PEER REVIEW HISTORY

ARTICLE DETAILS

TITLE (PROVISIONAL)	Association of individual and neighbourhood socioeconomic status with physical activity and screen time in 7th grade boys and girls in Berlin, Germany – a cross sectional study.
AUTHORS	Krist, Lilian; Bürger, Christin; Ströbele-Benschop, Nanette; Roll, Stephanie; Lotz, Fabian; Rieckmann, Nina; Muller-Nordhorn, Jacqueline; Willich, Stefan; Müller-Riemenschneider, Falk

VERSION 1 – REVIEW

REVIEWER	Bettina Bringolf-Isler Swiss Tropical and Public Health Institute Basel, Switzerland University of Basel
REVIEW RETURNED	09-Jun-2017

GENERAL COMMENTS	Association of individual and neighborhood socioeconomic status on physical activity and sedentary behavior in 7th graders in Berlin, Germany The aim of the present study was to assess the influence of the individual and neighborhood socioeconomic status on physical activity (PA) and screen time in 12-13 year old students. In general the paper is well structured, but some confusion occurs because of inconsistent/inappropriate wording (e.g. sitting time and sedentary behaviour for screen time). General remarks: The self-report of physical activity is a clear weakness of the study. On one hand the validity of self-reported PA in children and adolescents is rather low, on the other hand it has been shown that PA self-reports are influenced by family income and education. Several studies which recorded PA subjectively and objectively in the same sample disclosed that there were large differences in PA by SES if measured by questionnaire but no difference (or even an inverse association) if accelerometer were used (e.g. Slootmaker SM et al IJBNPA 2009). This makes it difficult to distinguish between real differences and reporting bias when testing family SES and children's education as main factors influencing PA and probably also sedentary behavior. The authors mix up screen based activities and overall sedentary behavior. These activities have to be clearly distinguished, as self-reported TV and computer time do not represent total sedentary time (see e.g. Verloigne M. et al. Eur J Public Health 2013). This has to be adopted through the whole paper.

	There are some inconsistencies between described methods and presented results. Either, some information is not mentioned in the methods or the authors over-interpret their findings. Specific remarks: Introduction: In the introduction, please acknowledge literature which has already reported the association between neighborhood SES and PA and sedentary behavior. (e.g.for European studies: De Meester F, BMC Public Health 2012, Bringolf-Isler et al. Prev Med Rep. 2014, Bürgi et al. BMC Public Health 2016). Methods: P6 L42: According to the methods part, overall screen time per day was asked but in table 2 separate information for TV and Computer is presented. Where does this information come from? P7 L3 It is not clear why BMI norm values for 18 years olds were used to define overweight as adolescents were aged 12 to 13 years. P7 L 36: How was the SES of the students neighborhood classified into “high” “middle” and “low” (as used in fig 2 and fig 3)? P8 L20 It would be clearer to write that you excluded all children younger than 12 or older than 13 (=8.1%). Results: Tab 1a.) Is there an explanation for the age difference by sex? Could this be a selection bias problem? P13 L 14 It is not mentioned in the methods part that sitting time has been assessed. Is it really sitting time or screen time? If it is screen time this has to be corrected through the whole paper (e.g. page 14 line 11, line 30…). Tab 2: Is it sitting time or overall screen time? Tab 2: It is not mentioned in the methods part that different domains of PA have been recorded (leisure time PA). Is it leisure time PA or time spent with PA? Tab 2: It is not mentioned in the methods part that TV and computer time has been recorded, neither what is included as computer time (smart phone, tablets…)? Discussion P15 L22 The reference of Verloigne et al. is not appropriate as they tested accelerometer based sedentary behavior and not screen time. The correct paper for the ENERGY study would be that of Brug J et al Plos One 2012. In line with the present paper, they found that boys spend more time with screen activities than girls. P15 L55 Testing the association between the SES-environment and PA is not really a new aspect. It is rather a standard in studies testing association between the built environment and PA (see e.g. the IPEN network by James Sallis). In the discussion part, findings from these previous studies should be included (As mentioned previously, beside the literature from the US and Australia, there are some studies from Europe: De Meester F, BMC Public Health 2012, Bringolf-Isler et al. Prev Med Rep. 2014, Bürgi et al. BMC Public Health 2016). P16 L23 The papers from De Meester et al. 2012 and from Bringolf-Isler et al. 2014 show different results. The statement has to be made taking this literature into account. Strength and limitation P16 L36 The sample size is definitively a strength, but the representativeness should not be mentioned here.

	A participation rate of 65% is ok but not extremely high for a questionnaire based assessment at school and at least for girls an unbalanced participation by age is shown in table 1. P16 48 For children and adolescents, it is recommended that PA should be assessed with objective measures. It is definitively not true, that children's PA indications are more reliable than those of adults! A statement is needed that the self-report of PA is a problem especially as time indications can be influenced by socioeconomic factors. P16 L50 It is indeed a limitation that sedentary behavior was assessed only as screen time and the use of the wrong terminology should be avoided. Sedentary behavior and sitting time should be replaced by screen time throughout the paper.

REVIEWER	JD Mackenbach VU Medical Center Amsterdam, Netherlands
REVIEW RETURNED	21-Jun-2017

GENERAL COMMENTS	Manuscript 'Association of individual and neighborhood socioeconomic status on physical activity and sedentary behavior in 7th graders in Berlin, Germany' Thank you for the opportunity to review this manuscript. It is potentially an important study, presenting data on the association between socioeconomic status and physical activity and sedentary behaviour among Berlin youth. The paper is well written, but I have a number of recommendations with regard to the structure and consistency of the manuscript. Two general points are: - The aim and title of the study do not match the introduction, methods, results and discussion. If it was the aim to study the association between neighborhood (and individual?) SES and PA/SB, than the introduction should be focused on this, the methods should be adapted to this aim, and the results and discussion section should mainly focus on this aim. Currently, this is not the case, as I explain in more detail below. - The discussion could be strengthened by exploring potential explanations for the current findings, rather than only comparing the results with previous study results. More details points are: Abstract: The abstract is well-written and clear. However, given the aim, the results and discussion section present a lot of unnecessary information (e.g. relation between all covariates and PA/SB, not meeting PA guidelines). If the aims were broader than to study the relation between individual/neighborhood SES and PA/SB, than this should be made explicit. Strengths and limitations: From the first bullet point, it seems like the aim was to assess the association between neighborhood SES and PA/SB, independent of individual SES. If so, this should be made explicit. From the last bullet point, it becomes clear that the authors did not assess SB, but screen time. This should be made explicit throughout the manuscript (including abstract).

	Introduction: I suggest that the authors mention the health impacts of both physical activity and sedentary behaviors in the first sentence, as they correctly mention in the second sentence that SB is an independent risk factor. It seems a bit random to cite the WHO for PA guidelines, and the AAP for SB guidelines, while the sample is German. Are there any European/German guidelines for PA/SB? Is the manuscript written in British or American spelling? The authors use both behaviour and behavior. In the third paragraph, the authors suggest that sedentary behaviour comprises only watching TV or playing computer games. They could cite the official definition of SB here, or make it clearer that TV viewing and playing computer games are two common SBs among youth. The authors mention a number of correlates of PA, BMI and SB, but it is unclear whether there is a certain perspective/framework/conceptual model underlying these correlates. Please describe this and then list correlates according to this perspective/framework/conceptual model. Currently, the potential explanation for an association between neighborhood SES and PA/SB is limited and I encourage the authors to present some alternative explanations as well (social cohesion, residential self-selection, …). Also, it would be recommended to speculate about the potential implications of finding an association between neighborhood SES and PA/SB in children; what is the potential for prevention/health promotion? Finally, the aim in the introduction does not correspond with the title and the aim in the abstract (focus on both individual and neighborhood SES), and does not suggest that the authors would like to investigate the role of neighborhood SES independent of individual SES (this would need some rationale in the introduction), or would like to investigate other factors than SES (this would also need some rationale in the introduction). Methods: Could the authors specify in what year baseline data was collected? Could the authors specify how many and what type of schools in these 12 districts of Berlin were contacted, and how many agreed to participate (response rate of schools), as well as how many students were contacted in each of these schools, what their response rates was, and how equal this response was distributed among schools? Under ‘measurements’, could the authors mention where and when the consent forms were distributed (at schools?), how much time was between the first and second visit, and how much time it took to complete the questionnaire? Were the three PA items validated? Please provide details. I would recommend referring to screen time instead of sedentary behaviour, unless the authors can provide a reference that screen time in youth is a good proxy for total SB. Were the two SB items validated? I am unsure what the authors mean by ‘Subgroups were chosen’. Why were subgroups chosen, and what kind of subgroups? Why did the authors classify weight status according to adult cut-offs? 85- and 95-percentile cut-offs are mostly used for youth. If the authors wish to measure their independent variable two years after measuring their dependent variable, they should at least provide reference that this measure is relatively stable over time. I can imagine that the number of computers in the home depends on the age of children in the household, which obviously changed during the two year follow up. Could the authors please define ‘neighborhoods’ (average size, how many are there in Berlin, etc). It comes as a surprise that the authors also measured the schools’ neighborhoods’ SES; why was this done? Why were students from other age groups removed if the authors analysed all age groups together?

	How many missings did each of the variables have, and as such, how many cases were deleted in a complete case analysis? Did the authors assess whether PA and SB were normally distributed? Did this allow for the presentation of means and SDs? Could the authors specify whether they added random intercepts only for the three levels, or also random slopes? The authors mention that for binary outcomes a logit link function was used, and for continuous outcomes an identity link function. The methods only describe continuous variables for PA and SB, so if any of them are binary, please describe this earlier in the methods section. Could the authors also provide a rationale for why they added the respective outcome as covariate? From the aims and introduction it is not clear why neighborhood SES, school type and schools' neighborhood SES were added to the models. Please provide a rationale. What do the authors mean by 'nominal p-values'? Results: I see that the authors present here a flow chart, but perhaps this could be moved to the methods section. Table 1a and 1b present p-values, but it is unclear from the Methods and footnote of the Table where these p-values are derived from. Please describe in Methods section. Why is the information presented in Table 2 not included in Table 1? PA and SB behaviors are also characteristics of the study sample. Were PA and SB normally distributed and as such did they allow for the presentation of means? Could the authors spell out all abbreviations used in their tables in the footnotes? On page 14 the authors describe results from interaction by gender, while this was not stated in the Methods section; please add. Further, it is not clear to me why – when the aim of this paper is to study the association between individual and neighborhood SES with PA/SB – the authors first present models without these independent variables included. I would have expected firstly a model with only neighborhood/individual SES, and then the inclusion of potential confounders. Please make sure the aims, methods and results are aligned. Also, with the present aim it is not necessary to describe the associations between covariates and outcomes. Discussion: the first sentence of the discussion suggests a different study aim than the authors have described. Please match aims with results/discussion. Given the current aim, the discussion should only focus on the findings with regard to neighborhood/individual SES, not associations of other covariates. I suggest the authors spend a bit more text on interpreting their findings rather than just comparing with previous studies. What do the results mean? I further disagree with the statement that 'physical activity is hardly influenced by neighborhood SES'. The authors did not conduct a longitudinal or experimental study that allows for speculation about causality. The conclusion should reflect the aims. Since it was not the aim to assess what proportion of students met the WHO guidelines and what range of covariates was associated with PA/SB, the conclusions and suggestions for prevention strategies are not appropriate for the study aims.

