (Kenya). The focus during modification was to retain those questions which were descriptive enough for children to understand, and that related to durations and participation in different activities. Modifications were made to account for the relevant usual activity types and the structuring of questions. These involved rewording of some questions, and removing questions that were

not appropriate for the Tanzania school children, (e.g., the question asking "How much time did you spend outside before school, or before bedtime?" was removed because it did not necessarily imply physical activity). Questions asking about attitudes and personal reasons for making someone active and sleep information were also removed as they were not under study aim (e.g., "I can ask my parent or other adult to do physically active things with me", "I find exercise a pleasure activity").

The modified questionnaire draft, available as *Extended data*[15], was shared with the region's school health coordinator for review and advice and then piloted with 15 school children to check for comprehension and relevance of questions used. Children were asked to indicate activities during typical days in their lives, stratified by school days and weekend days. Inputs from the students helped to modify the flow and the way some questions were asked. The changed tool was returned to the 15 students and after adjustment the final questionnaire for pilot was developed.

Physical activity measurements

Self-reports

The final questionnaire was designed to collect information on multiple dimensions of physical activities including types, frequency and duration. Therefore, the final sets of questions in the modified questionnaire focused on activities in a typical week (weekdays/ school days and weekends) as follows; "how many days you participated in physical education classes (PE), i.e. practical sessions", "transport means to school", how long did it take to travel/ walk to school", "participation in after school activities (e.g. house chores, exercise)", "when you are at school, during break time do you participate in any type of physical exercise such as playing netball, football, skipping etc. or any other activity", and "how many days were you physically active for 60 minutes a day", "how many days did you watch television", "how long did you watch television" "how many days did you play video games", "how long did you play video games or use computer on non-school activities".

Accelerometry

Children were instructed how to wear the triaxial accelerometers (ActiGraph, wGT3X-BT Pensacola, FL). An accelerometer is a device which is used to objectively measure and record physical activity movement associated with daily activity. Instructions (verbal and written) were given to teachers and parents in order to assist their children with accelerometer attachment. Research staff were making phone calls to parents/teachers every morning to make sure they remind their children to wear the accelerometers. Accelerometers were attached with an elastic band on children's right hip. Children were instructed to remove the accelerometers when bathing or engaging in any water activity such as swimming. Accelerometers were set to collect data from 06:00 AM to 09:00 PM (bedtime) except for the initiation day when accelerometers were commenced to start collecting data from 09:00 AM. Accelerometers were worn for seven consecutive days. When returned, data from each accelerometer were uploaded to the computer using Actigraph software, ActiLife version 6.13.4.

Statistical analysis

Self-report data were entered into Excel and accelerometer data were exported to Excel; both were then imported into STATA IC version 15.1 (StataCorp, College Station, TX, USA) for analysis.

Descriptive statistics were used to summarize the demographics and physical activity data from self-reports and accelerometers. The distribution of data were checked using Shapiro Wilk test and showed that daily average MVPA data from accelerometer were normally distributed ($p = 0.34$) while for self-reports MVPA, daily sedentary bouts from accelerometry and sedentary time from self-reports were positively skewed indicating high activity and sedentary levels in some children ($p < 0.05$), and therefore mean (standard deviation) and median (interquartile ranges) were used as appropriate. Further frequencies and proportions were used for categorical variables.

Estimating physical activity MVPA

Self-reports MVPA

Questions with information on time spent for participating in different activities were included, and total time calculated. Total weekday MVPA was defined as the sum of minutes for walking to school for five school days (Monday – Friday) and report of being physically active for at least 60 minutes for each day of the week. Minutes of walking to school were summarized by calculating a midpoint since this question had categorical responses. For example: a response of 15–30 minutes of walking to school was considered as 22.5 minutes. Reported being physically active for at least 60 minutes for each school (weekday) was calculated by multiplying the number of days and minutes. For example: if the child reported being active for 3 days, we multiplied by 60 minutes to get 180 active minutes. The average minutes of MVPA was thereafter estimated by dividing the total time of MVPA by the five days of the week.

Total weekday sedentary time was defined as the sum of minutes spent on leisure activities (sedentary behaviours) such as watching television, using a computer or playing with electronic games. The average minutes of sedentary time was estimated by adding all sedentary activities dividing by five days of the week.

Accelerometry MVPA

Data reduction and scoring

The raw activity data were reduced into 15-s epochs data for analysis, scored then converted to ".agd" files and imported into "CSV" and Excel sheets using Actigraph software, ActiLife version 6.13.4. Evenson's cut points for children were used to categorize activities in counts per minute (cpm); 0–100 (Sedentary), 101–2295 (Light), 2296–4011 (Moderate) and >4012 (vigorous)[16–18]. Thereafter, total time spent in moderate and vigorous physical activity (Total MVPA) and total sedentary time were estimated. Spike tolerance was set to zero and a minimum length of non-wear period was set to 60 minutes of consecutive zeros to allow for interruptions. The minimum wear time was set to 10 hours and children were included in the analysis if they had sufficient and valid accelerometer data

with a minimum of three weekdays and at least one weekend day. For weekends children were included in the analysis if they had sufficient accelerometer data with at least 1 weekend day. Children who did not meet these criteria were excluded from the analysis.

Using an Actigraph software and considering Tanzanian primary school daily timetable, we applied filters to define time blocks of activities from the accelerometer output to match with the questions from self-reports. This was done to countercheck if reported activities are well confirmed by the accelerometer MVPA e.g., walking to school.

An example of accelerometer captured patterns of activities in three spatial dimensions X, Y and Z and varied by time blocks is indicated in Figure 1. The graph was taken from one child in one day of the week. The period with no bars means the child was either not active or the device was not worn at all.

Correlation between self-reports and accelerometer MVPA. To examine validity, we included only school days (weekdays) assuming that children spend most of their time in schools and routinely participate in physical education classes. During weekend days children are engaged in unstructured activities which might be difficult for them to recall. We used scatter plots and Spearman's rank test to check for the correlation between overall weekdays physical activities (MVPA) from self-reports and measured by accelerometer. Also, Bland–Altman plots were used to assess the agreement between average weekday self-reported MVPA and accelerometer measured MVPA.

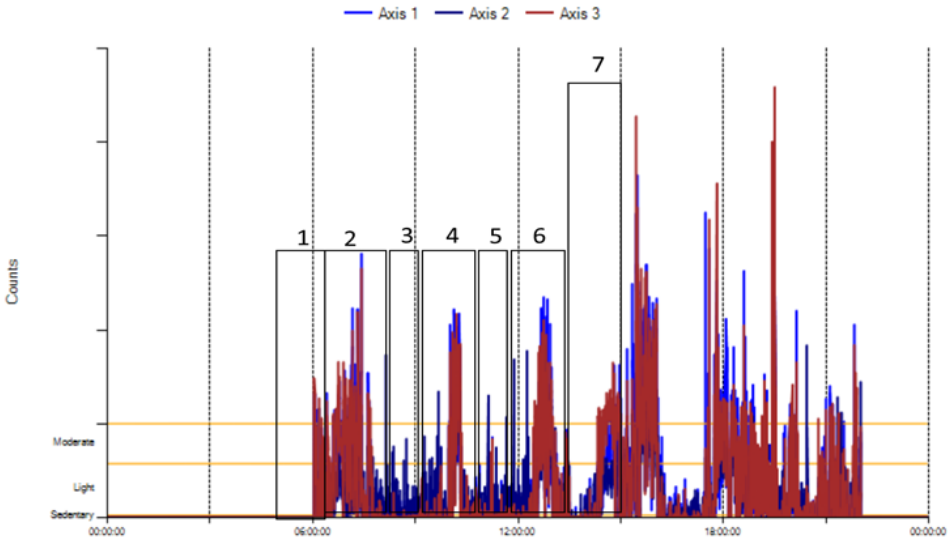
Variability between self-reports and accelerometer blocks. Box-and-whisker plots were constructed show the variability between self-reports responses (walking to school, exercise during tea break, exercise during lunch and after school activities) with the matching time blocks of activities from accelerometer MVPA across days of the week.

