Author's response to reviews

Title: Objectively determined physical activity levels of primary school children in south-west Germany

Authors:

Sarah Kettner (sarah.kettner@uni-ulm.de)
Susanne Kobel (susanne.kobel@uni-ulm.de)
Nanette Fischbach (nanette.fischbach@uni-ulm.de)
Clemens Drenowatz (clemens.drenowatz@uni-ulm.de)
Jens Dreyhaupt (jens.dreyhaupt@uni-ulm.de)
Tamara Wirt (tamara.wirt@uni-ulm.de)
Benjamin Koch (benjamin.koch@uni-ulm.de)
Jürgen M Steinacker (juergen.steinacker@uni-ulm.de)

Version: 2 Date: 30 June 2013

Author's response to reviews: see over
Dear editorial board,

Please find enclosed the revised manuscript “Objectively determined physical activity levels of primary school children in south-west Germany”, which we would like considered for publication in *BMC Public Health*.

The authors would like to thank the reviewers for their time and constructive comments to improve the manuscript and we greatly appreciate the opportunity to revise the manuscript accordingly. Following is a point-by-point response (*in italics*) to the comments made by the editorial office and the reviewers. Changes in the manuscript are highlighted in red.

Reviewer #1:
Ursina Meyer
Reviewer's report:
General Comments:

The manuscript describes the level of children’s objectively measured physical activity, including differences between the physical activity levels during the weekdays, between boys and girls, and between overweight/obese children and their normal weight counterparts. Due to the current importance of paediatric obesity and physical (in)activity, the article might be of interest for *BMC Public Health*. However, studies reporting children’s physical activity levels are excessively published and therefore it is important that the article clearly highlights what this study adds to the existing scientific knowledge. Thus, the introduction is very clearly and well written but could be better in revealing the void in literature. In the methods sections, a more precise description of the study sample and the used measurements would be helpful. The results section is clearly formulated and illustrated by several tables and figures. Some statements in the discussion should be documented more deeply.

**Major compulsory revisions:**
- Introduction: Page 4, Line 45+: Please highlight more precisely why your study is important and what will be the additive value of your study to the existing scientific knowledge.
  *While there is some epidemiological data on PA levels in Germany available based on questionnaires only limited information is available on objectively determined levels of PA, which is the focus of the present study. This aspect has now been reemphasized prior to the purpose statement.*

- Methods: Study population: Please provide more information on how the study sample was chosen. It is well described that the current measurements were performed in a subsample of a larger program. However, there is some missing information: were the classes/schools of the main sample, but also of subsample randomly selected? How was decided which of the consented children are measured? If I understood correctly, not all of the consented children were measured. Please provide also information about the representativeness of your
study sample. Were there any differences in characteristics between participating and non-participating children, or between children of the subsample and children of the main study?

The Baden-Württemberg study is a prospective, stratified, cluster-randomized, and longitudinal study (Dreyhaupt et al., 2012). For logistic reasons (distances between schools and scope of measurements of the Baden-Württemberg study) objective PA assessments were only carried out in a subsample in the region of Ulm.

In order to be eligible to participate at least 5 children of each school needed to provide consent. For more information which of the children were measured in the study figure 1 has been revised with more details about the activity measurement procedure.

There were no differences in descriptive characteristics (e.g. age, height, weight, BMI, PCT, migration background, parent education and sports participation) between the subsample and the total study population. Children from the 32 schools and 56 classes in the region of Ulm providing consent for the objective measurement did not differ from those refusing to participate in the objective measurement either. This information has been added in the revised manuscript.

- Methods: Physical activity measurement: It would be helpful if you provide more information on how the time in certain physical activity intensities was assessed. Did the Actiheart software calculate these values? If yes, does the algorithm of the software use the equations of the validation studies you mentioned, or is it a different algorithm validated for children?

Energy expenditure has been estimated via the captive Actiheart software (version 4.0.73) (Corder et al., 2005) according to branched model equations for children using a combination of data collection with heart rate and acceleration simultaneously and converted to MET-values.

- Methods: Physical activity measurement: What does “Data was extrapolated for a full day” mean? Does this mean that you (linearly?) extrapolated the data to 24h if a child had less than 24h of activity data? How did you then account for sleeping time (i.e. if a child has worn the accelerometer only during waking hours where sedentary behaviour is much less than during the night)?