VERSION 1 – AUTHOR RESPONSE

Reviewer: 1

Reviewer Name
Bettina Bringolf-Isler

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Swiss Tropical and Public Health Institute Basel, Switzerland
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Please state any competing interests or state 'None declared':
None decleared

Please leave your comments for the authors below
Association of individual and neighbourhood socioeconomic status on physical activity and sedentary behaviour in 7th graders in Berlin, Germany

The aim of the present study was to assess the influence of the individual and neighbourhood socioeconomic status on physical activity (PA) and screen time in 12-13 year old students. In general the paper is well structured, but some confusion occurs because of inconsistent/inappropriate wording (e.g. sitting time and sedentary behaviour for screen time).

General remarks:
The self-report of physical activity is a clear weakness of the study. On one hand the validity of self-reported PA in children and adolescents is rather low, on the other hand it has been shown that PA self-reports are influenced by family income and education. Several studies which recorded PA subjectively and objectively in the same sample disclosed that there were large differences in PA by SES if measured by questionnaire but no difference (or even an inverse association) if accelerometer were used (e.g. Slootmaker SM et al IJBNPA 2009). This makes it difficult to distinguish between real differences and reporting bias when testing family SES and children's education as main factors influencing PA and probably also sedentary behaviour.
There are some inconsistencies between described methods and presented results. Either, some information is not mentioned in the methods or the authors over-interpret their findings.

Answer: We focused the introduction as well as the methods, results and discussion section more on our primary aim, the association of the individual and neighbourhood SES with physical activity and screen time. The title and the rest of the manuscript are now modified accordingly.

The authors mix up screen based activities and overall sedentary behaviour. These activities have to be clearly distinguished, as self-reported TV and computer time do not represent total sedentary time (see e.g. Verloigne M. et al. Eur J Public Health 2013). This has to be adopted through the whole paper.
P13 L 14 It is not mentioned in the methods section that sitting time has been assessed. Is it really sitting time or screen time? If it is screen time this has to be corrected through the whole paper (e.g. page 14 line 11, line 30…).
Tab 2: Is it sitting time or overall screen time?
P16 L50 It is indeed a limitation that sedentary behaviour was assessed only as screen time and the use of the wrong terminology should be avoided. Sedentary behaviour and sitting time should be replaced by screen time throughout the paper.

Answer: Throughout the manuscript we changed ‘’sedentary behaviour’ into ‘screen time’ to clarify that we only assessed the screen time. We have also included this as a limitation of our study in the discussion.
‘Only screen time was assessed, while other kinds of sedentary behaviours like doing homework, talking on the phone and sitting at school were not taken into account.’

Specific remarks:
Introduction:
In the introduction, please acknowledge literature which has already reported the association between neighbourhood SES and PA and sedentary behaviour. (e.g.for European studies: De Meester F, BMC Public Health 2012, Bringolf-Isler et al. Prev Med Rep. 2014, Bürgi et al. BMC Public Health 2016).

Answer: We revised the whole introduction section taking the mentioned paper into account.
‘Studies investigating the influence of neighbourhood SES on health showed an association of disadvantaged neighbourhoods with worse health status(Ross & Mirowsky, 2001) or a higher risk for cardiovascular diseases(Cubbin, Hadden, & Winkleby, 2001). Mechanisms through which a lower neighbourhood socioeconomic status may influence physical activity and sedentary behaviour could be reduced municipal services such as recreational facilities and playgrounds, financial stress or less possibilities to own a gym membership(McNeill et al., 2006). Regarding physical activity or sedentary behaviour, study results are heterogenous ranging from no association to a clear association with neighbourhood SES (Bürgi, Tomatis, Murer, & de Bruin, 2016; Dragano et al., 2007; Kavanagh et al., 2005). Other studies in turn found that the neighbourhood SES was a positive modifier for the association of environmental factors with physical activity and sedentary behaviour(Bringolf-Isler et al., 2014; De Meester et al., 2012). Knowing more about the influence of SES would make it possible to develop more targeted prevention strategies for vulnerable groups.
Our aim was therefore to investigate the influence of individual and neighbourhood socioeconomic status on physical activity and screen time as one important form of sedentary behaviour in a population based sample of 12 to 13 year old secondary school students in Berlin, Germany.’

Methods:
P6 L42: According to the methods section, overall screen time per day was asked but in table 2 separate information for TV and Computer is presented. Where does this information come from?
Tab 2: It is not mentioned in the methods section that TV and computer time has been recorded, neither what is included as computer time (smart phone, tablets…)?

Answer: We assessed both, TV time and time spent with the Computer and game consoles, seperately. Smartphone of tablet use were not assessed. We added this information to the methods section as well as to the discussion section under limitations.
Methods
‘Screen time
Screen time (ST) was assessed with two questions asking for the time spent each day watching TV or playing with the Computer. TV time was assessed by asking ‘How many hours/day do you usually watch television in your free time?’ for weekdays and weekend days separately. Computer time (minutes/day) was assessed by asking ‘How many hours/day do you usually play games on a computer, or use a game console in your leisure time?’. Total screen-time was computed by adding up TV and computer time. Using a smartphone or tablet was not assessed.’

Discussion
‘Another limitation is that as screen time measures only the use of TV, Computer and video games was assessed by the applied HBSC questionnaire. Other kinds of divices (smart phones, tablets) and other kinds of sedentary behaviours like sitting during homework, talking on the phone and sitting at school were not taken into account, which may have led to an underestimation of the screen time.’

P7 L3 It is not clear why BMI norm values for 18 years olds were used to define overweight as adolescents were aged 12 to 13 years.

Answer: We clarified the definition of underweight, normal weight, overweight and obesity. We use percentiles, which has now been made clear.
‘BMI categories are presented using cut-offs defined by the specific percentiles which at age 18 years correspond to the adult cut-off points for underweight (<18.5kg/m2), overweight (25kg/m2) and obesity (30kg/m2). According to that definition, underweight is defined as a BMI <10th percentile, normal weight as a BMI between the 10th and the 90th percentile, overweight as a BMI between the 90th and the 97th percentile and obesity as a BMI ≥97th percentile(Cole, Bellizzi, Flegal, & Dietz, 2000a; Cole, Flegal, Nicholls, & Jackson, 2007a).’

P7 L 36: How was the SES of the students neighbourhood classified into ‘high’ ‘middle’ and ‘low’ (as used in fig 2 and fig 3)?

Answer: We described the classification in the methods section and added the values (0-7) of the FAS to better explain which number of points on the scale represents which SES level.
‘To assess the individual socioeconomic status (SES) of the student, we used the family affluence scale (FAS), a validated instrument to assess the material affluence of the family asking for the number of cars and computers in the family, for holidays during the past 12 months, and whether the child has its own room(C. E. Currie, Elton, Todd, & Platt, 1997). The FAS consists of values from zero to seven, with higher values indicating higher affluence, and can be categorized into three categories (low (0-3), moderate (4-5), and high affluence (6-7)).’

P8 L20 It would be clearer to write that you excluded all children younger than 12 or older than 13 (=8.1%).

Answer: We changed this according to suggestion.
‘All statistical analyses were performed for the 12 and 13 years old students due to the small number of students younger than 12 and older than 13 years (8.1%).’

Results:
Tab 1a.) Is there an explanation for the age difference by sex? Could this be a selection bias problem?

Answer: We think that the chance of selection bias is rather small, because we included whole classes and not individual students. Also, the mean age is very similar for boys and girls (12.5±0.5 years among boys and 12.4±0.5 years among girls). One explanation for the higher number of 12 years old girls compared to boys could be caused by a higher number of girls with ‘early school enrollment’ compared to boys. For the period between 1994 to 2004 the percentiage of girls with ‘early school enrollment’ was 62%.

This is described in the report of R. Schüler in Daten+Analysen 2004: ‘Einschulungen nach Geschlecht und Schulform - Bei der Auswertung der Verteilung der Mädchen und Jungen in den Kategorien der Einschulungsarten zeigt sich über diesen Zeitraum folgendes Bild. In diesen 10 Jahren lag der Anteil der Mädchen bei den fristgemäßen Einschulungen bei 49 Prozent, bei den vorzeitigen Einschulungen bei 62 Prozent und bei den verspäteten Einschulungen bei 38 Prozent.’ (In the last 10 years, the proportion of girls with early school enrollment was 62% (normal school enrollment 49%, late school enrollment 38%.))

Tab 2: It is not mentioned in the methods section that different domains of PA have been recorded (leisure time PA). Is it leisure time PA or time spent with PA?

Answer: We asked for time spent in PA: We mentioned the content of the questions already in the methods section. We added now that we asked for moderate intensity physical activity.
‘Physical activity (PA) was assessed using three adapted items of the HBSC questionnaire. The first question was assessed by asking: ‘On how many days in the past week were you physically active for at least 60 minutes?’ According to the WHO guidelines, for our primary outcome we defined a student as meeting current guidelines if he or she was active at least 60 minutes on each of the last seven days (yes/no)(WHO, 2010). The other questions asked for the number of days and hours of moderate intensity physical activity per week. ‘

Discussion
P15 L22 The reference of Verloigne et al. is not appropriate as they tested accelerometer based sedentary behaviour and not screen time. The correct paper for the ENERGY study would be that of Brug J et al Plos One 2012. In line with the present paper, they found that boys spend more time with screen activities than girls.

Answer: Thank you for pointing this inconsistency out, we have modified this section accordingly.

P15 L55 Testing the association between the SES-environment and PA is not really a new aspect. It is rather a standard in studies testing association between the built environment and PA (see e.g. the IPEN network by James Sallis). In the discussion section, findings from these previous studies should be included (As mentioned previously, beside the literature from the US and Australia, there are some studies from Europe: De Meester F, BMC Public Health 2012, Bringolf-Isler et al. Prev Med Rep. 2014, Bürgi et al. BMC Public Health 2016).