Mean weekday MVPA. The mean weekday MVPA (minutes per week) for both self-reports and accelerometer were calculated. Student's T test (for two groups) and ANOVA (for age only; > 2 groups) were used to compare the mean weekday MVPA from self-reports and accelerometer by sex, age, school location, school type, walking to school, exercise during breaks (tea and lunch break), after school activities and participation in physical education sessions while accounting for the clustering effect of children within schools. We further performed post hoc pairwise comparison using Bonferroni test for comparing the differences in mean total MVPA by age categories. There were no significant differences in means across age categories.

Sub-group analysis

Associations between child level variables and accelerometer MVPA

We performed further analysis to explore the associations between weekday accelerometer MVPA and different child level variables (sex, age, school type, school location and walking to school). Univariable and multivariable linear regression were done accounting for repeated measures of accelerometer for the same child on different days of the week. A child was regarded as a cluster since the repeated measurements of



Blocks were defined based on the normal school day routine (Monday – Friday) as follows: - 1. Morning walking to school block (0600 – 0730 hours), 2. Morning sitting for classroom sessions (0800 – 1000 hours), 3. Tea/ porridge break time (1002 – 1032 hours), 4. After break sitting for classroom sessions (1100 – 1220 hours), 5. Lunch time break time (1232 – 1332), 6. After lunch sitting for classroom sessions (1400 – 1500), 7. After school hours activities (1502 – 1730)

Figure 1. Illustrates the accelerometer output for a single child in one weekday (school day), with defined blocks of activities. Vertical axis shows the time in 24 hours, and horizontal axis shows the levels of activities achieved.

accelerometer were nested within the child. Regression coefficients from the linear regression, 95% confidence intervals (95% CI) and intra-class correlations were presented.

Ethics approval and consent to participate

We certify that all ethical procedures concerning human participants were followed. Ethics approval was obtained from the National Institute for Medical Research (NIMR), Tanzania certificate number: IX/2735 on 27/03/2018 and the Kilimanjaro Christian Medical University College Ethics Committee (KCMUCO) certificate number: 2225 on 21/09/2017. School permission was obtained from the regional medical officer, district education officers and school authorities. All parents of participating children signed a written informed consent for their children to participate. Children were asked to sign a brief written assent to participate in the study.

Results

Demographics and child characteristics

A total of 51 primary school children were enrolled in the study, interviewed and wore accelerometers. Of the 80 parents contacted for consenting their children's participation in the study, 51 (65%) accepted. Of these 51 primary school children, 32 (63%) were girls. The average minutes of MVPA per day from accelerometer was 96 (SD 35) and the daily average of sedentary bouts was 74 (IQR: 48, 118). Daily MVPA from self-reports was 60 (IQR: 26, 65) and sedentary time from self-reports was slightly higher 90 (IQR: 60, 150). Other characteristics of the study participants are shown in Table 1. All raw accelerometer and self-reporting data are available as *Underlying data*[15].

Correlation between self-reports and accelerometer MVPA

The correlation between self-reports and accelerometry is presented in Figure 2. Overall, a positive significant correlation was found between accelerometer measured MVPA and self-reported MVPA (rho = 0.36, p=0.009). The Bland–Altman plot of a difference between self-reports and accelerometer MVPA versus a mean of these two methods shows the mean difference of 29.9 minutes of MVPA per day, with the agreement limits ranges from -44 to 104 minutes per day (Figure 3).

Variability between self-reports and accelerometer blocks

Figure 4 presents the box-and-whisker plots on the comparison of MVPA from time blocks of activities for children who reported participating in activities versus not participating in activities across weekdays (from Monday to Friday). We found consistent results on accelerometer MVPA from time blocks of activities as reported by children. There are no large variations in the pattern of physical activities on a typical weekday. The highest level of activity is seen after school hours and this is consistently captured by both self-reports and accelerometer. The second most active time of the day is the mornings (walking to school). Compared to other blocks outside school hours, i.e. in addition to walking to school and after school hours, activity during school breaks (tea and lunch break) is

Table 1. Characteristics and physical activity data for primary school children (N=51).

Characteristic	n (%)
Socio demographics Age (years)	
Mean, SD	(10, 0.8)
9	11 (22)
10	17 (33)
11	23 (45)
Female	32 (63)
School type	
Government	27 (53)
Private	24 (47)
School location	
Moshi urban	33 (65)
Moshi rural	18 (35)
Accelerometry data Number of days during entire period for which accelerometer data were available	
3 days	1 (2)
4 days	1 (2)
6 days	1 (2)
7 days	48 (94)
Number of weekdays for which accelerometer data were available	
3 days	2 (4)
4 days	1 (2)
5 days	48 (94)
Number of weekend days for which accelerometer data were available (n = 49)[§]	
1 day	3 (6)
2 days	46 (94)
Daily average MVPA (minutes)*	98 (74, 118)
Daily average of sedentary bouts (10 minutes each)**	74 (48, 118)
Self-reported physical activity data	
Number (%) of children reporting:	
Walking to school	29 (57)
Screen time (electronic games, television)	48 (94)
Exercise during school breaks	41 (80)
After school exercises (house chores, games)	44 (86)
Attend physical education sessions (n=47)	36 (77)
Daily average MVPA (minutes)**	48 (26, 63)
Daily average sedentary time (minutes)**	90 (60, 150)

MVPA moderate to vigorous physical activity

[§]Two children were missing valid data for weekend days

*Data represent mean (standard deviation)

**Data represent median (interquartile range), IQR: 25%;75%

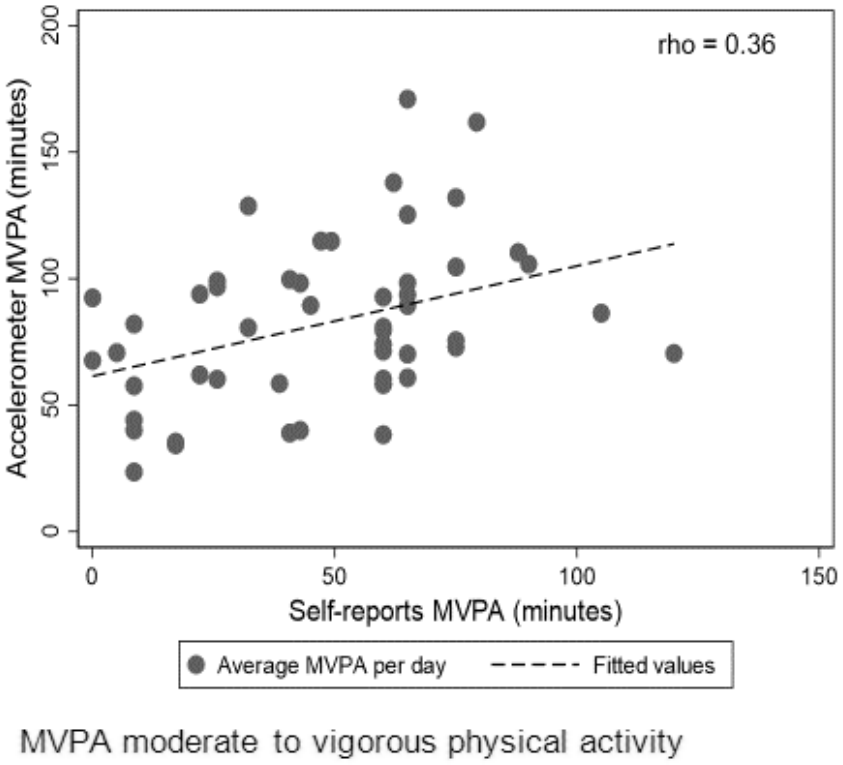


Figure 2. Scatter plot for correlation between average MVPA per day from self-reports and accelerometer MVPA per day, showing a Spearman rho = 0.36.

