Reviewer’s report

Title: Do country-level environmental factors explain cross-national variation in adolescent physical activity? A multilevel study in 29 European countries

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Reviewer: Ian Ang

Reviewer's report:

This study explores an interesting topic of how a country’s environment is associated with physical activity levels in adolescents. Such work is important in helping inform policies and interventions that can target adolescents to help counter the low or declining levels of physical activity. The study is well thought through and the manuscript clearly written. There are, however, some concerns about the methods used, specifically with the analysis approach, that would benefit from added justifications or rethinking.

The use of multilevel models with three levels of individuals clustered within schools within countries is the right approach. However, it is unclear what the rationale is for having 4 separate models for the country-level environmental factors before testing them together simultaneously in one model (model 6). It would be different if there were more variables within each category (physical environment, socio-cultural environment, etc.), and that the question was whether these broad categories of variables as a whole impacted physical activity. However, the research question focusses only on which of the 8 variables do impact physical activity, and so the approach should simply be to add them all in one model, removing the non-significant variables, and then running a final model.

If the authors wanted to use a step-wise approach, then why not 8 separate models for each of the variables? It seems arbitrary for temperature to be grouped with urbanisation when in this dataset they are not correlated with each other but actually with national income and income equality respectively. The rationale of the less stringent criterion of alpha=0.25 also seems weak - although there might not have been previous published models analysing these variables together, the variables were selected by the authors because there is existing literature supporting their impact on physical activity. So if the authors do want to first demonstrate significance of these variables in this cohort of countries individually before consideration into the full model, then they should be tested individually.

Additionally, there should be a final model after model 6 (the model with multiple variables), which removes the non-significant variables after testing for them as a group. This way, only significant variables are included, and accounts for the collinearity that exists between variables.
Another important point to note is the naming and framing of the temperature variable. The variable being analysed in this study is yearly average national temperature, and needs to be termed as such (like average national household income). Unlike most of the other 8 variables which are common national metrics, temperature is not commonly used at a national level but more at a city level or regional level. Temperature values fluctuate within day, from day to day, and from season to season, as well as from region to region within a country. As pointed out in the text, the literature suggests an inverted U-shaped curve of temperature's relationship with physical activity. The term temperature, in the context of such research, is at a cross-sectional level, with temperatures used from a limited time-frame of a season, months or maybe even days, with less fluctuations. It is more reflective of levels of heat in immediate surrounding for the day and more in line with what is commonly understood. The yearly average national temperature, however, is taking the average of temperatures through its fluctuations across seasons, which might somehow reflect more of a country's latitude and altitude than the immediate sensation of heat.

Even though the sensitivity analysis did not indicate any difference using the World Bank country-level temperature or Weatherbase's average of major cities, a better justification is needed than that it was also used by Lang et al.

The manuscript should also present details of the exact months from which the HBSC data was collected. As the question on physical activity asks for recall of behaviour in the past seven days to approximate for yearly or general behaviour of that group, any confounders due to systematic data collection biases would need to be accounted for. For example, if data for schools in Finland was collected in late Spring when it was warm, but data for schools in France was collected in dead of winter, near a national examinations period, then the timing of the data collection would have majorly impacted the results seen. If it is not possible to get this data, but that the understanding is that there is a large variation of when the data was collected between or within countries, then this potential confounder should at least be acknowledged in the limitations.

Table 1 should also include the number of schools since each unique school is a cluster in the second level of the models. Table 2 should not be in-text but be on a separate page at the end like the other three tables.

I think the work done thus far with this wealth of data is very exciting, and I hope my comments and suggestions can help make this an even stronger paper.

Are the methods appropriate and well described?
If not, please specify what is required in your comments to the authors.

Yes
Does the work include the necessary controls?
If not, please specify which controls are required in your comments to the authors.

No

Are the conclusions drawn adequately supported by the data shown?
If not, please explain in your comments to the authors.

No

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