Answer: We revised the discussion section substantially according to suggestion.
‘[…]
Another aspect of our study was the investigation of the neighbourhood SES as an influencing factor of physical activity and screen time. In contrast to the individual SES, an association was found for physical and screen time. After including school type, the association remained statistically significant only for screen time. Probably there was some interaction between the student’s neighbourhood SES and the school type, which is quite probable since there are more integrated secondary schools in neighbourhoods with lower SES than high schools. Also, it is known, that the neighbourhood SES as well as the SES of the students is often correlated with the school type (Robert Koch-Institut, 2004).In one previous study also using the social index for Berlin, an association of a lower neighbourhood SES with a higher BMI in 5-6 years old children living in Berlin was observed. However, the authors did not include health behaviours like physical activity or sedentary time in their analyses(Lakes & Burkart, 2016).

It is possible that other factors like the built environment play a more important role than individual or neighbourhood SES as factors influencing physical activity. Sallis et al. have shown in a study among adults, that the number of public transport stops, residential density, intersection density and the number of parks were independently and positively associated with the time spent in physical activity(Sallis et al., 2016). Other authors also found associations of the built environment and physical activity(Bringolf-Isler et al., 2014). In another study associations appeared to differ between population groups (persons with low neighbourhood SES had a bigger benefit of a good walkability than those with a high neighbourhood SES)(De Meester et al., 2012). Future research should include measurement of the built environment in Berlin to provide new insights into the associations with physical activity. […]

P16 L23 The papers from De Meester et al. 2012 and from Bringolf-Isler et al. 2014 show different results. The statement has to be made taking this literature into account.

Answer: We discussed the results of the mentioned papers in the discussion section.
'Sallis et al. has shown in a study among adults, that the number of public transport stops, residential density, intersection density and the number of parks were independently and positively associated with the time spent in physical activity(Sallis et al., 2016). Other authors found also associations of the built environment and physical activity(Bringolf-Isler et al., 2014). In another study associations appeared to differ between population groups (persons with low neighbourhood SES had a bigger benefit of a good walkability than those with a high neighbourhood SES)(De Meester et al., 2012).'

Strength and limitation
P16 L36 The sample size is definitively a strength, but the representativeness should not be mentioned here. A participation rate of 65% is ok but not extremely high for a questionnaire based assessment at school and at least for girls an unbalanced participation by age is shown in table 1.

Answer: We revised the Strengths and limitations section. Also, we added some information regarding the participation rate to the results section.
Strengths and limitations box after abstract: 'Also, the amount of students with migration background reflected the proportion of the student population of Berlin.'
Strengths and limitations section in the discussion 'Strengths of our study include the size of our sample, as well as the proportion of students with migration background, socioeconomic status and gender distribution, which appear to be very similar to the student population of Berlin(Senatsverwaltung für Gesundheit Umwelt und Verbraucherschutz, 2010)'
'Out of 214 contacted schools, 49 schools (23%; 4291 students) showed interest and were eligible for study participation. Before baseline assessment, 1268 out of these 4291 students dropped out including two entire schools. 2801 students participated at the baseline assessment. Out of those, we included 2586 students aged 12 and 13 years in our analysis. Figure 1 shows the recruitment process of the schools, classes and students.'

P16 48 For children and adolescents, it is recommended that PA should be assessed with objective measures. It is definitively not true, that children's PA indications are more reliable than those of adults! A statement is needed that the self-report of PA is a problem especially as time indications can be influenced by socioeconomic factors.

Answer: We believe this was a misunderstanding because we did not intend to suggest that children's self-reported physical activity is more accurate than that of adults We have now modified this part of the manuscript and highlighted the lack of objective measure as a limitation of the study.
'Self-report may lead to distorted results through misreporting(Merrill & Richardson, 2009). However, children and adolescents seem to be reliable in providing accurate and valid information as long as the questionnaires are developed for the respective age group, which was the case(Riley, 2004).'

Reviewer: 2

Reviewer Name
JD Mackenbach

Institution and Country
VU Medical Center Amsterdam, Netherlands

Please state any competing interests or state 'None declared':
None declared.

Please leave your comments for the authors below
Manuscript 'Association of individual and neighbourhood socioeconomic status on physical activity and sedentary behaviour in 7th graders in Berlin, Germany'

Thank you for the opportunity to review this manuscript. It is potentially an important study, presenting data on the association between socioeconomic status and physical activity and sedentary behaviour among Berlin youth. The paper is well written, but I have a number of recommendations with regard to the structure and consistency of the manuscript.

Two general points are:
- The aim and title of the study do not match the introduction, methods, results and discussion. If it was the aim to study the association between neighbourhood (and individual?) SES and PA/SB, than the introduction should be focused on this, the methods should be adapted to this aim, and the results and discussion section should mainly focus on this aim. Currently, this is not the case, as I explain in more detail below.

Answer: We have now focussed the introduction as well as the methods, results and discussion section more clearly on the primary aim of the study: 'the association of the individual and neighborhood SES with physical activity and screen time.'
Title: 'Association of individual and neighborhoodneighbourhood socioeconomic status with physical activity and sedentary behavior screen time in 7th graders in Berlin, Germany'
Abstract: Main outcome measures […]'Primary outcome was the association of individual and neighbourhood SES with daily PA and daily screen time.'
Introduction: 'Our aim was therefore to investigate the influence of individual and neighbourhood socioeconomic status on physical activity and screen time as one important form of sedentary behaviour in a population based sample of 12 to 13 year old secondary school students in Berlin, Germany.'

- The discussion could be strengthened by exploring potential explanations for the current findings, rather than only comparing the results with previous study results.

Answer: We revised the discussion section substantially, taking the above comment into account.
More details points are:

Abstract: The abstract is well-written and clear. However, given the aim, the results and discussion section present a lot of unnecessary information (e.g. relation between all covariates and PA/SB, not meeting PA guidelines). If the aims were broader than to study the relation between individual/neighbourhood SES and PA/SB, than this should be made explicit.

Answer: As suggested, we removed unnecessary information in order to focus more on the primary aim of the study.

‘ABSTRACT
Objectives Few studies have explored the impact of neighbourhood socioeconomic status (SES) on health behaviour in youths. Our aim was to investigate the association of individual and neighbourhood socioeconomic status with physical activity (PA) and screen time (ST) in 12-13 years old students in Berlin, Germany.
Design Cross-sectional study.
Setting Secondary schools (high schools and integrated secondary schools) in Berlin, Germany.
Participants A total of 2586 students aged 12-13 years (7th grade).
Main outcome measures Sociodemographics, anthropometric data and health behaviour were assessed by self-report during classes. Primary outcome was the association of individual and neighbourhood SES with daily PA and daily ST. Students’ characteristics were described with means or percentages. Comparisons were performed with Generalized Linear Mixed Model yielding odds ratios with 95% confidence intervals.
Results Mean (±SD) age was 12.5±0.5 years, 50.5% were girls, and 34.1% had a migrant background.Individual SES was only associated with screen time. The odds ratio of engaging in more than two hours of ST per day was 1.28 [1.00;1.64] and 2.03 [1.30;3.15] for students with middle and low SES, respectively, compared to students with high SES. Neighbourhood SES was associated with both, PA and ST. The odds ratios of spending more than 60 minutes per day in PA and of engaging in more than two hours of ST per day in screen time were 1.67 [1.14;2.44] and 1.68 [1.22;2.29], respectively, each for students with low compared to high neighbourhood SES.
Conclusions Both, individual and neighbourhood SES as well as school type are important factors that have to be considered, when developing prevention programs for school students. Future research should include measurement of the built environment in Berlin to provide further insights into the associations with PA.

Strengths and limitations: From the first bullet point, it seems like the aim was to assess the association between neighbourhood SES and PA/SB, independent of individual SES. If so, this should be made explicit.

Answer: Our aim was to assess the association between individual and neighborhood SES with PA and screen time. We made that now clear throughout the whole paper.
‘This study provides important new insights into the association of individual and neighbourhood socioeconomic status with physical activity and screen time in school students in Berlin, Germany.’

From the last bullet point, it becomes clear that the authors did not assess SB, but screen time. This should be made explicit throughout the manuscript (including abstract).

Answer: We changed ‘sedentary behavior’’ into ‘screen time’’ .

Introduction: I suggest that the authors mention the health impacts of both physical activity and sedentary behaviours in the first sentence, as they correctly mention in the second sentence that SB is an independent risk factor.

Answer: Changed according to suggestion.
‘Physical activity as well as sedentary beaviour have an important impact on health and wellbeing(WHO, 2009).’
It seems a bit random to cite the WHO for PA guidelines, and the AAP for SB guidelines, while the sample is German. Are there any European/German guidelines for PA/SB?

Answer: The WHO guidelines for PA as well as the AAP guidelines are the guidelines which are used in Germany and other European Countries as well. One important European study investigating physical activity and sedentary behaviour among youths is the IDEFICS study. In this study the guidelines of the AAP are used. See e.g. Ferreira de Moraes et al. International Journal of Cardiology 2015).

Is the manuscript written in British or American spelling? The authors use both behaviour and behaviour.

Answer: We corrected that and use the British spelling throughout the whole manusctipt.

Comment: In the third paragraph, the authors suggest that sedentary behaviour comprises only watching TV or playing computer games. They could cite the official definition of SB here, or make it clearer that TV viewing and playing computer games are two common SBs among youth.

Answer: In line with previous comments we changed ‘sedentary behavior’’ into ‘screen time’’ to make clear that we only assessed the screen time.
‘Screen time (time spent watching TV or playing games on the computer or playing video games) is one important aspect of sedentary behaviour, even though it does not represent the overall sedentary time (Maite Verloigne et al., 2013).’

Comment: The authors mention a number of correlates of PA, BMI and SB, but it is unclear whether there is a certain perspective/framework/conceptual model underlying these correlates. Please describe this and then list correlates according to this perspective/framework/conceptual model.

Answer: Covariates were selected based on existing literature highlighting the important role of BMI, Sex, and other individual characteristics in influencing PA and screen time (e.g. Bucksch et al. BMC Public Health 2014). We decided therefore not to restrict the analyses to only the forms of SES but to include theses variables as adjustment variables.

Comment: Currently, the potential explanation for an association between neighbourhood SES and PA/SB is limited and I encourage the authors to present some alternative explanations as well (social cohesion, residential self-selection, …). Also, it would be recommended to speculate about the potential implications of finding an association between neighbourhood SES and PA/SB in children; what is the potential for prevention/health promotion?