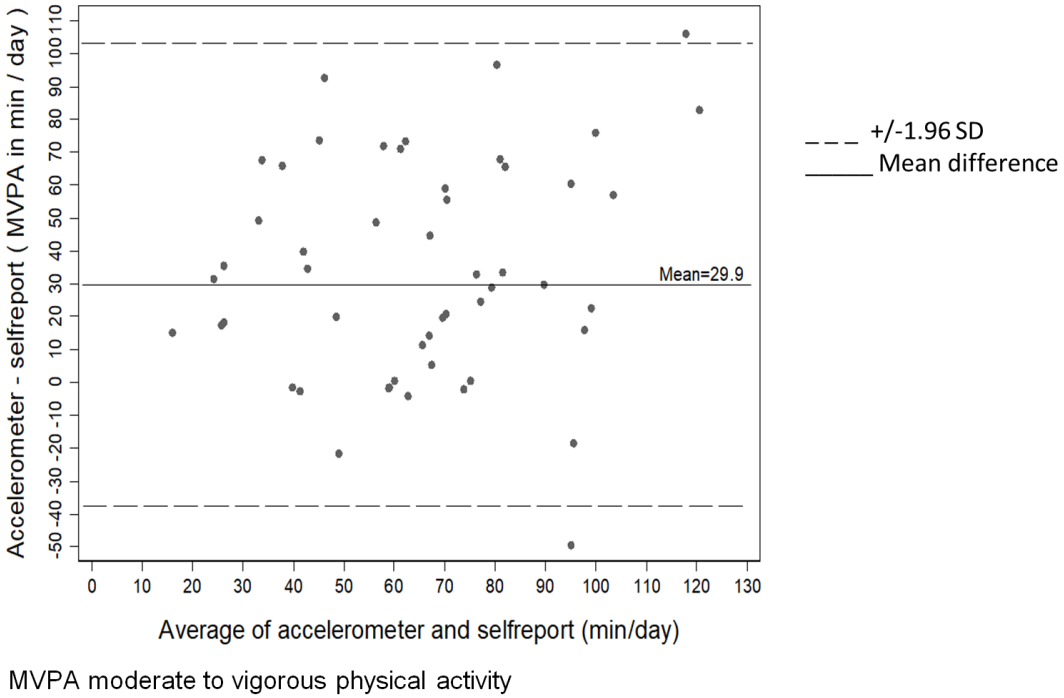


Figure 3. Bland Altman plot of accelerometer and self-reports MVPA, indicating level of agreements between the two measurements.

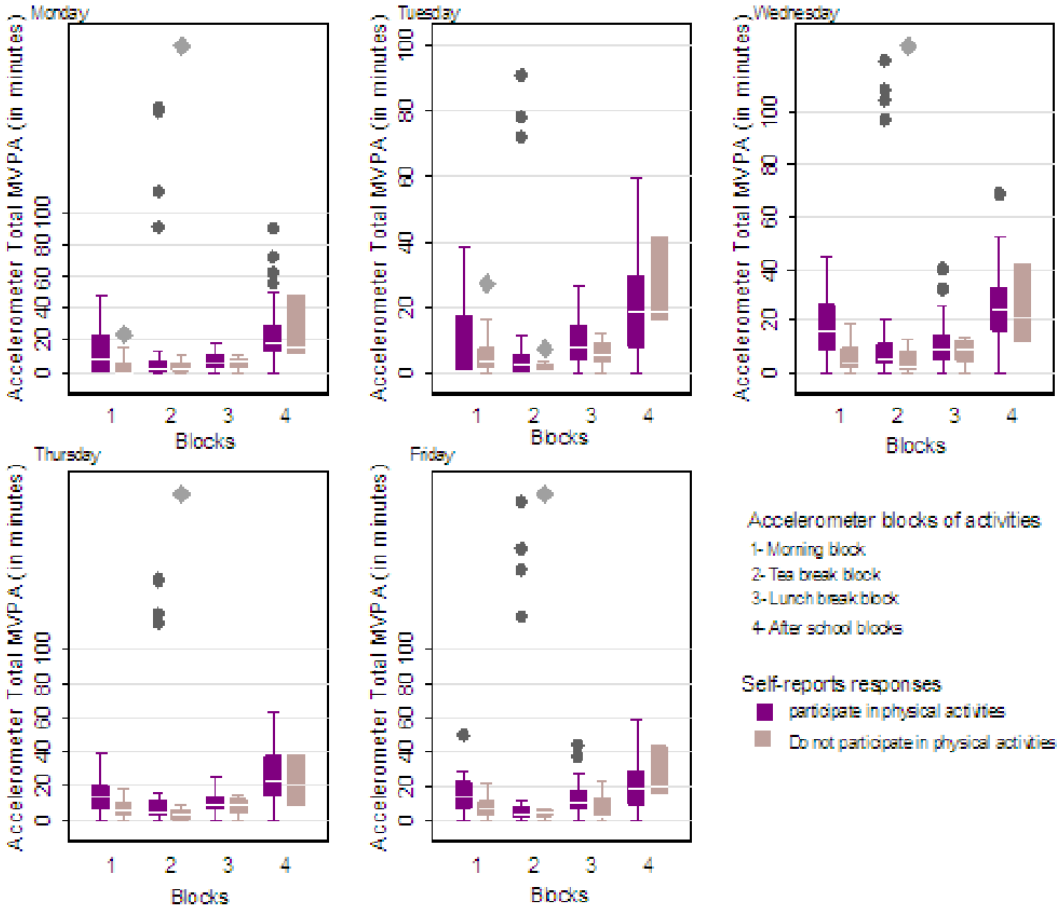


Figure 4. Box and whisker plot presenting accelerometer total MVPA from blocks of activities and self-reports responses across weekdays (school days).

consistently lower with no marked difference in children who report exercising and those who do not report exercising during school breaks. Separately, the accelerometer measured total MVPA during the first block of the day (walking to school) was consistently higher for children who report walking to school compared to those who do not report walking to school or use other means of transport such as private cars or school buses (Figure 3).

Mean weekday MVPA

Table 2 illustrates the mean weekday MVPA minutes from self-reports and accelerometer were 261 (SD=179) and 408 (SD=66) respectively. There is evidence of a consistently higher mean MVPA minutes for both accelerometer and self-reports for children who reported walking to school, 480 and 302 ($p < 0.001$) compared to those who don't walk or use other means of transport to school (Table 2). Similarly, for weekend data the mean accelerometer MVPA was higher compared to that of self-reported weekend activities (Table 3).

Subgroup analysis for associations between child level variables and total weekday accelerometer MVPA

Table 4 presents the subgroup analysis of the associations between child level variables and the accelerometer MVPA. In the crude analysis, we found that attending government school (33.6, 95% CI 18.9–48.4) and walking to school (33.4, 95% CI 18.5–48.3) variables were strongly associated with the total weekday accelerometer-measured MVPA. In the multivariable model, after accounting for the effect of child level factors, only school type remains significantly associated with the total weekday accelerometer-measured MVPA (23.4, 95% CI 4.0–42.8), while for walking to school the association was lost.

Table 2. Mean weekday moderate to vigorous physical activity (MVPA) of self-reports and accelerometer (N=51).

Characteristic	n	Accelerometer		Self-report	
		Mean MVPA[a] (95% CI)	p-value	Mean MVPA[a] (95% CI)	p-value
Overall		408 (361- 455)		261 (199 - 323)	
Sex					
Male	19	441 (361-522)	0.3	294 (225 - 362)	0.2
Female	32	388 (328 - 448)		231 (185 - 278)	
Age (years)					
9	11	307 (92 - 523)		248 (164 - 332)	
10	17	457 (296 - 617)	0.06	266 (200 - 331)	0.9
11	23	420 (247 - 592)		242 (184 - 301)	
School type					
Government	27	490 (434 - 547)	<0.001	279 (222 - 335)	0.1
Private	24	315 (255 - 374)		221 (170 - 272)	
School location					
Moshi urban	33	389 (331 - 448)	0.3	253 (199 - 308)	0.9
Moshi rural	18	441 (357 - 526)		248 (202 - 295)	
Walking to school					
Yes	29	480 (419 - 541)	<0.001	302 (254 - 350)	0.002
No	22	313 (258 - 367)		185 (134 - 237)	
Screen time (games, television)					
Yes	47	395 (347 - 444)	0.1	243 (204 - 284)	0.2
No	4	555 (372 -738)		344 (263 - 424)	
Exercise during school breaks					
Yes	41	402 (352 - 453)	0.6	238 (202 - 275)	0.2
No	10	430 (288 - 572)		307 (168 - 445)	
After school exercises					
Yes	44	407 (358 - 456)	0.9	256 (215 - 296)	0.1
No	7	412 (214 - 611)		284 (131 - 438)	
Attend physical education sessions (n=47)					
Yes	36	380 (332 - 428)	0.2	248 (212 - 285)	0.3
No	11	456 (300 - 611)		202 (91 – 313)	

Data are shown in mean minutes of MVPA for weekdays.