The captive Actiheart software extrapolates available data for each day to calculate time spent at different intensities for each day (MET-values). On average the Actiheart was worn 1348±172 min/day which included sleep. Wearing time was defined as available heart rate data controlling with a developed protocol.

  - Interpolation if only one HR-value is missing
  - HF <= 30 bpm: Value is not available
  - HR > HR\(_{max}\) (individual HR\(_{max}\) was determined before analyses): Value is not available
  - Consecutively at least 3 HR-values were required to be defines as valid values
  - Change in HR > 56 bpm (Finley & Nugent, 1995)

At least two weekdays and one weekend day were required with at least 10 h of data collection each, first and last recording days were excluded from analyses.

- Methods: Physical activity measurement: You mentioned that to be included into the analysis, at least 3 days (1 weekend day and 2 week days) were required. How did you handle the data if a child had less than 6 days of measurement? When extrapolating the available days, did you account for the 5:2 ratio for weekend and week days?

To extrapolate the available days the 5:2 ratio for weekdays and weekend days was used. In general, first and last recording days were excluded from analysis. The criteria of at least two weekdays and one weekend day have to be achieved, for example children took the Actiheart off at one weekend day, but fulfilled the criteria of data collection, data have to be included in the analyses. In general, first day and last day of recording days were excluded from analyses, because the children have to get familiar with the accelerometer (first day) and there were a lot of lost data (last day) because of the early collection on that day. Trost et al. (2000) indicate that 4 and 5 days of recording physical activity would be necessary to gain a reliability of 0.80 in children.

- Results: As mentioned above, it would be helpful if you could provide information on the representativeness of your sample.
Due to the nature of the study, we are not able to claim representativeness of the sample as only children whose teachers were willing to participate in the intervention were approached. Characteristics of the large sample size of the total study population, however, are similar to the German population. The subsample also did not differ from the total study population.

Data of representative German studies were added to show the representativeness of the study sample (discussion): “A national sample (KiGGS study) showed only a marginally higher prevalence of 15% overweight and obese children aged 7-10 years (Kurth et al., 2010). A comparable overweight prevalence of about 13% was found in German children in the state of Baden-Württemberg at school entry [Moss et al., 2007].” The KiGGS study showed a prevalence of 25.4% of children with migration background. Similar results were assessed in the present study, where the proportion of children with a migration background was 27.1% (Schenk et al., 2007). Regarding socio-economic status or rather parental education 72.9% of the children in the KiGGS study were assigned at lower and middle level vs. 65.2% in the present sample and 27.1% vs. 34.8% were assigned of the high status group, respectively (Lange et al., 2007). Therefore, it can be assumed that the present sample is representative of south-west Germany comparing to the German representative data of the KiGGS study.

- Results: You report an average of 135±61 min/day MVPA, which, according to the guidelines, is more than double the amount of time children should spend in MVPA per day. How is it possible that only 48% of the children met the 60 min of MVPA? How did you define if a child met the guidelines or not; was it based on the average amount of time spent in MVPA per week, or had every single day to be above 60 min MVPA? 60 min/day of MVPA for each valid day needed to be present in order to be considered as meeting PA guidelines. This has now been clarified in the manuscript.

- Results: Figure 1: please also add the information why children dropped off, and how you selected the participating children.

The figure 1 has been revised accordingly.

- Discussion: Regarding your finding that overweight children were more active than their normal weight counterparts; do your data support your hypothesis that the physical activity levels of overweight children could be higher due to a higher heart rates? For instance, did you test whether there were differences when looking at the accelerometer data only (without heart rate), or when looking at the total amount of physical activity counts rather than minutes spent in a certain intensity? Please set your results more in context of the existing literature. HR was also analysed with ANCOVA adjusted for sex and age separately as well, where no differences in PA intensities between overweight/obese and normal weight children were found (data not shown in the manuscript). No differences only looking at accelerometer data (mean value over recording time) were found as well.

- Discussion: Page 9, Line 170+: Is it surprising that children are less active during weekend days? There are several studies that have reported a similar picture. Please set your results in context of the existing literature. Several studies of current literature were added in the manuscript suggesting that children are more active during weekdays versus weekend days.