Answer: We revised the introduction as well as the discussion section and added potential explanations, taking the above comment into account.
Introduction: ‘Mechanisms through which a lower neighbourhood socioeconomic status may influence physical activity and sedentary behaviour could be reduced municipal services such as recreational facilities and playgrounds, financial stress or less possibilities to own a gym membership(McNeill et al., 2006). Knowing more about the influence of different forms of SES would make it possible to tailor more adapted prevention strategies for vulnerable groups.’
Discussion: ‘In this study we investigated the association of individual and neighbourhood SES with physical activity and screen time among school students. The individual SES of the students in our study sample, measured with the family affluence scale, was significantly associated with screen time. Students with lower SES were more likely to spend more than 2 hours per day viewing screen devices. Low SES was stronger associated with screen time than middle SES, compared to high SES. Physical activity, however, was not associated with the individual SES.

This is in line with other studies which showed that the individual SES is not a strong predictor of high PA among youths(Bucksch, Inchley, Hamrik, Finne, & Kolip, 2014; Finne, Bucksch, Lampert, & Kolip, 2011; Jekauc, Reimers, Wagner, & Woll, 2012). A possible explanation for these results is that PA consists not only of organised sports or activities that require a club membership. A large part of PA among youths are daily life activities and are based on activities in the neighbourhood and in parks which is independent from the individual SES(Schott, Hunger, Spenger, Mess, & Mielck, 2015)..[…] It is possible that other factors like the built environment play a more important role than individual or neighbourhood SES when exploring influencing factors for physical activity. Sallis et al. has shown in a study among adults, that the number of public transport stops, residential density, intersection density and the number of parks were independently and positively associated with the time spent in physical activity(Sallis et al., 2016). Other authors found also associations of the built environment and physical activity. However, associations appeared to differ between population groups(Bringolf-Isler et al., 2014; De Meester et al., 2012). Future research should include measurement of the built environment in Berlin to provide new data of the associations with physical activity.'

Comment: Finally, the aim in the introduction does not correspond with the title and the aim in the abstract (focus on both individual and neighbourhood SES), and does not suggest that the authors would like to investigate the role of neighbourhood SES independent of individual SES (this would need some rationale in the introduction), or would like to investigate other factors than SES (this would also need some rationale in the introduction).

Answer: we made clear that our aim was to investigate the association between the individual or the neighbourhood SES and PA/SB.
'Our aim was therefore to investigate the influence of individual and neighbourhood socioeconomic status on physical activity and screen time as one important form of sedentary behaviour in a population based sample of 12 to 13 year old secondary school students in Berlin, Germany.'

Methods: Could the authors specify in what year baseline data was collected?

Answer: We added this information in the methods section under 'Study design and setting'.
'The present cross-sectional analysis is part of the BEST-prevention study, a three armed cluster randomized controlled trial that was conducted from 2010 to 2014 (baseline assessment was conducted from 2010 to 2011) with the aim to evaluate a parent involving smoking prevention program for 7th grade students in Berlin(Krist et al., 2016).'

Comment: Could the authors specify how many and what type of schools in these 12 districts of Berlin were contacted, and how many agreed to participate (response rate of schools), as well as how many students were contacted in each of these schools, what their response rates was, and how equal this response was distributed among schools?

Answer: This information is provided in the recruitment flow chart and in Table 1a. According to the consort guidelines, the recruitment flowchart is recommended to be in the results section. We have now also added some information regarding participation rate to the results section.
'Out of 214 contacted schools, 49 schools (23%; 4291 students) showed interest and were eligible for study participation. Before baseline assessment, 1268 out of these 4291 students dropped out including two entire schools. 2801 students participated at the baseline assessment. Out of those, we included 2586 students aged 12 and 13 years in our analysis. Figure 1 shows the recruitment process of the schools, classes and students.'

Comment: Under ‘measurements’, could the authors mention where and when the consent forms were distributed (at schools?), how much time was between the first and second visit, and how much time it took to complete the questionnaire? Were the three PA items validated? Please provide details. I would recommend referring to screen time instead of sedentary behaviour, unless the authors can provide a reference that screen time in youth is a good proxy for total SB. Were the two SB items validated?

Answer: We added this information under ‘measurements’ to the methods section. The PA and SB-questions were taken from the HBSC questionnaire which is a validated questionnaire (Ottova et al., Gesundheitswesen 2012).As mentioned above, we replaced sedentary behaviour by screen time throughout the whole manuscript.
‘The study questionnaire is based on existing and validated questionnaires investigating adolescent health behaviour (e.g. Health Behaviour in School Aged Children, HBSC(Ottova et al., 2012); German Children and Youths Survey, KIGGS(Opper, Worth, Wagner, & Bös, 2007)). It includes questions related to socio-demographics, smoking and other health behaviours, such as alcohol consumption, nutrition, physical activity and screen time, as well as height and weight. It took about 30-40 minutes to complete the questionnaire. Our study group has the status of an associated project of the HBSC. During a first visit to schools, the BEST study was presented to the students by trained research personnel and consent forms were distributed for students and parents/caregivers. During the second visit, which took place a few weeks later, baseline data were assessed with the questionnaire in the classroom among children, who had provided both consent forms.’

Comment: I am unsure what the authors mean by ‘Subgroups were chosen’. Why were subgroups chosen, and what kind of subgroups? Why did the authors classify weight status according to adult cut-offs? 85- and 95-percentile cut-offs are mostly used for youth.

Answer: We clarified the definition of underweight, normal weight, overweight and obesity. The term ‘subgroups’ was not a good choice, as we are merely looking at categories. We changes the term accordingly. We use percentiles to define the weight categories.
‘BMI categories are presented using cut-offs defined by the specific percentiles which at age 18 years correspond to the adult cut-off points for underweight (<18.5kg/m2), overweight (25kg/m2) and obesity (30kg/m2). According to that, underweight is defined as a BMI <10th percentile, normal weight as a BMI between the 10th and the 90th percentile, overweight as a BMI between the 90th and the 97th percentile and obesity as a BMI ≥97th percentile(Cole, Bellizzi, Flegal, & Dietz, 2000a; Cole, Flegal, Nicholls, & Jackson, 2007a).’

Comment: If the authors wish to measure their independent variable two years after measuring their dependent variable, they should at least provide reference that this measure is relatively stable over time. I can imagine that the number of computers in the home depends on the age of children in the household, which obviously changed during the two year follow up.

Answer: We agree with the comment and we added the following phrase in the strengths and limitations section:
‘FAS was only assessed at the 24 month follow up. However, we assessed one item of the FAS (holiday) both at baseline and at the 12 month follow-up. The answers were quite similar over the two years. We thus think the period of two years implicates only minimal changes in the FAS level.’

Comment: Could the authors please define ‘neighbourhoods’ (average size, how many are there in Berlin, etc).

Answer: We have now explained the term ‘neighborhoods’ more clearly in the methods section.

‘For the SES of the students’ neighbourhood, we used the social index defined and implemented by the ‘Atlas of Social Structure’ (Sozialstukturatlas), an instrument used in Berlin to describe the social situation of Berlin by classifying 447 sub-areas (with on avarage 7500 habitants) of the 12 districts of Berlin accordingly(Senatsverwaltung für Gesundheit Umwelt und Verbraucherschutz, 2008; Senatsverwaltung für Gesundheit und Soziales, 2013).’

Comment: It comes as a surprise that the authors also measured the schools’ neighbourhoods’ SES; why was this done?

Answer: In addition to the individual neighbourhood SES, we assessed also the school neighbourhood SES. Since the neighbourhood of the school can be different to that of students, we decided to assess this information as well in order to take an additional influencing factor of the students behavor into account.

Comment: Why were students from other age groups removed if the authors analysed all age groups together?

Answer: We aimed to investigate a homogenous age group. Since we recruited the children according to school and class and not individually, some students with extreme ages were included as well. However, those students tend to differ from those with an age that is ‘normal’ at the 7th grade. That is why we decided to exclude all students younger than 12 years or older than 13 years.

Comment: How many missings did each of the variables have, and as such, how many cases were deleted in a complete case analysis?

Answer: We included the number of available data for each analysis in the respective tables.

Comment: Did the authors assess whether PA and SB were normally distributed? Did this allow for the presentation of means and SDs?

Answer: Both, physical activity and screen time were not perfectly normally distributed, but were somewhat right-skewed. For interpretative reasons, we decided to use means to summarize these data. Because of the large number of observations in each comparison group (e.g. more than 1000 boys and girls, respectively), statistical inferences (p values)are considered to be valid.

Comment: Could the authors specify whether they added random intercepts only for the three levels, or also random slopes?

Answer: The models were fit with random intercepts only. We clarified this in the methods section. ‘Because of the nested structure of the data with both fixed and random effects, a generalized linear mixed model (GLMM) was used for the analysis when comparing groups (models with random intercept)’

Comment: The authors mention that for binary outcomes a logit link function was used, and for continuous outcomes an identity link function. The methods only describe continuous variables for PA and SB, so if any of them are binary, please describe this earlier in the methods section.

Answer: Both, physical activity and screen time were analyzed as continuous as well as dichotomous variables. Physical activity was dichotomized by the WHO criterion of ‘being active for at least 60 minutes per day’. Screen time was dichotomized by ‘2 hours or more per day’. This is decribes in the methods section (Outcome measures); results are shown in Table 1c.

Comment: Could the authors also provide a rationale for why they added the respective outcome as covariate?

Answer: We wanted to investigate associations for the two variables PA and ST independently. We showed that being active is not necessarily associated with low screen time.

Comment: From the aims and introduction it is not clear why neighbourhood SES, school type and schools' neighbourhood SES were added to the models. Please provide a rationale.

Answer: We changed the approach of our multivariable analysis. We investigate now at first the association of the individual SES with PA and ST then of the neighbourhood SES with PA/ST (for both, we present crude and adjusted data), and then we add the other variables.
Please see the supplementary tables.

Comment: What do the authors mean by 'nominal p-values'?

Answer: Using the term 'nominal' we wanted to express that p-values were not adjusted for multiplicity (multiple testing), but are 'original' p-values. We changed and clarified this in the methods section.
'All p-values are considered exploratory (with no adjustment for multiple testing).'

Results: I see that the authors present here a flow chart, but perhaps this could be moved to the methods section.

Answer: According to the CONSORT guidelines, the recruitment flowchart is to be presented in the results section.

Comment: Table 1a and 1b present p-values, but it is unclear from the Methods and footnote of the Table where these p-values are derived from. Please describe in Methods section.