[a] Mean adjusted for schools as clusters.

CI, confidence interval.

Table 3. Mean weekend moderate to vigorous physical activity (MVPA) of self-reports and accelerometer (N=49).

Characteristic	n	Accelerometer		n	Self-report	
		Mean MVPA[a] (95% CI)	p-value		Mean MVPA[a] (95% CI)	p-value
Overall	49	186 (155 - 218)		24	113 (104 - 121)	
Sex						
Male	17	235 (161 - 309)	0.02	10	108 (90 - 126)	0.37
Female	32	160 (134 -187)		14	116 (107 - 125)	
Age (years)						
9	10	169 (94 - 244)		6	100 (74 -126)	
10	16	226 (164 - 287)	0.21	9	120	0.17
11	23	166 (128 - 204)		9	113 (100 -127)	
School type						
Government	27	231 (190 - 272)	<0.001	13	115 (105 - 125)	0.46
Private	22	131 (93 - 170)		11	109 (93 -125)	
School location						
Moshi urban	32	186 (143 - 228)	0.95	14	107 (92 -122)	0.13
Moshi rural	17	188 (139 - 236)		10	120	
Screen time (electronic games, television)						
Yes	41	183 (149 - 218)	0.66	19	114 (105 - 123)	0.59
No	8	202 (106 - 298)		5	108 (75 - 141)	

MVPA moderate to vigorous physical activity, CI confidence interval. Data are shown in minutes per weekend days.

[a]Mean adjusted for schools as clusters

Notes: Two children were missing the weekends valid data

We noted that, 32% (ICC) of the variations in accelerometer MVPA were explained by the differences in accelerometer MVPA measurements between one child to another. This means that there is a higher variation of MVPA measurements within the same child compared to the variation between different children.

Discussion

This study provides evidence regarding the validity of self-reports to measure physical activity in primary school children. We found a positive significant correlation between self-reports and accelerometry MVPA. Walking to school and afterschool activity time blocks from self-reports corresponds with accelerometer measured activities from these blocks.

A positive significant correlation was observed between self-reports and accelerometer can be explained by the inconsistences of children to report their actual minutes of MVPA. The level of agreement between these two measurements indicates that accelerometer is measuring what self-report is measuring, and the error observed may be due to over- and under-reporting of the actual MVPA. Other validation studies reported similar findings, which reflects the limitations of children's accuracy to report their actual minutes of MVPA[8,19,20].

Our findings are consistent with other studies validating physical activity instruments in children. Few studies have evaluated objective measures against self-reporting of children's physical activity in different parts of the world and reported low to moderate correlations. For instance, a study for tracking physical activity trends in youth aged 10–18 years reported a correlation of 0.27 and 0.34 for boys and girls[21]. Similarly, other validation studies using accelerometers as a criterion method, reported low correlations and documented that most physical activity questionnaires have low to moderate validity[20–25]. Together, these data highlight that researchers should interpret self-reported physical activity data with caution due to the limited validity in assessment of physical activity. However,

Table 4. Associations between child level variables and total weekday accelerometer moderate to vigorous physical activity (MVPA) for primary school children (N = 249).

Characteristic	Crude Coefficient (95% CI)	p-value	Adjusted Coefficient (95% CI)	p-value	ICC
Sex					
Female	1		1		0.32
Male	12.5 (-5.2-30.1)	0.17	13.2 (-1.0-27.3)	0.07	
Age (years)	7.9 (-2.9-18.8)	0.15	5.4 (-4.0-14.8)	0.26	
School type					
Private	1		1		
Government	33.6 (18.9-48.4)	<.001	23.4 (4.0-42.8)	0.02	
School location					
Moshi urban	1		1		
Moshi rural	11.5 (-6.4-29.3)	0.21	7.7 (-8.8-24.2)	0.36	
Walking to school					
No	1		1		
Yes	33.4 (18.5-48.3)	<0.001	13.7 (-6.8-34.3)	0.19	

47 children had a total of 5 days, 4 had either 3 or 4 days) which made a total number of 249 of observations (5 days x 47, 3 days x 2, 4 days x 2).

ICC, intra class correlation coefficient; CI, confidence interval.

self-reports are cheaper and easy to administer than objective measurements, and thus they can still be used to estimate physical activity levels.

The majority of children reported less time in total MVPA than actually confirmed by the accelerometer. The most plausible explanation can be due to recall bias, children could not recall every minute they participated in physical activity. Also, accelerometer capture and count everybody movement while self-reports follow only a series of questions included in the questionnaire. Differences in activity levels between self-reports and accelerometer correspond to what is found in the literature, which reflects the difficulties for children to quantify bouts of activities performed[7,22,26]. Recently, researchers in the Active Healthy Kids Global Alliance aimed at promoting physical activity in children and youth around the world pointed out that estimating prevalence of physical activity is a worldwide concern, and thus there is a need for standardized physical assessment surveillance systems in each country[18].

Daily routine of walking to school every day, especially for children in government schools, could explain the higher MVPA captured by both self-reports and accelerometer, and it is possible that this regular activity is easily recalled by school children and well captured by accelerometer. Furthermore, there is a list of several activities which occur after school daily routine; these "after school activities" include running to catch a school bus, playing while waiting for the school bus/ private cars, some children play on their way home or participate in several unstructured activities and participate in household chores. All these activities can explain the higher MVPA observed for after school activities. Studies in Global matrix report highlighted that walking to school was a reliable indicator for assessing physical activity in children and youth[27].

In the present study, we found that 68% of the daily variation of MVPA was due to day-to-day variability within children and 32% was explained by the effect of a cluster. These variations can be explained by the differences in daily activities whereby children may not follow the same activity routine every day. Most children in government schools walk to school every day while most in private schools use private cars to school. However, there may be other activities which contribute to the variation in MVPA from day to day, e.g. some children like to be active and jump to play during school sessions, or engage in activities such as skipping, gardening during breaktime while others just stay idle or sit still most of their time. Some studies reported that variations of activities in children depends on habitual behaviours and thus children differ in activity types and levels depending on the time and opportunities to be involved in activities, and supportive environment[26,28]. The inclusion of the cluster in the analysis of the association between child characteristics and accelerometer MVPA should not be ignored as it might led to overestimation of the effect of the child characteristics on MVPA. Further, these variations might contribute to the observed correlations.

The strengths of this study include the use of an objective method "accelerometers" to validate physical activity questionnaire "self-reports". To our understanding, this was one of the few studies conducted in resource-restricted countries that aimed to validate self-reported physical activity questionnaire by applying an objective method. We achieved a high compliance of wearing accelerometers since most enrolled children wore them for 7 days as instructed. Also, this study explored the effect of the cluster in explaining the variations between children activities.

In contrast, limitations of this study need to be acknowledged. The high refusal rate (36%) from parents to allow their children to participate in the study because of fear with accelerometer contributed to a potential bias in our results as these children who did not participate may have been systematically different from those who participated. Further there are no standard protocols for processing accelerometer data which makes interpretation of physical activity data complex.

Conclusions

This study found the positive significant correlation between self-reports and accelerometers. Self-reports are prone to errors due to recall bias which might interfere their validity. Despite these flaws, assessing physical activity using devices is often not possible, especially in low- and middle-income countries due to cost. More research is recommended to develop better self-reported measures with specific types of physical activities that can easily be recalled by children.

Data availability

Underlying data

Figshare: Validation of self-reported physical activity by accelerometry among primary school children in Kilimanjaro, Tanzania: a pilot study. https://doi.org/10.6084/m9.figshare.12763946.v2[15].

This project contains the following underlying data:

- Accelerometry with all days.xlsx. (Raw accelerometry data for each participant.)
- All data_accelerometry_self reports.csv. (Self-reported data for each participant.)

Extended data

Figshare: Validation of self-reported physical activity by accelerometry among primary school children in Kilimanjaro, Tanzania: a pilot study. https://doi.org/10.6084/m9.figshare.12763946.v2[15].

This project contains the following extended data:

- Bland Altman data.csv. (Data used to generate Bland Altman plots.)
- Box plots data.csv. (Data used to generate box plots.)
- Additional file 1_Self reports questionnaire.docx. (Questionnaire used for self-reporting of activity.)
- Accelerometer time blocks.docx (Description of the different time blocks given for accelerometer data.)