Minor essential revisions
==============================================
- Abstract, first sentence: the current recommendations are 60 min of moderate-and-vigorous physical activity per day. Please add the intensity of PA. 

Intensity of PA (moderate to vigorous) has been added accordingly.

- Figures 2+3: Please indicate that the bars are means ± SD. Discretionary revisions

Figure 2+3 have been revised by indication that the bars are means ± SD in the legend

==============================================
- Keywords: Please change keywords since keywords should not appear in the title.

Keywords has been revised
Abstract: Purpose: think of adding the other aims (differences between boys and girls; differences between overweight/obese and normal weight children) to the study purpose.

The study aims have been adjusted and added according to the aims of the introduction.

Introduction: Page 4; Line 34/35: The definition of MVPA might sometimes be confusing as certain researchers use “moderate-to-vigorous”, others use “moderate-and-vigorous”, or “moderate-vigorous” physical activity. In order to clarify, I would suggest that you change the sentence into “60 minutes per day in at least moderate physical activity (moderate to vigorous physical activity (MVPA))”.

The sentence has been adjusted accordingly.

Methods: Statistical analysis: Please be clearer: Did you adjust the ANCOVA for BMI or for a binary variable (overweight/obese vs. normal weight)? Was grade (first grade vs. second grade) also included into the model? Differences in body weight status (overweight/obese children vs. normal weight children) were explored adjusting for sex and age. To explore differences between girls and boys, age and BMIPCT have been used as covariates and differences between first and second graders were analysed adjusting for sex and BMIPCT. This has been clarified in the manuscript.

Results: Please also report the compliance of the physical activity measurements. How many days was the accelerometer in average worn, and for how many hours? If there is a high variability between children, it might be necessary to adjust the model for the wearing time. Were there differences in the wearing time between boys and girls, first and fifth graders, or overweight/obese and normal weight children?

Wear time information is now included in the manuscript. There were no differences between boys and girls, first and second grade children or overweight/obese and normal weight children. Average recording time has been added in the manuscript.

Discussion: Page 8, line 158: You mention that sports club participation may be higher in second grade children. Are there any (German) data of the rate of first and second grade children participating in a sport club, maybe from the main study?

75% of the children in the subsample as well as the children in the main study participate in sports clubs. These results are consistent with the representative KiGGS study, where nearly three-fourths of the children participate in sports clubs (Lampert et al., 2007). The KiGGS study also showed increased sports participation with increasing age throughout childhood. The descriptive data from the subsample shows a similar trend, even though results were not statistically significant.

Discussion: Do you have data of an idea of how long the children slept when they wore the accelerometer? Is the time spent in sedentary physical activity during weekend days less because children sleep more during the weekend?

Unfortunately the results refer to the whole day including sleeping time.
The stated purpose of this study was to “objectively determine the amount of children’s PA and sedentary time with a multi-sensor device”, with an interest in differences between weekday and weekend days, overweight and non-overweight children, and 1st and 2nd graders.

**Major Compulsory Revisions:**

- While the flow chart in Figure 1 is appreciated, it can be improved by providing the specific reasons for why sample size changed from one step to the next.
  *The figure has been revised accordingly. More information why the sample size changed from one step to the next was given in the methods.*

- It is recommended that you use WHO BMI charts, for example, to assess the prevalence of obesity in your sample. This can be in addition to using the German norms you already provide, but using WHO or another international cut-off will help your paper be compared to others in the field.
  *IOTF cut-offs had been added (Appendix) for a better comparison with other studies in the field. However we refer to German reference values in the main document for a better rating the results of the current study.*

- The authors appear to have included sleep time in their analysis of sedentary time. If this is the case, it is recommended that you remove sleep from your analysis. It is important to identify waking hours and to frame your analysis of physical activity and sedentary time within that framework. Sleep is another dimension that has its own measurement issues. To this end, it is important for the authors to explain in detail how they determined waking hours. Were log books used? Additional details are also needed regarding how meeting physical activity recommendations (guidelines) was ascertained and analyzed, keeping in mind that guidelines state daily physical activity.
  *No log books were used, because of the high effort for parents, who are involved in PA measurements and the main study, e.g. care for their child if the Actiheart was disconnected from the electrodes or to fill out an extensively questionnaire in the main study. In addition, the return rate of informed consent in PA measurements should be kept as high as possible, which was achieved with 62%. Since the Actiheart is aligned with a wearing period of 24 h, no diaries were used. The focus of this study was on the detection of physical activity, particularly the health-related MVPA and not on sedentary activities. 60 min/day of MVPA for each valid day needed to be present in order to be considered as meeting PA guidelines. This has now been clarified in the manuscript.*