Answer: For 'Table 1a-c' we added the footnote 'descriptive statistical methods'. 'We also added a comment in the methods section.
'Characteristics of schools and students were analysed by descriptive statistical methods (e.g. mean and standard deviation (SD), frequencies and percentages; p-values are derived from t-tests and chi-square-tests).'

Comment: Why is the information presented in Table 2 not included in Table 1? PA and SB behaviours are also characteristics of the study sample.

Answer: Table 2 is also presenting Odds Ratios. It would be diffcult to include table 2 in table 1. However, we re-arranged the first part of the results section (first all text passages, after that the three tables) and changed the title of 'Table 2' into 'Table 1c') Also, we spelled out all abbreviations in the table.

Comment: Were PA and SB normally distributed and as such did they allow for the presentation of means?

Answer: Both, physical activity and screen time were not perfectly normally distributed, but were somewhat right-skewed. For interpretative reasons, we decided to use means to summarize these data. Because of the large number of observations in each comparison group (e.g. more than 1000 boys and girls, respectively), statistical inferences (p values)are considered to be valid.

Comment: Could the authors spell out all abbreviations used in their tables in the footnotes?

Answer: We did that according to the proposition.

Comment: On page 14 the authors describe results from interaction by gender, while this was not stated in the Methods section; please add.

Answer: We added this in the methods section.
'As sensitivity analyses, to assess if associations are modified by gender, interaction effects on gender were included into the models.'

Comment: Further, it is not clear to me why – when the aim of this paper is to study the association between individual and neighbourhood SES with PA/SB – the authors first present models without these independent variables included. I would have expected firstly a model with only neighbourhood/individual SES, and then the inclusion of potential confounders. Please make sure the aims, methods and results are aligned.
Also, with the present aim it is not necessary to describe the associations between covariates and outcomes.

Answer: We changed the approach of our multivariable analysis. We investigate now at first the association of the individual SES with PA and ST then of the neighbourhood SES with PA/ST (for both, we present crude and adjusted data), and then we add the other variables.
Please see the supplementary tables above.

Discussion: the first sentence of the discussion suggests a different study aim than the authors have described. Please match aims with results/discussion. Given the current aim, the discussion should only focus on the findings with regard to neighbourhood/individual SES, not associations of other covariates.
I suggest the authors spend a bit more text on interpreting their findings rather than just comparing with previous studies. What do the results mean?
I further disagree with the statement that 'physical activity is hardly influenced by neighbourhood SES'. The authors did not conduct a longitudinal or experimental study that allows for speculation about causality.

Answer: We revised the discussion section fundamentally taking the above comment into account.
Please see the discussion section

Comment: The conclusion should reflect the aims. Since it was not the aim to assess what proportion of students met the WHO guidelines and what range of covariates was associated with PA/SB, the conclusions and suggestions for prevention strategies are not appropriate for the study aims.

Answer: After the revision of the discussion section we also revised the conclusion.
'Lower individual and neighbourhood SES were independently associated with higher screen time in students. Physical activity was not associated with the individual SES, but with neighborhood SES. Both, individual and neighbourhood SES as well as school type are important factors that have to be considered, when developing prevention programs for school students. Future research should include measurement of the built environment in Berlin to provide new insights into associations with physical activity.'

VERSION 2 – REVIEW

REVIEWER	Bettina Bringolf-Isler Swiss Tropical and Public Health Institute Basel, Switzerland and University of Basel, Switzerland
REVIEW RETURNED	04-Sep-2017

GENERAL COMMENTS	The authors answered to most of my questions appropriately and the introduction, the method and the result part have much improved. The discussion part is still a weakness of the paper. On one hand the results are not adequately set in the context of the literature and on the other hand an interpretation of the findings is largely missing. It should be better elaborated what the implications are and what the study adds. Moreover, the text of the discussion part needs a more logical structure. One of my main concerns has been ignored by the authors: The self-report of PA is a limitation because for PA differences in response behaviour by SES have been shown previously. At least a respective statement in the limitation part should be included. In addition, I have some specific comments that I believe would contribute to improve the quality of the present manuscript. Abstract: The conclusions should derive from the results, therefore the school type should either be mentioned in the results part or be removed in the conclusions part. Introduction: P4 L 16: The IDEFIX paper and the KIGGS paper might not be appropriate references for a decrease of PA and an increase of sedentary behaviour over time as in the respective papers cross-sectional analyses were conducted. Methods P9 L12-29 This part should be revised, as it is not very clear. In addition, I suggest including the paragraph on page 12 (line 41-50) in the method part. Results P10 L3 According to the text in the results part boys were more active OUTSIDE SCHOOL than girls, but according to the methods part physical activity was asked for the whole day without distinction in time spent at school and time spent outside school. A clarification is needed. Table 1 The significant difference for age and the family affluence scale (FAS) by gender should be mentioned and explained in the text. Especially the significant difference for the FAS is surprising.

	Discussion: P14 L 28 The word “activity” is missing (after physical) P14 L 31 The authors assume that there was an interaction between the neighbourhood SES and the school type. This should be verified analysing the data. P14 48-59 This part is not well written and the statement not very clear. Why did the authors cite a study conducted in adults and focussing on cycling? There are several studies testing the association of neighbourhood factors and PA in children and adolescents. These studies are more appropriate for the research question and the study population of the present paper. Moreover, reference 24 can be added to 23 as in the respective paper also differences by subgroups were found, whereas the sentence “other authors also found associations of the built environment and physical activity” can be removed. P16 L11-15 The sentence about children and adolescents providing accurate and valid information is misleading and not appropriate in this context. The cited paper tested whether youth are cognitively able to report health outcomes (e.g. whether they have asthma or not). The problem of self-reported PA is not a cognitive one: children perform more spontaneous movements, resulting in brief bouts of varied intensities, which are difficult to capture with questionnaires. It is known that in children and adolescents PA-questionnaires showed a low validity when tested against objective measures.

REVIEWER	JD Mackenbach VU University Medical Center Amsterdam, the Netherlands
REVIEW RETURNED	21-Aug-2017

GENERAL COMMENTS	I would like to thank the authors for their substantive work on this manuscript. As a result, it has much improved. However, there are some remaining issues that I think need to be resolved before this study can be published. First, while the focus of the study has improved, the aims and methods are still not completely aligned. The aim of the study was to investigate the influence of individual and neighbourhood socio-economic status with physical activity and screen time. The authors present these analyses, but also present analyses where they mutually adjust the analyses with each socioeconomic indicator. It is unclear what the rationale behind this methodological choice was. Also, it seems like the authors do not value these results too much, as the interpretation of their results focuses completely on the analyses where no mutual adjustment took place. For example, in the abstract the authors mention the OR for neighbourhood SES retrieved from model 2b (OR=1.67, 95%CI=1.14;2.44), while the ORs in models 3a-3c are no longer significant. Why did the authors perform these analyses if they only interpret the analyses that were not mutually adjusted? In addition to that, it is still not clear why the authors used school neighbourhood SES as covariate (or exposure of interest?).

	In the methods, it is described as covariate, but in the results section, the authors describe that 'Schools' neighbourhood SES had no effect on physical activity nor on screen time.', thereby suggesting that they were interested in school neighbourhood SES as exposure of interest. If the school neighbourhood SES was just a covariate like any of the other covariates, than the interpretation of the models adjusted for school neighbourhood SES should be similar to the interpretation of the models adjusted for other covariates. This also goes for 'school type'. Second, it is problematic that the sample size differs between the statistical models. If the authors present different models because they would like to be able to draw conclusions from the differences between the models, than the sample size should be equal. Currently the authors cannot infer whether differences between models are due to the inclusion or covariates or due to the loss of individuals. I suggest the authors either perform complete case analyses (only include those individuals who have observations for each variable in each model) or to impute missing values using multiple imputation. Third, there are some smaller issues: - The text should undergo some language edits. The authors often use commas when unnecessary. For example, in the abstract: 1) "Neighbourhood SES was associated with both, PA and ST"; remove the comma between both and PA, 2) "Both, individual and neighbourhood SES […]"; remove the comma between bothy and individual. Also in the abstract: "[…] more than two hours of ST per day in screen time […]"; screen time is mentioned twice. These are just some examples, but please check the text carefully. - The conclusions in the abstract focus on the built environment, while the authors have not studied the association between the built environment and PA/ST. It might well be that any associations between neighbourhood SES and PA/ST are due to social environmental, rather than built environmental factors, but the authors did not study this. - Similarly, in the introduction the authors state that 'Knowing more about the influence of SES would make it possible to develop more targeted prevention strategies for vulnerable groups.', but this study does not allow for disentangling the underlying mechanisms that could be used for 'more targeted prevention strategies'. Perhaps the authors could explain this a bit more. - From the methods section, it is unclear what the exposure of interest is (individual SES, home neighbourhood SES, school neighbourhood SES, or only the first two?). Also, why why is migration background listed separately, rather than under 'individual level variables'? - I am not an expert in this area, but please check if it is necessary to perform cross-classified multilevel models rather than mixed models. Since the exposure of interest ('home neighbourhood SES') is not measured at the level of the school and not measured at the level of the class (half of the class can be living in neighbourhood A while the other half can be living in neighbourhood B) it may be necessary to account for additional clustering of students within home neighbourhoods (see the figure below). - It is unclear why the authors need tables 1a and 1c to show the differences between boys and girls, while this is not the primary aim of the study. - The discussion should be adapted reflecting the updated analyses (complete cases or imputed data).

	- In the discussion, the authors speculate that 'other factors like the built environment play a more important role than individual or neighbourhood SES'. This is puzzling to me, as the built environment was introduced as a potential explanatory mechanism in the introduction. Please explain whether the authors view the built environment as an explanation of the socioeconomic differences in PA and ST, or whether they view the built environment as a separate factor also influencing PA and ST. - I did not have access to any of the figures so could not assess those.

VERSION 2 – AUTHOR RESPONSE

Reviewer: 1
Reviewer Name: Bettina Bringolf-Isler
Institution and Country: Swiss Tropical and Public Health Institute Basel, Switzerland and University of Basel, Switzerland Please state any competing interests or state 'None declared': None decleared

Please leave your comments for the authors below

1. The authors answered to most of my questions appropriately and the introduction, the method and the result part have much improved.
The discussion part is still a weakness of the paper. On one hand the results are not adequately set in the context of the literature and on the other hand an interpretation of the findings is largely missing. It should be better elaborated what the implications are and what the study adds. Moreover, the text of the discussion part needs a more logical structure.

Answer: We completely restructured and revised the discussion part, taking the above suggestions into consideration.

2. One of my main concerns has been ignored by the authors: The self-report of PA is a limitation because for PA differences in response behaviour by SES have been shown previously. At least a respective statement in the limitation part should be included.