Acknowledgements

We thank the school authorities, parents and children for their participation in this study. We would like to acknowledge the contribution of Glory Salla and Victor Mosha for data collection and follow-up visits. Special thanks to Fredirick L Mashili for accelerometry training and Mwita Wambura for statistical advice.

References

1. Branca F, Nikogosian H, Lobstein T: **The challenge of obesity in the WHO European Region and the strategies for response: summary**. World Health Organization; 2007.
Reference Source
2. World Health Organization: **World Health Organization Global recommendations on physical activity for health**. Geneva, Switzerland: WHO, 2010.
Reference Source
3. Janssen I, Leblanc AG: **Systematic review of the health benefits of physical activity and fitness in school-aged children and youth.** *Int J Behav Nutr Phys Act.* 2010; **7**: 40.
PubMed Abstract | **Publisher Full Text** | **Free Full Text**
4. Poitras VJ, Gray CE, Borghese MM, *et al.*: **Systematic review of the relationships between objectively measured physical activity and health indicators in school-aged children and youth.** *Appl Physiol Nutr Metab.* 2016; **41**(6 Suppl 3): S197–239.
PubMed Abstract | **Publisher Full Text**
5. Muthuri SK, Wachira LJM, Onywera VO, *et al.*: **Correlates of objectively measured overweight/obesity and physical activity in Kenyan school children: results from ISCOLE-Kenya.** *BMC Public Health.* 2014; **14**: 436.
PubMed Abstract | **Publisher Full Text** | **Free Full Text**
6. Mwaikambo SA, Leyna GH, Killewo J, *et al.*: **Why are primary school children overweight and obese? A cross sectional study undertaken in Kinondoni district, Dar-es-salaam.** *BMC Public Health.* 2015; **15**: 1269.
PubMed Abstract | **Publisher Full Text** | **Free Full Text**
7. Guthold R, Stevens GA, Riley LM, *et al.*: **Global trends in insufficient physical activity among adolescents: a pooled analysis of 298 population-based surveys with 1.6 million participants.** *Lancet Child Adolesc Health.* 2020; **4**(1): 23–35.
PubMed Abstract | **Publisher Full Text** | **Free Full Text**
8. Loprinzi PD, Cardinal BJ: **Measuring Children's Physical Activity and Sedentary Behaviors.** *J Exerc Sci Fit.* 2011; **9**(1): 15–23.
Publisher Full Text
9. Dollman J, Okely AD, Hardy L, *et al.*: **A hitchhiker's guide to assessing young people's physical activity: Deciding what method to use.** *J Sci Med Sport.* 2009; **12**(5): 518–25.
PubMed Abstract | **Publisher Full Text**
10. Hu F: **Obesity epidemiology**. Oxford University Press; 2008.
Reference Source
11. Riddoch CJ, Andersen LB, Wedderkopp N, *et al.*: **Physical activity levels and patterns of 9- and 15-yr-old European children.** *Med Sci Sports Exerc.* 2004;

36(1): 86–92.
PubMed Abstract | **Publisher Full Text**

12. Trost SG, Pate RR, Freedson PS, *et al.*: **Using objective physical activity measures with youth: how many days of monitoring are needed?** *Med Sci Sports Exerc.* 2000; **32**(2): 426–31.
PubMed Abstract | **Publisher Full Text**

13. Goran MI: **Application of the doubly labeled water technique for studying total energy expenditure in young children: a review.** *Pediatr Exerc Sci.* 1994; **6**(1): 11–30.
Publisher Full Text

14. Katzmarzyk PT, Barreira TV, Broyles ST, *et al.*: **The International Study of Childhood Obesity, Lifestyle and the Environment (ISCOLE): design and methods.** *BMC Public Health.* 2013; **13**: 900.
PubMed Abstract | **Publisher Full Text** | **Free Full Text**

15. Mosha M, Kasagama E, Ayieko P, *et al.*: **Validation of self-reported physical activity by accelerometry among primary school children in Kilimanjaro, Tanzania: a pilot study.** *figshare.* Dataset. 2020.
http://www.doi.org/10.6084/m9.figshare.12763946.v2

16. Freedson PS, Melanson E, Sirard J: **Calibration of the Computer Science and Applications, Inc. accelerometer.** *Med Sci Sports Exerc.* 1998; **30**(5): 777–81.
PubMed Abstract | **Publisher Full Text**

17. Freedson P, Pober D, Janz KF: **Calibration of accelerometer output for children.** *Med Sci Sports Exerc.* 2005; **37**(11 Suppl): S523–30.
PubMed Abstract | **Publisher Full Text**

18. Evenson KR, Catellier DJ, Gill K, *et al.*: **Calibration of two objective measures of physical activity for children.** *J Sports Sci.* 2008; **26**(14): 1557–65.
PubMed Abstract | **Publisher Full Text**

19. Ayala-Guzman CI, Ramos-Ibanez N, Ortiz-Hernandez L: **[Accelerometry does not match with self-reported physical activity and sedentary behaviors in Mexican children].** *Bol Med Hosp Infant Mex.* 2017; **74**(4): 272–81.
PubMed Abstract | **Publisher Full Text**

20. Muthuri SK, Wachira LJM, Onywera VO, *et al.*: **Direct and self-reported measures of physical activity and sedentary behaviours by weight status in school-aged children: results from ISCOLE-Kenya.** *Ann Hum Biol.* 2015; **42**(3): 237–45.
PubMed Abstract | **Publisher Full Text**

21. Hardie Murphy M, Rowe DA, Belton S, *et al.*: **Validity of a two-item physical activity questionnaire for assessing attainment of physical activity guidelines in youth.** *BMC Public Health.* 2015; **15**(1): 1080.
PubMed Abstract | **Publisher Full Text** | **Free Full Text**

22. Helmerhorst HJF, Brage S, Warren J, *et al.*: **A systematic review of reliability and objective criterion-related validity of physical activity questionnaires.** *Int J Behav Nutr Phys Act.* 2012; **9**(1): 103.
PubMed Abstract | **Publisher Full Text** | **Free Full Text**

23. Bingham DD, Collings PJ, Clemes SA, *et al.*: **Reliability and Validity of the Early Years Physical Activity Questionnaire (EY-PAQ).** *Sports (Basel).* 2016; **4**(2): 30.
PubMed Abstract | **Publisher Full Text** | **Free Full Text**

24. Benitez-Porres J, Lopez-Fernandez I, Raya JF, *et al.*: **Reliability and Validity of the PAQ-C Questionnaire to Assess Physical Activity in Children.** *J Sch Health.* 2016; **86**(9): 677–85.
PubMed Abstract | **Publisher Full Text**

25. Sarker H, Anderson LN, Borkhoff CM, *et al.*: **Validation of parent-reported physical activity and sedentary time by accelerometry in young children.** *BMC Res Notes.* 2015; **8**: 735.
PubMed Abstract | **Publisher Full Text** | **Free Full Text**

26. Nilsson A, Anderssen SA, Andersen LB, *et al.*: **Between- and within-day variability in physical activity and inactivity in 9- and 15-year-old European children.** *Scand J Med Sci Sports.* 2009; **19**(1): 10–8.
PubMed Abstract | **Publisher Full Text**

27. Aubert S, Barnes JD, Abdeta C, *et al.*: **Global Matrix 3.0 Physical Activity Report Card Grades for Children and Youth: Results and Analysis From 49 Countries.** *J Phys Act Health.* 2018; **15**(S2): S251–S73.
PubMed Abstract | **Publisher Full Text**

28. Wilkin TJ, Mallam KM, Metcalf B, *et al.*: **Variation in physical activity lies with the child, not his environment: evidence for an 'activitystat'in young children (EarlyBird 16).** *Int J Obes (Lond).* 2006; **30**(7): 1050–5.
PubMed Abstract | **Publisher Full Text**

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Reviewer Report 26 November 2020

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Edvard H. Sagelv

School of Sport Sciences, Faculty of Health Sciences, UiT the Arctic University of Norway, Tromsø, Norway

General comment:
Thank you for the opportunity to review this paper. This paper assessed the criterion validity of self-report in children in Tanzania. The study is well conducted and the results support the conclusion. The language and structure of the manuscript is good, and the reading flows nicely. Overall, this manuscript holds high quality in all parts.