**Minor Essential Revisions**

- Please provide some additional explanation for the statistical analysis using ANCOVAs to compare overweight/obese and normal weight children and then adjusting for BMI – doesn’t that negate the point of your analysis? Likewise, for boys vs. girls and differences in grades, if you adjust for sex and age, respectively?
  *The adjustment for BMICPT has only occurred in the analysis regarding age- and sex-related differences. Differences in body weight status (overweight/obese children vs. normal weight children) were explored adjusting for sex and age. To explore differences between girls and boys, age and BMIPCT have been used as covariates and differences between first and second graders were analysed adjusting for sex and BMIPCT. This has been clarified in the manuscript.*

- In your discussion, you introduce another study involving German children. Perhaps, it is important to add more details of this study in the introduction to help build your justification for the current study.
More information about the German KiGGS-study has been added in the introduction accordingly to emphasise the lack of scientific knowledge regarding objective PA measurements in German primary school children.

- Perhaps a note on the representativeness of this sample to the German population would be warranted, or at least more details, if possible on the socioeconomic status of the families who participated.

Data of representative German studies were added to show the representativeness of the study sample (discussion): “A national sample (KIGGS study) showed only a marginally higher prevalence of 15% overweight and obese children aged 7-10 years (Kurth et al., 2010). A comparable overweight prevalence of about 13% was found in German children in the state of Baden-Württemberg at school entry [Moss et al., 2007].” The KiGGS study showed a prevalence of 25.4% of children with migration background. Similar results were assessed in the present study, where the proportion of children with a migration background was 27.1% (Schenk et al., 2007). Regarding socio-economic status or rather parental education 72.9% of the children in the KiGGS study were assigned at lower and middle level vs. 65.2% in the present sample and 27.1% vs. 34.8% were assigned of the high status group, respectively (Lange et al., 2007). Therefore, it can be assumed that the present sample is representative of south-west Germany comparing to the German representative data of the KiGGS study.

Discretionary Revisions
====================================================================================================
- In the introduction, please add age ranges of the studies you are describing to help justify why more research in younger children is necessary.
At this time, more information about PA levels of German primary school children of first and second grade are warranted. This aspect has now been reemphasised prior to the purpose statement.

- Please add age range of your participants to Table 1.
Age ranges in Table 1 have been added.

Reviewer #3
Reviewer: Sigmund Anderssen
Reviewer's report:
====================================================================================================
The purpose of this study was to objectively determine the amount of children's PA and sedentary time with a multi-sensor device. The authors conclude: "roughly half of primary schoolchildren in first and second grade meet current PA recommendations."

Comments:
The authors report the results within a topic that is important in public health. However there is potential for improvement in the manuscript.

Major issues requiring attention:
====================================================================================================
- Page 5 The description of study population is brief, and some more information is needed. The authors write that a subsample from a large study was used. Explain how this subsample consisting of 32 schools were selected. Further, a total of 703 children were included in the study, but due to limited number of devices only 384 children provided physical activity assessments. How were these 384 children selected? How is the distribution between first and second grade children? Are there any differences between the children with PA assessments and those who did not take part in the PA assessments with regard to descriptive variables (weight, BMI, etc.)? If you have any information about season, please give that. Can you give some comments of the generalizability of the results? Please explain why 66 subjects were excluded from the analyses.
Figure 1 has been revised with detailed information about PA measurement procedure, e.g. which children were selected for PA measurements or why they dropped out.

The distribution between first and second grade children has been added to the manuscript. There were no differences in descriptive characteristics between the subsample and the total study population. Children who wore the multi-sensor device did not differ from those not providing consent or assent either.

PA measurements were conducted in autumn between September and November 2009. Therefore, the influence of weather on PA patterns of children was not examined in the present study. For further investigations this aspect should be more involved. This has been added to the limitations in the discussion.