Answer: We apologize for overlooking part of this previous comment. We have now added this aspect in the limitations of our manuscript in the following way:

"Self-report of children and adolescents, especially regarding PA, may lead to biased results through misreporting(75). Measurement errors associated with self-report may further be influenced by SES of adolescents(76)."

In addition, I have some specific comments that I believe would contribute to improve the quality of the present manuscript.

3. Abstract:
The conclusions should derive from the results, therefore the school type should either be mentioned in the results part or be removed in the conclusions part.

Answer: According to the proposition of the reviewer we concentrated the conclusions only on our main results:

“Lower individual SES was only associated with higher ST but not with PA, whereas lower neighbourhood SES was associated with higher PA and higher ST. After consideration of the school environment (school type and schools neighbourhood SES) the effect of neighbourhood SES on PA and ST was attenuated somewhat, suggesting an important role in the complex relationship between individual SES, neighbourhood SES and school environment. Further research is war-ranted to unravel these relationships and to develop more targeted health promotion strategies in the future."

4. Introduction:
P4 L 16: The IDEFIX paper and the KIGGS paper might not be appropriate references for a decrease of PA and an increase of sedentary behaviour over time as in the respective papers cross-sectional analyses were conducted.

Answer: We added two recent studies investigating physical activity and sedentary behaviour longitudinally. We changed the sentence in the introduction section as follows:

“In the last decades however, sedentary behaviour among children and adolescents is increasing while the rates of children being active appear to be decreasing over time(4–7). In addition, longitudinal studies have shown a decline in PA and at the same time an increase in sedentary behaviour among children and adolescents with increasing age(8–10).“

5. Methods
P9 L12-29 This part should be revised, as it is not very clear. In addition, I suggest including the paragraph on page 12 (line 41-50) in the method part.

Answer: We revised the statistical analysis section and moved the description of the multivariable models from the results section to the statistical analysis section as proposed:

”Because of the nested structure of the data with both fixed and random effects, a generalized linear mixed model (GLMM) with a logit link function was used for the analysis when comparing groups (models with random intercept). In general, the random factors ‘school’ and ‘class within school’ (as nested factor) were included into the models, with either physical activity or screen time as the dependent variable. Results are presented as odds ratios (OR) and 95%-confidence intervals (CI). These models were used to determine the association of several factors. For physical activity as the dependent variable, sex, migration background, BMI and screen time were included into all models, in addition with either or both individual socioeconomic status (FAS-score) (Model 1) or students’ neighbourhood SES (Model 2) or both (Model 3a). A final model included the aforementioned plus the two school level variables school type and schools’ neighbourhood (Model 3b). The same procedure was performed for screen time as the dependent variable, respectively.”

6. Results
P10 L3 According to the text in the results part boys were more active OUTSIDE SCHOOL than girls, but according to the methods part physical activity was asked for the whole day without distinction in time spent at school and time spent outside school. A clarification is needed.

Answer: Thank you for pointing out this contradiction. The wording was wrong: as described in other parts of the manuscript we assessed the overall physical activity and not just the leisure time PA. We deleted the words “outside school”.

“Of the total sample, 12.8% fulfilled the WHO criteria being active for at least 60 minutes per day. The proportion of boys fulfilling the criteria was higher than in girls (15.9% of the boys vs. 9.8% of the girls, OR 1.7 [1.4;2.2]; p<0.001) and boys were more active than girls (0.9±0.8 versus 0.6±0.6 hours per day, mean difference 0.3 hours [0.2;0.3], p<0.001).”

7. Table 1
The significant difference for age and the family affluence scale (FAS) by gender should be mentioned and explained in the text. Especially the significant difference for the FAS is surprising.

Answer: The mean age of participating girls and boys was similar: 12.4 years and 12.5 years. Due to the large sample size (n=2586) and especially due to the small variation in age (only 12 and 13 years old students) this small gender difference in mean age has a low p-value. However, the difference in 0.1 years between girls and boys is not considered relevant.

Regarding the FAS difference we now mention this finding in the result section:
“Boys reported more often a high individual SES than girls (53.7% vs. 46.3%).”

We have now also added it in our discussion under strengths and limitations:
“We also found differences in the self-report FAS of boys and girls, which is somewhat surprising. It is possible that the structure of the questionnaire led to an overestimation among boys due to a higher interest in cars and computers (i.e. two key elements of the FAS).”

8. Discussion:
P14 L 28 The word “activity” is missing (after physical)

Answer: Thank you for this comment. We added the word “activity”.

9. P14 L 31 The authors assume that there was an interaction between the neighbourhood SES and the school type. This should be verified analysing the data.

Answer: We agree with the comment. We added the following phrase to the result section:

“An association between the students’ neighbourhood SES and the school type could be observed, indicating that the mean students’ neighbourhood SES was higher among highschool students than integrated secondary school students.”

We added the following phrase to the discussion section:
“A possible explanation for this finding could be that adolescents living in areas with lower neighbourhood SES are more often attending an integrated secondary school.”

10. P14 48-59 This part is not well written and the statement not very clear. Why did the authors cite a study conducted in adults and focussing on cycling? There are several studies testing the association of neighbourhood factors and PA in children and adolescents. These studies are more appropriate for the research question and the study population of the present paper. Moreover, reference 24 can be added to 23 as in the respective paper also differences by subgroups were found, whereas the sentence “other authors also found associations of the built environment and physical activity” can be removed.

Answer: We revised the discussion section substantially according to suggestions. The respective paragraph now reads:
“In addition to individual and neighbourhood SES, other factors like the built environment (i.e. number of public transport stops, residential density, intersection density and the number of parks) could also play an important role in adolescents’ health behaviors(73). These factors may be mediators of the observed associations but studies have also suggested that associations may be moderated by the built environment (studies have shown that individuals with low neighbourhood SES had a greater benefit of a good walkability than those with a high neighbourhood SES)(31,32). Future research should therefore also include measurements of the built environment in Berlin to provide new insights into the associations with PA.”

11. P16 L11-15 The sentence about children and adolescents providing accurate and valid information is misleading and not appropriate in this context. The cited paper tested whether youth are cognitively able to report health outcomes (e.g. whether they have asthma or not). The problem of self-reported PA is not a cognitive one: children perform more spontaneous movements, resulting in brief bouts of varied intensities, which are difficult to capture with questionnaires. It is known that in children and adolescents PA-questionnaires showed a low validity when tested against objective measures.

Answer: We agree with the reviewer and added this as a limitation:

“Self-report of children and adolescents, especially regarding PA, may lead to biased results through misreporting(75). Measurement errors associated with self-report may further be influenced by SES of adolescents(76). Future studies should use accelerometers or other means to objectively measure PA and sedentary behaviour(77).“

Reviewer: 2
Reviewer Name: JD Mackenbach
Institution and Country: VU University Medical Center Amsterdam, the Netherlands
Please state any competing interests or state ‘None declared’: None declared

Please leave your comments for the authors below
Please see attached PDF file.

I would like to thank the authors for their substantive work on this manuscript. As a result, it has much improved. However, there are some remaining issues that I think need to be resolved before this study can be published.

1. First, while the focus of the study has improved, the aims and methods are still not completely aligned. The aim of the study was to investigate the influence of individual and neighbourhood socioeconomic status with physical activity and screen time. The authors present these analyses, but also present analyses where they mutually adjust the analyses with each socioeconomic indicator. It is unclear what the rationale behind this methodological choice was.

Answer: We revised the methods section in order to clarify that school type and schools’ neighbourhood SES were covariates that were included in the final model:

“These models were used to determine the association of several factors. For physical activity as the dependent variable, sex, migration background, BMI and screen time were included into all models, in addition with individual socioeconomic status (FAS-score) (Model 1) or students’ neighbourhood SES (Model 2) or both (Model 3a). A final model included the aforementioned plus the two school level variables school type and schools’ neighbourhood (Model 3b). The same procedure was performed for screen time as the dependent variable, respectively.”

2. Also, it seems like the authors do not value these results too much, as the interpretation of their results focuses completely on the analyses where no mutual adjustment took place. For example, in the abstract the authors mention the OR for neighbourhood SES retrieved from model 2b (OR=1.67, 95%CI=1.14;2.44), while the ORs in models 3a-3c are no longer significant. Why did the authors perform these analyses if they only interpret the analyses that were not mutually adjusted?
In addition to that, it is still not clear why the authors used school neighbourhood SES as covariate (or exposure of interest?). In the methods, it is described as covariate, but in the results section, the authors describe that ‘Schools’ neighbourhood SES had no effect on physical activity nor on screen time.’, thereby suggesting that they were interested in school neighbourhood SES as exposure of interest. If the school neighbourhood SES was just a covariate like any of the other covariates, than the interpretation of the models adjusted for school neighbourhood SES should be similar to the interpretation of the models adjusted for other covariates. This also goes for ‘school type’.

Answer: We thank the reviewer for pointing out this inconsistency. We have now clarified it and present four models (1,2,3a and 3b) to make our analyses strategy easier to follow. Model 1 includes only the individual SES, Model 2 includes only the neighbourhood SES. Both models are adjusted for individual covariates. Model 3a includes both individual and neighbourhood SES (again adjusted for individual corariates), Model 3b is additionally adjusted for school type and schools’ neighbourhood SES. Regarding the inconsistency of the role of school type and schools’ neighbourhood SES (covariate or exposure of interest?) we made clear that these both variables are covariates in the final model and no additional exposures of interest. However, we discuss the influence of school type as a potential objective for future research.
We revised the results section as follows:

“Individual SES was not associated with PA, but with ST. The lower the students’ SES the higher the odds to spent more than two hours of ST per day (1.31 [1.00; 1.72] and 2.08 [1.26; 3.43]; p=0.008) for middle and low individual SES, respectively, compared to high SES). This associa-tion was attenuated slightly when additionally adjusting for school type and school neighbour-hood SES (1.25 [0.95;1.64] and 1.88 [1.12;3.14]; p=0.036).
In contrast to individual SES, a lower neighbourhood SES was associated with a higher odds of engaging in 60 minutes per day in PA (1.34 [0.86;2.08] and 1.76 [1.12; 2.75]) for middle and low neighbourhood SES, respectively, compared to high neighbourhood SES; this association was attenuated somewhat when additionally adjusting for the school type and schools’ neigh-bourhood SES.
Compared with high neighbourhood SES, students with lower neighbourhood SES were also more likely to spend more than two hours of ST per day. The effect was stronger for low than for middle neighbourhood SES (1.54 [1.10; 2.17] and 1.03 [0.75; 1.41]), and remained largely consistent when additionally adjusting for school type and school neighbourhood SES (1.40 [0.98; 2.00] and 1.37 [0.99; 1.91]).
There was no interaction effect between gender and ST regarding PA, nor between gender and PA regarding ST (data not shown).”