My major concern is Figure 3. I do not understand it, or the time blocks to assess for the bias. Could you please elaborate and/or at least make it easier to understand?

Below follow minor concerns. My biggest comment here is the long conclusion, that in my view could benefit from being shorter.

Abstract:

- Results: “Accelerometer had higher MVPA compared to self-reports.” Please report some statistical output here. A t-test results f.ex.

- “Conclusions: This study found the moderate positive correlation between self-reports and accelerometers.” – please replace “the moderate..” with “a moderate..”.

Intro:

- Statement: “Accelerometers provide valid estimates of activity levels by capturing movement in real time and having low technical error of measurement” – You need a reference for this. However, whether the estimates from accelerometry is valid can be debated. I suggest to state: *“more valid than self-report when evaluated against doubly labelled water estimated energy expenditure”* or something similar.

- Statement: “The validity of self-reports for assessing physical activity in primary school

children have not been fully explored in our setting. It is unclear if children from Tanzania can accurately report their physical activity, or estimate minutes spent in physical activity." – just omit the last sentence here and replace "our setting" with "Tanzania" in the first sentence.

Methods:

- Shapiro-wilk: so how did your normality distribution turn out? I assume acc MVPA are positively skewed due to the acc intensity cut-offs? Please report the results from your normality tests. F.ex. you use spearman as I assume MPVA is not normally distributed?#

- You mention moderate correlation in results, but I do not see any reference to strength of correlation cut-offs under statistical analysis?

- Sub-group analysis: in my view, this is far from your aim and adds little to any validity study? You may consider to place all these things in supplementary? Or further.

- Bias/time blocks/Figure 3: the box and whisker plots. I do not follow this figure, nor do I follow your chosen blocks. Those in purple reported in the PAQ to perform MVPA in that specific time period (morning, tea, lunch, after school), while those in pink reported not to? If so, you lined the median and quartiles, and you have no outliers? So, what is that used for? This figure shows accelerometry detected MVPA in those reporting no MVPA to, so I do not follow. Could you please make this easier for a reader to follow? So, on nr 4: after school, the no PA reporters are all over the acc measured MVPA?

Results:

- In page 5 you have a statement in results: *"The highest level of activity is seen after school hours and this is consistently captured by both self-reports and accelerometer."* How can I see that from figure 3? The quartiles are all over each other?

- In page 6, you have a statement in results: *"Separately, the accelerometer measured total MVPA during the first block of the day (walking to school) was consistently higher for children who report walking to school compared to those who do not report walking to school or use other means of transport such as private cars or school buses (Figure 3)."* Do you have any statistical analysis to back this up? But more importantly, what does this say? That those who produces much acc measured MVPA before school hours also reports higher MVPA in walking to school? Good, but that does not add anything to the validity of the PAQ, the validity of the PAQ is nicely presented in figure 2: correlations and B and A plot.

- Table 2: ok, good. Here comes the states about MVPA before school etc. then, I do not see what figure 3 and the box and whisker add, and the whole variability/bias in methods add.

Discussion

- Para 2: typo: "a moderate correlation observed", should be "a moderate correlation <u>was</u> observed."

- Para 3: typo: "a few studies", should be "few studies". This first sentence in this para needs rephrasing: my suggestion: *"Our findings are consistent with other studies validating self-reported physical activity instruments in children"* – you cite quite many studies further into

the para, so few studies is perhaps an overstatement?

- Para 3: *"Similarly, other validation studies using accelerometers as a reference method, reported low correlations and documented that most physical activity questionnaires have low to moderate validity19,21–27"* replace "acc as reference" to "acc as the criterion", as you and these studies report on the acc as the criterion method. Further, what is low to moderate validity?

- Para 3: "…and speak to the need for using both methods i.e objective measures and self-reports where possible."" Sure, but more importantly, as you mention in the intro, perhaps not all can afford ACCs, so in my view, the most important take home is: "…this highlight that researchers should interpret self-reported PA data with caution due to the imprecise assessment of PA." but still, they are not way off, indicating that it is better than no assessment.

- Para 4: first sentence, typo: "…confirmed by acc". Should be "… confirmed by the acc".

- Para 4: alternatively, the most plausible explanation is that recall bias influences this. How can a 10-year old precicely remember all MVPA minutes? I am not 10 years old, but still, I cannot recall every MVPA minute I did.

- Para 4: here are recall. I simply suggest to restructure this para. Make recall come first.

- Para 5: I refer the authors to my statement in methods: this is outside the aims, consider supplementary or omit.

- Para 6: there is no gold standard for assessing PA (Hills AP, Mokhtar N, Byrne NM.. *Front Nutr*

- 2014;1:5; Westerterp KR. *Eur J Appl Physiol* 2009;105:823–8). This is no strength of the study. Please omit. The high compliance is a strength.

- Limitations: the refuse rate is a limitation. The nature of self-report PA, i.e. recall bias, is not a limitation OF this study. This study aimed to assess the validity of self-reported PA.

- A limitation can be the no standard of acc protocol for processing the data?

Conclusion:

- Quite long. I suggest to cut it after: *"This study found the moderate positive correlation between self-reports and accelerometers. Self-reports are prone to errors due to recall bias which might interfere their validity. Despite these flaws, assessing physical activity using devices is often not possible, especially in low- and middle-income countries due to cost."* The other things you mention: "Secondly…", that is suitable for the discussion.

Is the work clearly and accurately presented and does it cite the current literature?
Partly

Is the study design appropriate and is the work technically sound?

Yes

Are sufficient details of methods and analysis provided to allow replication by others?
Partly

If applicable, is the statistical analysis and its interpretation appropriate?
Partly

Are all the source data underlying the results available to ensure full reproducibility?
Yes

Are the conclusions drawn adequately supported by the results?
Yes

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Physical activity measurements, epidemiology, exercise physiology

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard, however I have significant reservations, as outlined above.

Author Response 05 Jan 2021

Mary Mosha, Kilimanjaro Christian Medical University College, Moshi/ KIlimanjaro, Tanzania

General comment:
Thank you for the opportunity to review this paper. This paper assessed the criterion validity of self-report in children in Tanzania. The study is well conducted and the results support the conclusion. The language and structure of the manuscript is good, and the reading flows nicely. Overall, this manuscript holds high quality in all parts.

My major concern is Figure 3. I do not understand it, or the time blocks to assess for the bias. Could you please elaborate and/or at least make it easier to understand?

Response:
Thanks for this concern, figure 3 is now elaborated to make it easier to understand

Below follow minor concerns. My biggest comment here is the long conclusion, that in my view could benefit from being shorter.

Abstract:

- *Results: "Accelerometer had higher MVPA compared to self-reports." Please report some statistical output here. A t-test results f.ex.*

Response
We have added the mean MVPA differences and standard deviation.

- *"Conclusions: This study found the moderate positive correlation between self-reports and*

accelerometers." – please replace "the moderate.." with "a moderate..".

Response:
We have corrected the sentence as suggested, "the moderate" is replaced with "a positive significant".

Intro:

- *Statement: "Accelerometers provide valid estimates of activity levels by capturing movement in real time and having low technical error of measurement" – You need a reference for this. However, whether the estimates from accelerometry is valid can be debated. I suggest to state: "more valid than self-report when evaluated against doubly labelled water estimated energy expenditure" or something similar.*

Response:
We have worked on the sentence, and it now reads as "Accelerometers are more valid than self-reports in estimating physical activity, however some studies suggest doubly labeled water method as a gold standard to measure energy expenditure related physical activity"

- *Statement: "The validity of self-reports for assessing physical activity in primary school children have not been fully explored in our setting. It is unclear if children from Tanzania can accurately report their physical activity, or estimate minutes spent in physical activity." – just omit the last sentence here and replace "our setting" with "Tanzania" in the first sentence.*

Response:
We have added the word Tanzania, and the last sentence is omitted it now reads "It is unclear if children from Tanzania can accurately report their physical activity, or estimate minutes spent in physical activity. Please see line 79.

Methods:

- *Shapiro-wilk: so how did your normality distribution turn out? I assume acc MVPA are positively skewed due to the acc intensity cut-offs? Please report the results from your normality tests. F.ex. you use spearman as I assume MPVA is not normally distributed?#*

Response:
We have presented the results from Shapiro Wilk test.