- Page 6. Physical activity measurements. The authors need to describe the Actiheart, and to describe how the information from the HR and the acceleration were combined. When is HR used? Did you perform any step test etc for individual calibration of the ActiHeart?

Energy expenditure has been estimated via the captive Actiheart software (version 4.0.73) (Corder et al., 2005) according to branched model equations for children using a combination of data collection with heart rate and acceleration simultaneously and converted to MET-values.

We did not perform any step for individual calibration of the Actiheart given that school-setting conditions aggravate PA measurements (e.g. less space and time) comparing to laboratory conditions. The step test requires at least 10 min for each child. Prior internal test have shown no difference in results whether the Actiheart was calibrated or not (unpublished data from within the study group).

- Page 7, line 127-131: There is sex differences in time spent sedentary and time spent in MVPA. However, the associations between physical activity/sedentary time and overweight/obesity are not presented separately by sex. This is also the case for the associations between PA and 1st/2nd grade. Explain whether interaction terms have been tested and what these tests show.

Girls spent more time in sedentary time (841±97 min/day vs. 775±86 min/day; p<0.001), while boys were more active than girls in MVPA (164±57 min/day vs. 106±50 min/day; p<0.001). This information has been emphasized to the results. Interaction terms have been testes, but no associations between sex and overweight/obese children or between first and second grade children as well have been found.

Minor issues requiring attention:

1) Abstract line 5: The purpose is quite different in the abstract compared to the purpose given in the introduction.

The aims of the study have been adjusted and added according to the aims of the introduction.

2) The background is short - which is ok - however the level of precision should be improved.

While there is some epidemiological data on PA levels in Germany available based on questionnaires only limited information is available on objectively determined levels of PA, which is the focus on the present study. This aspect has now been reemphasised prior to the purpose statement.

- a. line 36. "A considerable amount of children however, does not meet these recommendation" What is "children" and what is "considerable"?

The results of the review from Ekelund et al. (2011) were described in more detail regarding age and the amount which young people meeting current guidelines.


The proposed original reference from Telama et al. (2005) has been added in the manuscript.

- c. Line 45. Please give information about the assessment method.

Self-reported PA was used for assessing PA which has been added in the appropriate position.
- d. line 47-48: The authors write that "PA data in younger children, however, is sparse." Specify what age groups you are referring to.

In Germany, only limited information on objective PA levels in first and second grade school children is available. This has been clarified in the manuscript (background).

- e. Please give a brief rationale why objective assessment is superior to questionnaires when measuring physical activity.

The differences between subjective and objective methods have been briefly integrated in the manuscript. For an increase of accuracy of the PA measurements an objective tool was used in this study.

3) Methods
a. Line 78 I think it is wise to use Cole et al's reference values instead of German reference values. IOTF cut-offs had been added (Appendix) for a better comparison with other studies in the field. However we refer to German reference values in the main document for a better rating the results of the current study.

4) Results. It is a bit strange that there were only 28% of the girls who met the recommendations when they on average had 103 min per day of MVPA.

60 min/day of MVPA needed to be present for each valid day in order to be considered as meeting PA guidelines. This has now been clarified in the manuscript.

5) Discussion
a) Line 147-149. The authors write: "A previous study examining children's PA across Europe using accelerometer data also showed that nearly all 9-year-old children met MVPA recommendations." This is in contrast to the statement which is written in line 36 in the Background section. Please clarify.

Hence, for better understanding the proportion of children achieving PA guidelines was supplemented in the manuscript: Riddoch et al. (2004) reported that 80% of 9-year-old children from a large Norwegian sample meet current PA guidelines. These results underline that the prevalence of children meeting current PA recommendations varies enormously and differs between countries explained by a different interpretation of guidelines, different methodologies along with the utilisation of different cut points to determine MVPA when using accelerometry.

b) Line 158: The authors speculate that higher MVPA level among 2nd graders might be caused by higher sports club participation in this group. Do you have any questionnaire data to support this statement?

75% of the children in the subsample as well as the children in the main study participate in sports clubs. These results are consistent with the representative KiGGS study, where nearly three-fourths of the children participate in sports clubs (Lampert et al., 2007). The KiGGS study also showed increased sports participation with increasing age throughout childhood. The descriptive data from the subsample shows a similar trend, even though results were not statistically significant.