3. Second, it is problematic that the sample size differs between the statistical models. If the authors present different models because they would like to be able to draw conclusions from the differences between the models, than the sample size should be equal. Currently the authors cannot infer whether differences between models are due to the inclusion or covariates or due to the loss of individuals. I suggest the authors either perform complete case analyses (only include those individuals who have observations for each variable in each model) or to impute missing values using multiple imputation.

Answer: As proposed we now also performed the multivariable analyses as complete case analyses with equal sample sizes. The results did not change considerably. Within the manuscript we are now primarily presenting the results of the multivariable analysis using complete cases by means of forest plots. We added the respective tables as supplementary tables (new supplementary files 1 and 2). In addition we present results from unequal sample sizes as supplementary files 3 and 4.

4. Third, there are some smaller issues:
- The text should undergo some language edits. The authors often use commas when unnecessary. For example, in the abstract: 1) “Neighbourhood SES was associated with both, PA and ST”; remove the comma between both and PA, 2) “Both, individual and neighbourhood SES […]”; remove the comma between bothy and individual. Also in the abstract: “[…] more than two hours of ST per day in screen time […]”; screen time is mentioned twice. These are just some examples, but please check the text carefully.

Answer: We have carefully revised the whole manuscript.

5. The conclusions in the abstract focus on the built environment, while the authors have not studied the association between the built environment and PA/ST. It might well be that any associations between neighbourhood SES and PA/ST are due to social environmental, rather than built environmental factors, but the authors did not study this.

Answer: We agree with the reviewer and have revised our conclusions as follows:

“Lower individual SES was only associated with higher ST but not with PA, whereas lower neighbourhood SES was associated with higher PA and higher ST. After consideration of the school environment (school type and schools neighbourhood SES) the effect of neighbourhood SES on PA and ST was attenuated somewhat, suggesting an important role in the complex relationship between individual SES, neighbourhood SES and school environment. Further research is warranted to unravel these relationships and to develop more targeted health promotion strategies in the future.”

6. Similarly, in the introduction the authors state that ‘Knowing more about the influence of SES would make it possible to develop more targeted prevention strategies for vulnerable groups.’, but this study does not allow for disentangling the underlying mechanisms that could be used for ‘more targeted prevention strategies’. Perhaps the authors could explain this a bit more.

Answer: We agree with the reviewer and stepped back from this wording. We changed the sentence and described the possible study aim as follows:

“Knowing more about independent associations of individual and neighbourhood SES could help to address more targeted groups of adolescents in a more targeted way when implementing prevention strategies (e.g. adapting the content of health promotion strategies to different neighbourhoods).”

7. From the methods section, it is unclear what the exposure of interest is (individual SES, home neighbourhood SES, school neighbourhood SES, or only the first two?). Also, why is migration background listed separately, rather than under ‘individual level variables’?

Answer: We have clarified this in line with previous comments.

8. I am not an expert in this area, but please check if it is necessary to perform cross-classified multilevel models rather than mixed models. Since the exposure of interest (‘home neighbourhood SES’) is not measured at the level of the school and not measured at the level of the class (half of the class can be living in neighbourhood A while the other half can be living in neighbourhood B) it may be necessary to account for additional clustering of students within home neighbourhoods (see the figure below).

Answer: We agree with the reviewer that the data has a partially cross-classified structure (as well as a nested/hierarchical structure). Students nested within classes within schools show a hierarchical form, while students’ neighbourhood SES is cross-classified with respect to the school and class clusters. However, for the analysis, we want to assess the association of physical activity (or screen time) with students’ neighbourhood SES. We thus need to include students’ neighbourhood SES as a fixed effect into the model (to obtain odds ratios). Contrary to this approach, for the clusters schools and classes within schools as random effects, the aim is to account for the clustered data structure (in order to obtain correct p-values and confidence intervals) and not to assess associations.

9. It is unclear why the authors need tables 1a and 1c to show the differences between boys and girls, while this is not the primary aim of the study.

Answer: We agree that this is not the primary aim of the study. However we feel that it provides valuable information regarding the the study population. However, if the editors feel that the number of tables should be reduced we could omit this part.

10. The discussion should be adapted reflecting the updated analyses (complete cases or imputed data).

Answer: We revised the analysis and updated the discussion section according to suggestions.

11. In the discussion, the authors speculate that ‘other factors like the built environment play a more important role than individual or neighbourhood SES’. This is puzzling to me, as the built environment was introduced as a potential explanatory mechanism in the introduction. Please explain whether the authors view the built environment as an explanation of the socioeconomic differences in PA and ST, or whether they view the built environment as a separate factor also influencing PA and ST.

Answer: Built environment could be a mediating factor on the one hand (e.g. poorer districts have less money for playgrounds, sport fields etc), but the built envioronment may also have influences independent from neighbourhood SES (e.g. safety or the fact that certain features, such as cycling lanes etc. may not determined at the neighbourhood level and are thus independent from SES). We changed that part of the discussion section accordingly:

„In addition to individual and neighbourhood SES, other factors like the built environment (i.e. number of public transport stops, residential density, intersection density and the number of parks) could also play an important role in adolescents’ health behaviors(73). These factors may be mediators of the observed associations but studies have also suggested that associations may be moderated by the built environment (studies have shown that individuals with low neighbourhood SES had a greater benefit of a good walkability than those with a high neighbourhood SES)(31,32).

Future research should therefore also include measurements of the built environment in Berlin to provide new insights into the associations with PA."

12. I did not have access to any of the figures so could not assess those.

VERSION 3 – REVIEW

REVIEWER	Bettina Bringolf-Isler Swiss TPH Basel, Switzerland University of Basel, Switzerland
REVIEW RETURNED	16-Oct-2017

GENERAL COMMENTS	Thank you for the comprehensive revision. The manuscript has much improved. However, there are still some minor issues that should be adopted. Abstract: The odds ratios presented in the result part are different from those in the main text and they are probably not the intended ones as they are both non-significant. Introduction: Page 4 line 6: The IDEFICS and the KIGGS paper are still used as a reference for trends over time. This is not appropriate as the cited papers describe cross-sectional findings. Other papers should be cited. Methods: Page 6 "Outcome measures physical activity": The second question is not well described. Please specify. Was it really a "two-in-one" question (MPA per day and days per week)? What was the outcome: Hours of MPA per week? I could not find any results based on MPA per week in the result-section. Results: Page 9 line 4 from the bottom: "School characteristics of…" (a word is missing) Page 12: The title of table 1c does not well describe the content. However, I suggest to present another table: Instead of differences by sex, one comparing PA and ST by neighborhood SES and/or individual SES as these are the two main research questions. The results by sex could be included in the text. In addition it should at least be shown whether there was an association between individual and neighborhood SES. (including a p-value). Page 13 line 6 from the bottom: The results of the adjusted odds ratios are missing. Page 13 line 4 from the bottom: The word "stronger" implies that there was also a difference between middle neighborhood SES and high neighborhood SES, this should be changed as no difference was found.

	Page 13 line 3 from the bottom: It is not true that the adjusted results are largely consistent when additionally adjusting for school type and school neighborhood SES. On the one hand both odds ratios became non-significant and on the other hand the odds ratio for middle neighborhoods SES became similar to the OR for low neighborhood SES. Conclusion I suggest clarifying that lower neighborhood SES was associated with higher PA and higher ST compared to higher neighborhood SES.

REVIEWER	JD Mackenbach VU University Medical Center Amsterdam
REVIEW RETURNED	15-Oct-2017

GENERAL COMMENTS	I think the author(s) have done a great job on the revisions for this manuscript and should be commended for undertaking such a substantial project. I do, however, have a number of additional comments about the manuscript. 1. The flowchart should be adapted since no longer N=2586 were included in the analysis, but N=1523. 2. The second and third figure (with regression coefficients) should have a footnote explaining the bold variables. 3. The authors have greatly improved the linkage between the aims and the methods/results. However, in the abstract, this is still confusing. The authors state that it is their aim to relate individual and neighbourhood SES to PA and ST. They provide the results of these analyses, but in their conclusion section focus on the adjustment for school type and schools' neighbourhood SES, which was not the aim of this study. Or perhaps it was, but then the aims should be adapted. In fact, the authors have much improved their Results section to reflect their aims, but the abstract and Discussion section could be further improved. The authors spend quite some text in the Discussion on the 'complex interplay between individual SES, neighbourhood SES and the school environment', while they did not investigate this interplay. They added two school-level variables to the model, but did not test an interaction between school-level variables and individual and neighbourhood SES (or other types of interactions) that warrants the speculation about a complex interplay between these factors. Please further adjust the text so that it matches the aim, or vice versa. 4. Also, the sentence 'Additional adjustment for school type and neighbourhood SES attenuated the associations somewhat.' in the results section is confusing, since the coefficients that the authors present are already adjusted for these two variables (so the coefficients are not further attenuated than what is already presented). The authors could perhaps say: "After adjustment for [these and these covariates], …". 5. Finally, neighbourhood SES was not significantly associated with PA or ST -if defined by $p<0.05$- which is in contrast with what the authors present in the abstract and the Discussion. The authors should be clear about what they regard as statistical significance. If they do not wish to focus on statistically significant results they should present other results in the abstract as well (e.g., association of individual SES with PA). In any case, the Discussion section should reflect the fact that neighbourhood SES was not significantly associated with PA or ST, and this is currently not the case.

VERSION 3 – AUTHOR RESPONSE

Reviewer: 1
Reviewer Name: Bettina Bringolf-Isler
Institution and Country: Swiss TPH Basel, Switzerland; University of Basel, Switzerland Please state any competing interests or state 'None declared': None decleared

Please leave your comments for the authors below Thank you for the comprehensive revision. The manuscript has much improved. However, there are still some minor issues that should be adopted.

1. Abstract:
The odds ratios presented in the result part are different from those in the main text and they are probably not the intended ones as they are both non-significant.

Answer: We revised the results section in the abstract and in the main text. We present now the results 1. with adjustment for individual variabels and 2. with adjustment for all variables including school variables. Due to limited space in the abstract we present only the comparison between low and high individual and neighbourhood SES.