- *You mention moderate correlation in results, but I do not see any reference to strength of correlation cut-offs under statistical analysis?*

Response:
We would like to acknowledge your observation on the strength of correlation. The decision of the cutoffs was informed by the previous studies as indicated under discussion section references 19 - 25.

- *Sub-group analysis: in my view, this is far from your aim and adds little to any validity study? You may consider to place all these things in supplementary? Or further.*

Response:
Thank you for the important concern, we thought it is important to understand the effect of the cluster on MVPA. We therefore performed the subgroup analysis to explore the associations (sex, age, school type and school location), considering clustering effect (child) in order to understand the effect of cluster on MVPA, which could explain the amount of variability in child MVPA

Bias/time blocks/Figure 3: the box and whisker plots. I do not follow this figure, nor do I follow your chosen blocks. Those in purple reported in the PAQ to perform MVPA in that specific time period (morning, tea, lunch, after school), while those in pink reported not to? If so, you lined the median and quartiles, and you have no outliers? So, what is that used for? This figure shows accelerometry detected MVPA in those reporting no MVPA to, so I do not follow. Could you please make this easier for a reader to follow? So, on nr 4: after school, the no PA reporters are all over the acc measured MVPA?

Response:
This has been elaborated, and included the outliers as suggested.

Results:

- *In page 5 you have a statement in results: "The highest level of activity is seen after school hours and this is consistently captured by both self-reports and accelerometer." How can I see that from figure 3? The quartiles are all over each other?*

Response:
From figure 3, vertical axis represents the total MVPA captured by accelometer while horizontal presents the blocks of activities. The bars and whisker present the responses from self-reported activities. Thus, from that we can link with the output from accelerometer on the vertical axis. More importantly, the whiskers present the variations of MVPA captured from different blocks of activities between children who participate and not participate in activities

- *In page 6, you have a statement in results: "Separately, the accelerometer measured total MVPA during the first block of the day (walking to school) was consistently higher for children who report walking to school compared to those who do not report walking to school or use other means of transport such as private cars or school buses (Figure 3)." Do you have any statistical analysis to back this up? But more importantly, what does this say? That those who produces much acc measured MVPA before school hours also reports higher MVPA in walking to school? Good, but that does not add anything to the validity of the PAQ, the validity of the PAQ is nicely presented in figure 2: correlations and B and A plot.*

Responses:
Thanks for the comment, we do not have any statistical test for this, rather the median and quartiles. This figure tries to confirm or compare if at all those children who reported yes/no, they participate in physical activity is well captured by accelerometer.

Table 2: ok, good. Here comes the states about MVPA before school etc. then, I do not see what figure 3 and the box and whisker add, and the whole variability/bias in methods add.

Response:
Thanks for the suggestion, we included the box and whisker plots to understand if accelerometer time blocks output (MVPA) and self-reports responses are matching. Eg. We were expecting to see the higher MVPA from children who said yes, they walk to school than those who don't.

Discussion

- *Para 2: typo: "a moderate correlation observed", should be "a moderate correlation <u>was</u> observed."*

<u>Response:</u>
We have corrected the paragraph and the word "was" added.

- *Para 3: typo: "a few studies", should be "few studies". This first sentence in this para needs rephrasing: my suggestion: "Our findings are consistent with other studies validating self-reported physical activity instruments in children" – you cite quite many studies further into the para, so few studies is perhaps an overstatement?*

<u>Response:</u>
We have corrected the typo. We cited several studies to show the range of correlations from different studies of the same nature, and how were they reported.

- *Para 3: "Similarly, other validation studies using accelerometers as a reference method, reported low correlations and documented that most physical activity questionnaires have low to moderate validity19,21–27" replace "acc as reference" to "acc as the criterion", as you and these studies report on the acc as the criterion method. Further, what is low to moderate validity?*

<u>Response:</u>
We have included the word criterion as suggested. Low to moderate validity depends on the nature of the study, that is there is no specific cut off points. For most studies of these nature validity was described as the strength of the correlations and ranked as small (>0.1), moderate (>0.3) and strong (>0.5)

- *Para 3: "…and speak to the need for using both methods i.e objective measures and self-reports where possible."" Sure, but more importantly, as you mention in the intro, perhaps not all can afford ACCs, so in my view, the most important take home is: "…this highlight that researchers should interpret self-reported PA data with caution due to the imprecise assessment of PA." but still, they are not way off, indicating that it is better than no assessment.*

<u>Response:</u>
Thanks for this comment, we have added some more details as suggested and it now reads "these data highlight that researchers should interpret self-reported physical activity data with caution due to the limited validity in assessment of PA. However, self-reports are cheaper and easy to administer than objective measurements, and thus they can still be used to estimate physical activity levels".

- *Para 4: first sentence, typo: "…confirmed by acc". Should be "… confirmed by the acc".*

<u>Response:</u>
We have corrected they typo as suggested, please see line 335.

- *Para 4: alternatively, the most plausible explanation is that recall bias influences this. How can a 10-year old precicely remember all MVPA minutes? I am not 10 years old, but still, I cannot recall every MVPA minute I did.*

- *Para 4: here are recall. I simply suggest to restructure this para. Make recall come first.*

<u>Response:</u>

We have restructured paragraph 4 as suggested.

- *Para 5: I refer the authors to my statement in methods: this is outside the aims, consider supplementary or omit.*

Response:
Thanks for this concern, we have modified the title to include this information as it was important to understand the relevance of reporting physical activity from children as compared with accelerometry.

- *Para 6: there is no gold standard for assessing PA (Hills AP, Mokhtar N, Byrne NM.. Front Nutr*

- *2014;1:5; Westerterp KR. Eur J Appl Physiol 2009;105:823–8). This is no strength of the study. Please omit. The high compliance is a strength.*

Response:
We have reviewed this paper and changed the first part of the paragraph as suggested.

- *Limitations: the refuse rate is a limitation. The nature of self-report PA, i.e. recall bias, is not a limitation OF this study. This study aimed to assess the validity of self-reported PA.*

- *A limitation can be the no standard of acc protocol for processing the data?*

Response:
We have included more details on this section.

Conclusion:

- Quite long. I suggest to cut it after: *"This study found the moderate positive correlation between self-reports and accelerometers. Self-reports are prone to errors due to recall bias which might interfere their validity. Despite these flaws, assessing physical activity using devices is often not possible, especially in low- and middle-income countries due to cost."*
  The other things you mention: "Secondly…", that is suitable for the discussion.

Response:
We have reduced the conclusion as suggested.

Competing Interests: No competing interests were disclosed.

Reviewer Report 29 September 2020

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The findings of the presented manuscript add value to the existing knowledge in this field of research. However, there are some minor and major aspects that need to be addressed by the authors before approval.

Title:

- The authors present quite a lot of data that is more of a description of PA level and pattern in the examined group in addition to the validation data, and may want to change the title to include that, or exclude some of the presented results.

Abstract:

- Please omit “using a simple random sampling technique” as this implies that is was not a convenience sample.

- Change to “A moderate, positive correlation was found between self-reports and accelerometer for weekday MVPA.. “ and “Accelerometer data showed more time in MVPA..”

- Maybe leave out since this is not really a validation result, but rather a description of PA level: “Children who reported walking to school had higher MVPA for both accelerometer and self-reports compared to children who use other means of transport to school, e.g. school buses ($p < 0.001$).”

Introduction:

- Please add: “In Tanzania, 82.1% of school-going children are not meeting the recommended physical activity levels according to self-reports.”

- The sentence: “Objective measures have been widely used in high-income… can be replaced by this sentence further down “Over the years, accelerometers have been used increasingly in high-income countries for assessment of physical activity in children[11,12]. Methods include…”

- Please change "self-reports" in the aim to a modified questionnaire.

Methods:

- I suggest the following changes:
"The World Health Organization (WHO) recommends an average of at least 60 minutes per day of moderate to vigorous physical activity (MVPA) for 5–17-year-olds…" and “Our main study variable was minutes per day spent in MVPA which was obtained from self-reports and accelerometry.” I guess it is not minutes per week?

- Please include the final set of questions that you used, in this section. The reader should be able to understand how the study was performed without having to go an appendix to get information.

