Reviewer's report

Title: A repeated measurement study investigating the impact of school outdoor environment upon physical activity across ages and seasons in Swedish second, fifth and eighth grade pupils

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Reviewer: Meghan Senso

Reviewer's report:

The stated purpose of this manuscript is to examine the effects of the outdoor environment on physical activity levels across age, gender, and seasons in a group of elementary-aged children. The authors make a strong case for the importance of physical activity throughout the lifespan and draw attention to the consistent findings of health risks associated with reduced physical activity levels. They also nicely highlight the importance of the school environment on child physical activity, given the large portion of the week days spent in school. This study has a number of strengths including, (1) the use of objective measurements (e.g. physical activity, weather, play spaces, indoor/outdoor time) and (2) high participation rates. The authors report that participants attending the school with large play areas and the school with woodland recorded higher percent PA during outdoor time. Authors also reported difference in physical activity levels by age and gender in the expected directions. Finally, differences in physical activity by season were seen in the expected direction. The abstract and title accurately convey the findings of the manuscript. Though this article has a number of strengths, there were also some limitations that could be further addressed to improve the overall impact and readability. My comments and suggestions are broken up into the three categories outlined by the Journal below.

Discretionary Revisions

1. In the Background section, the following statement could be expounded upon: “Outdoor environment has been proven to be a strong predictor of PA, but the evidence of its actual role for PA is conflicting or unclear.” (Line 82)

2. The research aims do not map easily onto the analysis plan and results section, making the paper harder to follow.

3. The use of the Actilux technology is a new and interesting direction for the field. Though there are potential limitations to this approach, the authors reconciled by comparing to direct observation. The results of these comparisons could be explicitly presented and highlighted as a strength in the discussion section.

4. Authors state, “The weather conditions were uniform within each measurement period and similar during all season…” There is no descriptive data presented here showing differences between schools for these variables.
Minor Essential Revisions

1. It is unclear how time spent at school (Line 241) and time spent outside (line 243) for each age group was calculated. Adding more detailed information about this measure would be important for repeatability.

2. On Line 184, the authors state, “There was no significant difference between the total MVPA averages for one or more days of monitoring, thus all children with at least one day of data were included in the analysis…” The results of the statistical test should be presented, as well as descriptive data regarding the average number of valid days across the sample.

3. Descriptive results for minutes of MVPA and %MVPA by grade and by school are not clearly described, and it is unclear whether or not statistical tests for differences between schools within a given grade were done.

4. There is a statement in the abstract referring to sun exposure that does not appear anywhere else in the manuscript.

5. A number of grammatical errors were found throughout the manuscript that should be addressed.

Major Compulsory Revisions (which the author must respond to before a decision on publication can be reached)

1. In the Background section, the authors note a number of previous studies that explore the impact of the outdoor environment on physical activity levels. These findings are not sufficiently summarized. There are also a number of important and more recent articles (including review articles) addressing the school environment and/or seasonality that are not included. Additionally, an obvious gap in the literature is not clear from the authors’ introduction. Finally, the introduction did not clearly lead up to the final paragraph stating the aim of the paper, which was broad and not well defined. Clearly outlining the aims (and hypotheses), building a case for the importance of the current study, and showing how the current study will build on previous research could improve the impact of the current manuscript.

2. In general, details about measurements and data reduction techniques are minimal. More information about how measures were implemented and analysed would strongly improve the manuscript. Along with this, providing information about reliability and/or validity of measures used could be a great addition to the findings. A specific example would be to including more detailed information about how wearing and non-wearing time was distinguished in accelerometry data reduction.

3. The analysis section is also lacking in overall detail making future replication challenging. Because children were nested within schools and have repeated measures over time, the proposed mixed model is appropriate. But, more detailed information about the statistical models used to test the main outcomes is necessary in backing up the interpretation of the findings.

4. The fact that only 4 schools were included greatly limits the ability draw conclusions about the impact of school-level (e.g. environmental) factors. The
authors appropriately note this limitation, and state that due to budgetary restraints chose a smaller number of schools in exchange for higher quality measures. But do not fully discuss the assumptions being made in order to have confidence in the results. The authors might also address why they did not match schools on potential confounders (e.g. socio-economic status, population size), which could have decreased the severity of the assumptions being made.

5. The contributions this study makes to the field are not clearly delineated throughout the discussion and conclusions. By more explicitly describing the current findings in comparison to previous findings, the contributions made could be more obvious to the reader. Additionally, the authors should avoid overstating the findings, as the study design was experimental in nature. Potential confounding at the school levels seems to be a major limitation of the analyses and hinder the conclusions drawn. Finally, the manuscript could be improved by stating more fully the potential further directions or necessary next steps generated by the current findings.

**Level of interest:** An article of importance in its field

**Quality of written English:** Needs some language corrections before being published

**Statistical review:** Yes, but I do not feel adequately qualified to assess the statistics.

**Declaration of competing interests:**

I declare that I have no competing interests