"Results Mean (±SD) age was 12.5±0.5 years, 50.5% were girls, and 34.1% had a migrant background. When adjusting for individual covariates, associations of low versus high individual SES were 0.85 [0.48;1.52] for PA and 2.08 [1.26;3.43] for ST. Associations of low versus high neighbourhood SES were 1.76 [1.12;2.75] for PA and 1.54 [1.10;2.17] for ST. After additional adjustment for school type and school neighbourhood SES, associations comparing low versus high individual and neighbourhood SES were attenuated for PA (individual SES 0.74 [0.41;1.33] and neighbourhood SES 1.51 [0.93;2.46]) and ST (individual SES 1.88 [1.12;3.14] and neighbourhood SES 1.40 [0.98;2.00]."

2. Introduction:
Page 4 line 6: The IDEFICS and the KIGGS paper are still used as a reference for trends over time. This is not appropriate as the cited papers describe cross-sectional findings. Other papers should be cited.

Answer: We removed both papers and apologize for having omitted this in the last revision. We added two more appropriate papers that show results of temporal trends regarding physical activity and screen time among youths (Sigmund et al, 2015 and Loprinzi et al, 2016).

3. Methods:
Page 6 "Outcome measures physical activity": The second question is not well described. Please specify. Was it really a "two-in-one" question (MPA per day and days per week)? What was the outcome: Hours of MPA per week? I could not find any results based on MPA per week in the result-section.

Answer: We now added the original question and the explanation how we calculated the number of hours of physical activity per day:

"The other question asked for the number of hours of moderate intensity PA per week ('How many hours per week are you physically active (any activity that increases your heart rate and makes you get out of breath)?') with examples of such activities. This number was divided by seven to obtain the number of hours of PA per day."

4. Results:
Page 9 line 4 from the bottom: “School characteristics of…” (a word is missing)

Answer: The word “of” was redundant and we deleted it.

5. Page 12: The title of table 1c does not well describe the content. However, I suggest to present another table: Instead of differences by sex, one comparing PA and ST by neighborhood SES and/or individual SES as these are the two main research questions. The results by sex could be included in the text. In addition it should at least be shown whether there was an association between individual and neighborhood SES. (including a p-value).

Answer: Considering this and previous comments we decided to delete the table 1c and to present the results only in the main text. The correlation between individual and neighbourhood SES was 0.36 with $p<0.001$. We added that to the results section:
“Individual and neighbourhood SES were moderately correlated (spearman’s rank correlation coefficient =0.36; $p<0.001$).”

6. Page 13 line 6 from the bottom: The results of the adjusted odds ratios are missing.

Answer: As described in the answer to question 1, we revised the results section and present now the results 1. with adjustment for individual variables and 2. with additional adjustment for school variables.

7. Page 13 line 4 from the bottom: The word “stronger” implies that there was also a difference between middle neighborhood SES and high neighborhood SES, this should be changed as no difference was found.
Page 13 line 3 from the bottom: It is not true that the adjusted results are largely consistent when additionally adjusting for school type and school neighborhood SES. On the one hand both odds ratios became non-significant and on the other hand the odds ratio for middle neighborhoods SES became similar to the OR for low neighborhood SES.

Answer: To clarify the paragraph we revised it as follows:
“Compared with high neighbourhood SES, students with low neighbourhood SES were more likely to spend more than two hours of ST per day (OR 1.54 [1.10; 2.17]), while there was no association for students with middle neighbourhood SES (1.03 [0.75; 1.41]); $p=0.019$). When additionally adjusting for school variables, neighbourhood SES was no longer independently associated with ST and the OR of middle and low neighborhood SES, compared to high neighbourhood SES, became almost equal (1.37 [0.99; 1.91] and 1.40 [0.98; 2.00]; $p=0.109$).”

8. Conclusion
I suggest clarifying that lower neighborhood SES was associated with higher PA and higher ST compared to higher neighborhood SES.

Answer: We revised the conclusion as follows:
“Lower individual and neighbourhood SES was associated with higher ST. Lower neighbourhood but not individual SES was associated with higher PA. After consideration of school type and school neighbourhood SES, associations were attenuated and became insignificant for the relationship between neighbourhood SES, PA and ST. Further research is warranted to unravel the complex relationships between individual SES, neighbourhood SES and school environment to develop more targeted health promotion strategies in the future.”

Reviewer: 2
Reviewer Name: JD Mackenbach
Institution and Country: VU University Medical Center Amsterdam Please state any competing interests or state 'None declared': None declared

Please leave your comments for the authors below I think the author(s) have done a great job on the revisions for this manuscript and should be commended for undertaking such a substantial project. I do, however, have a number of additional comments about the manuscript.

1. The flowchart should be adapted since no longer N=2586 were included in the analysis, but N=1523.

Answer: We modified the flowchart to describe the sample of n=1523 which was used for our complete case analysis. Please see Figure 1.

2. The second and third figure (with regression coefficients) should have a footnote explaining the bold variables.

Answer: We decided to present the results in the forest plots without bold characters and therefore did not add a footnote. Please see Figure 2 and Figure 3.

3. The authors have greatly improved the linkage between the aims and the methods/results. However, in the abstract, this is still confusing. The authors state that it is their aim to relate individual and neighbourhood SES to PA and ST. They provide the results of these analyses, but in their conclusion section focus on the adjustment for school type and schools' neighbourhood SES, which was not the aim of this study. Or perhaps it was, but then the aims should be adapted.

Also, the sentence 'Additional adjustment for school type and neighbourhood SES attenuated the associations somewhat.' in the results section is confusing, since the coefficients that the authors present are already adjusted for these two variables (so the coefficients are not further attenuated than what is already presented). The authors could perhaps say: "After adjustment for [these and these covariates], …".

Answer: We revised the abstract and the results section and present now all results (1. With adjustment for individual variabels and 2. With adjustment for school variables). We don't focus on the adjustment for the school variables but present them separately in the result sections of the abstract and the main text.

"Results Mean (±SD) age was 12.5±0.5 years, 50.5% were girls, and 34.1% had a migrant background. When adjusting for individual covariates, associations of low versus high individual SES were 0.85 [0.48;1.52] for PA and 2.08 [1.26;3.43] for ST. Associations of low versus high neighbourhood SES were 1.76 [1.12;2.75] for PA and 1.54 [1.10;2.17] for ST. After additional adjustment for school type and school neighbourhood SES, associations comparing low versus high individual and neighbourhood SES were attenuated for PA (individual SES 0.74 [0.41;1.33] and neighbourhood SES 1.51 [0.93;2.46]) and ST (individual SES 1.88 [1.12;3.14] and neighbourhood SES 1.40 [0.98;2.00]."

4. In fact, the authors have much improved their Results section to reflect their aims, but the abstract and Discussion section could be further improved. The authors spend quite some text in the Discussion on the 'complex interplay between individual SES, neighbourhood SES and the school environment', while they did not investigate this interplay.

They added two school-level variables to the model, but did not test an interaction between school-level variables and individual and neighbourhood SES (or other types of interactions) that warrants the speculation about a complex interplay between these factors. Please further adjust the text so that it matches the aim, or vice versa.

Answer: We agree with the reviewer that many interactions could be possible. If we would investigate interactions between the two forms of SES (with three categories each) and the two school variables, we would find almost 20 different pairs of variables that interact. We wanted to avoid “picking” results since that could be considered as multiple testing. In contrast, we think that the discussion part allows to hypothesize about potential explanations, which is what we did by mentioning the complex interplay between the different forms of SES and the school variables. In addition, we cited other studies that have investigated this topic and suggest further investigations of this topic in future research.

5. Finally, neighbourhood SES was not significantly associated with PA or ST -if defined by $p<0.05$- which is in contrast with what the authors present in the abstract and the Discussion. The authors should be clear about what they regard as statistical significance. If they do not wish to focus on statistically significant results they should present other results in the abstract as well (e.g., association of individual SES with PA). In any case, the Discussion section should reflect the fact that neighbourhood SES was not significantly associated with PA or ST, and this is currently not the case.

Answer: As described in the methods section, all p-values are considered exploratory. For all results, we present OR with confidence intervalls. In our results section as well as in the conclusion we mention now that after adjustment for school variabels neighbourhood SES was not any longer independently associated with PA and ST and we also present p-values.
Results (main text)
“In multivariable analyses individual SES was not associated with PA. The ORs after adjustment for individual factors were 0.90 [0.63;1.29] and 0.85 [0.48;1.52]; p=0.792 for middle and low SES, respectively, compared to high SES. Additional adjustment for school type and school neighbourhood SES did not change the results notably (0.83 [0.58;1.20] and 0.74 [0.41;1.33]; p=0.476). ST in contrast was associated with individual SES. The lower the students’ SES the higher the odds to spent more than two hours of ST per day (1.31 [1.00; 1.72] and 2.08 [1.26; 3.43]; p=0.008) for middle and low individual SES, respectively, compared to high SES. This association was attenuated slightly when additionally adjusting for school variables (1.25 [0.95;1.64] and 1.88 [1.12;3.14]; p=0.036).
In contrast to individual SES, a lower neighbourhood SES was associated with a higher odds of engaging in 60 minutes per day in PA (1.34 [0.86;2.08] and 1.76 [1.12; 2.75]; p=0.047) for middle and low neighbourhood SES, respectively, compared to high neighbourhood SES after adjustment for individual factors; after adjustment for school variables, the association of neighbourhood SES with PA was attenuated somewhat and no longer independently associated (OR 1.19 [0.78; 1.82] and 1.51 [0.93; 2.46]; p=0.253).
Compared with high neighbourhood SES, students with low neighbourhood SES were more likely to spend more than two hours of ST per day (OR 1.54 [1.10; 2.17]), while there was no association for students with middle neighbourhood SES ((1.03 [0.75; 1.41]); p=0.019). When additionally adjusting for school variables, neighbourhood SES was no longer independently associated with ST and the OR of middle and low neighborhood SES became almost equal (1.37 [0.99; 1.91] and 1.40 [0.98; 2.00]; p=0.109), compared to high neighbourhood SES. There was no interaction effect between gender and ST regarding PA, nor between gender and PA regarding ST (data not shown).”

Conclusion
“Lower individual and neighbourhood SES was associated with higher ST. Lower neighbourhood but not individual SES was associated with higher PA. After consideration of school type and schools’ neighbourhood SES associations were attenuated and became insignificant for the relationship between neighbourhood SES, PA and ST.

Further research is warranted to unravel the complex relationships between individual SES, neighbourhood SES and school environment to develop more targeted health promotion strategies in the future.“

VERSION 4 – REVIEW

REVIEWER	Bettina Bringolf-Isler Swiss TPH Basel and University of Basel, Switzerland
REVIEW RETURNED	09-Nov-2017

GENERAL COMMENTS	Thank you for the revision. I have no further comments.