- Did you ask the children to note any removals of the accelerometer during the day? How did you treat non-wear time during the day? Did you have a minimum hours of wear time for a valid day?

- Figure 1 is now hard to read. Please only show the vertical axis as this is the cutpoints refer to, and clarify the blocks and numbers. In the figure legend, specify if it shows weekday data.

Results:

- Please clarify if your main outcome is mean or median minutes in MVPA per day or total MVPA per week? I do not understand how daily MVPA minutes from the accelerometers can be median 98 as stated in table 1 and in the results on p 5, when mean weekday MVPA minutes are 408 in table 2? It also seems highly unlikely that only 74 minutes per day (median) are spent sedentary during a 15 hour day. Are these data in table 1 correct?

- Figure 2: A) should the value for r be 0.36? B) It is unclear if the outer dotted lines are ± 1.96 SD? It is not necessary to report CI for the mean difference (inner dotted lines), it only makes the graph hard to read.

- Figure 3: It is unclear how the pink and purple boxplots represent children participating in physical activity or not. What was this classification based on? This is not explained in the figure legend.

- The ICC calculations and the results presented in table 3 and 4 are only relevant if they are used for validation of the questions. For example, is the self-report questions more valid for boys or girls or children in one type of school. Please revise.

- In the discussion you state that “Walking to school and afterschool activity blocks from self-reports corresponds with accelerometer measured activities from these blocks.” Please present clearly these results and how this was analyzed.

- Please comment on why you did not use weekend data in the validation or data on sedentary time. I think this would strengthen the results.

Is the work clearly and accurately presented and does it cite the current literature?
Partly

Is the study design appropriate and is the work technically sound?
Yes

Are sufficient details of methods and analysis provided to allow replication by others?
Partly

If applicable, is the statistical analysis and its interpretation appropriate?
Partly

Are all the source data underlying the results available to ensure full reproducibility?
Yes

Are the conclusions drawn adequately supported by the results?

Partly

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: My areas of expertise are physical activity and sedentary behavior and associations with health, and objective assessment methods for physical activity and sedentary behavior, such as accelerometry.

I confirm that I have read this submission and believe that I have an appropriate level of expertise to state that I do not consider it to be of an acceptable scientific standard, for reasons outlined above.

Author Response 05 Jan 2021

Mary Mosha, Kilimanjaro Christian Medical University College, Moshi/ KIlimanjaro, Tanzania

The findings of the presented manuscript add value to the existing knowledge in this field of research. However, there are some minor and major aspects that need to be addressed by the authors before approval.

Title:

- *The authors present quite a lot of data that is more of a description of PA level and pattern in the examined group in addition to the validation data and may want to change the title to include that or exclude some of the presented results.*

Response:
We have altered the title to reflect reviewers' comments. Please see line 1

Abstract:

- *Please omit "using a simple random sampling technique" as this implies that is was not a convenience sample.*

Response:
We have revised this section and clarify, it is now written as "Four primary schools conveniently selected in Moshi municipal and Moshi rural districts, Kilimanjaro, Tanzania. A total of 51 primary school children aged 9 – 11 years were randomly selected from the 4 schools". Please see lines 22 - 24

- *Change to "A moderate, positive correlation was found between self-reports and accelerometer for weekday MVPA.. " and "Accelerometer data showed more time in MVPA.."*

Response:
We have changed the sentence as suggested, please see line 33

- *Maybe leave out since this is not really a validation result, but rather a description of PA level: "Children who reported walking to school had higher MVPA for both accelerometer and self-reports compared to children who use other means of transport to school, e.g. school buses ($p < 0.001$)."*

Response:

We have removed that section from the abstract as suggested.

Introduction:

- *Please add: "In Tanzania, 82.1% of school-going children are not meeting the recommended physical activity levels according to self-reports."*

Response:
We have added the sentence as suggested, please see line 55

- *The sentence: "Objective measures have been widely used in high-income… can be replaced by this sentence further down "Over the years, accelerometers have been used increasingly in high-income countries for assessment of physical activity in children[11,12]. Methods include…"*

Response:
We have replaced the sentences as suggested, see lines 66 - 76

- *Please change "self-reports" in the aim to a modified questionnaire.*

Response:
We have changed this sentence, please see line 80

Methods:

- *I suggest the following changes:*
  "The World Health Organization (WHO) recommends an average of at least 60 minutes per day of moderate to vigorous physical activity (MVPA) for 5–17-year-olds…" and "Our main study variable was minutes per day spent in MVPA which was obtained from self-reports and accelerometry." I guess it is not minutes per week?

Response:
We have made changes so that it is now clear, please see lines 98 – 99.

- *Please include the final set of questions that you used, in this section. The reader should be able to understand how the study was performed without having to go an appendix to get information.*

Response:
We have now included the final set of questions used as suggested, please see lines 129 - 139

- *Did you ask the children to note any removals of the accelerometer during the day? How did you treat non-wear time during the day? Did you have a minimum hours of wear time for a valid day?*

Response:
Thank you for this question. Children were told to note the time when they remove the accelerometers, but it didn't work out. However, with the Actigraph software you can determine the non-wear time, and we defined non wear time during analysis. This section is now elaborated, please see lines 193 - 196

- *Figure 1 is now hard to read. Please only show the vertical axis as this is the cutpoints refer to, and clarify the blocks and numbers. In the figure legend, specify if it shows weekday data.*

Response:
We have modified the figure to improve clarity, the figure legend has been improved as suggested. The figure shows one weekday / school day accelerometer output from a single child. More details of blocks descriptions is found in the supplementary file, please see lines 199 - 204

Results:

- *Please clarify if your main outcome is mean or median minutes in MVPA per day or total MVPA per week? I do not understand how daily MVPA minutes from the accelerometers can be median 98 as stated in table 1 and in the results on p 5, when mean weekday MVPA minutes are 408 in table 2? It also seems highly unlikely that only 74 minutes per day (median) are spent sedentary during a 15 hour day. Are these data in table 1 correct?*

Response:
The MVPA data from table 1 is the average MVPA per day, while for table 2, is the mean MVPA per week. The sedentary time from accelerometer is correct but is now clarified as a daily sedentary bouts of 10 minutes each, please see table 1

- *Figure 2: A) should the value for r be 0.36? B) It is unclear if the outer dotted lines are ± 1.96 SD? It is not necessary to report CI for the mean difference (inner dotted lines), it only makes the graph hard to read.*

Response:
We have corrected the figure, and CI removed from the figure, please see figure 2

- *Figure 3: It is unclear how the pink and purple boxplots represent children participating in physical activity or not. What was this classification based on? This is not explained in the figure legend.*

Response:
We have improved the figure legend, and elaborate more on the document that this figure compares the total MVPA from accelerometer output with children who either said yes they participate in physical activity or no they don't . Please see lines 219 – 222, and figure 3

- *The ICC calculations and the results presented in table 3 and 4 are only relevant if they are used for validation of the questions. For example, is the self-report questions more valid for boys or girls or children in one type of school. Please revise.*

Response:

We performed the analysis to explore the associations between weekdays accelerometer MVPA and different child level variables, since child was having repeated measurements from accelerometer i.e. Monday to Friday we regarded child as a cluster. This helped to understand the effect of a child as cluster on accelerometer MVPA. i.e understanding how much of the variations in MVPA is contributed by child.

- *In the discussion you state that "Walking to school and afterschool activity blocks from self-reports corresponds with accelerometer measured activities from these blocks." Please present clearly these results and how this was analyzed.*

Response:
Box and whisker plots were plotted to present these findings. The horizontal axis informs us about the total MVPA captured by accelerometry from the children who said they

participate in certain activities versus those who they don't participate (from self-reports). Therefore for walking to school and afterschool activity blocks, we see high levels of total MVPA which indicates that participation in these activities was well captured by accelerometer.

Please comment on why you did not use weekend data in the validation or data on sedentary time. I think this would strengthen the results.

Response:
Thanks for sharing this concern, we targeted school days as we expected that during school days children are participating in a set of activities which can easily be remembered than weekends in which there are several unstructured activities in which we could not capture by a questionnaire. However, some of the weekend data are presented in table 3. This is elaborated in lines 210 - 213

Competing Interests: No competing interests were disclosed.