

## PEER REVIEW HISTORY

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### ARTICLE DETAILS

<b>TITLE (PROVISIONAL)</b>	Camden Active Spaces: Does the Construction of Active School Playgrounds Influence Children's Physical Activity Levels? A Longitudinal Quasi-Experiment Protocol
<b>AUTHORS</b>	Smith, Lee; Kipps, Courtney; Aggio, Daniel; Fox, Paul; Robinson, Nigel; Trend, Verena; Munnery, Suzie; Kelly, Barry; Hamer, Mark

### VERSION 1 - REVIEW

<b>REVIEWER</b>	Associate Professor Rachael Taylor University of Otago Dunedin, New Zealand
<b>REVIEW RETURNED</b>	17-Jun-2014

<b>GENERAL COMMENTS</b>	<p>The paper presents an interesting project examining how changes to school playgrounds might affect PA in children of all ages. While it is an interesting study, insufficient information was provided regarding 1) what those changes might be and 2) the limitations of the design. Nowhere do the authors acknowledge that this is a weaker study design for the lack of control groups - this must be added. Why not recruit 7 additional schools to act as controls - it obviously can't be an RCT but is Camden large enough to be able to find 7 similar schools? It would provide a much stronger study given that 1) the authors are only looking for a small effect size and 2) being involved in interventions often changes behaviour - which can be accounted for if control groups are included.</p> <p>Specific comments:</p> <ol style="list-style-type: none"><li>1. I was surprised in some way at this comment "Children spend approximately 60% of their weekday in school where physical 117 activity levels are at their lowest" in the introduction - I had thought the prevailing view was that much of the MVPA children participate in takes place at school? You seem to be suggesting that children are very inactive at school?</li><li>2. It would be useful to (very) briefly summarise any interventions that have tried to change the playgrounds. The authors only include two studies - but there is quite a body of work that has included changes to playgrounds within a wider intervention - and this should be summarised (eg. Am J Pub Health 2010;100:1672, JPAH 2010;7:167, J Phys Act health 2008;5:319, Advances in Nutrition 2011;2:171S, Preve Med 2005;41:828 etc).</li><li>3. More information on the qualitative work in each school which led to redesign of the playgrounds would be an advantage - perhaps this could be summarised fairly easily as a table?</li><li>4. Page 11 - what intensity cutoffs will be used given your wide age range? What are your data reduction procedures ie. minimum hours, non-wear time etc</li></ol>
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	<p>5. If fasting conditions for BIA are not possible (which I assume they aren't) this should be clearly stated. Are any guidelines being followed? eg voiding before measurement etc</p> <p>6. The GEMS study did not include children as young as 5 (think they were 8-10) so what procedures will be put in place to ensure that 5 year olds understand the questionnaire? This would seem unlikely to me knowing some of these questions.</p> <p>7. More information is required on the assessment of playground policy - will only 1 head teacher per school assess this? This only provides of course a sample of 7. What other questions are included? How will this data be used. Will it also be assessed at all time points?</p> <p>8. What loss to follow-up do you expect over the course of this study?</p> <p>9. The abstract does not appear to be conventional</p> <p>This is a protocol paper outlining a proposed project. While the project itself is interesting I felt insufficient detail was provided in terms of background and methods given not results or discussion is included. My recommendation is because I felt in its current form it was not of great interest to the BMJ readership. However, with expansion of the intro/methods it could be suitable for publication.</p>
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<b>REVIEWER</b>	<p>Sanne de Vries The Hague University of Applied Sciences, Research group Healthy Lifestyle in a Supporting Environment The Hague, The Netherlands</p>
<b>REVIEW RETURNED</b>	08-Jul-2014

<b>GENERAL COMMENTS</b>	<p>This papers describes the protocol to evaluate a playground intervention on children's physical activity level.</p> <p>Abstract: according to the abstract the primary aim of the study is to discover how playground design influences children's PA. The term HOW suggests you examine working mechanisms. This is not the case in this study. Please mention the lack of control-group in the abstract and specify the age range of the study population and whether you focus on PA in general or during recess or both. Given the aim of the study it is not clear why fitness tests and anthropometric measurements are conducted. Can you explicitly mention the use of (ActiGraph) accelerometers in the abstract?</p> <p>Introduction: There is ample emperical evidence on the effects of playground interventions on children's physical activity level. Please refer to reviews as Broekhuizen (2014), Escalente (2013) and Parrish (2013) and change the strengths and the blind spots that this study addresses accordingly. line 117: the line of reasoning does not make sense. can you add a sentence like children are not very active at school, changes are needed/much profit is to be made at schools, the school environment offers a great opportunity...</p> <p>Aim: 147: encompasses?, 149-151: can you copy this aim in the abstract. Why do you expect an effect of the new playgrounds on children"s fitness level and wellbeing? What are your hypotheses + references? This has not been discussed at all in the introduction. What do you mean by wellbeing, engagement?</p>
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	<p>Participant inclusion criteria: Why did you choose to include such a broad age range? If you want to perform subgroup analyses this sample size is too small. Are boys and girls also evenly distributed?</p> <p>Recruitment: It is not clear to me how the seven school haven been selected. What were the inclusion criteria? What does the intervention/ redesign contains, only changes in play equipment or also surface, organized activities, supervision and so on? 182-184: to what extent do you think that the provision of information influences the expectations of the students and teachers and thereby the self-reported outcomes?</p> <p>procedures: 195: shouldn't this be 12 months?</p> <p>accelerometer: can you add information on the size, validity and reliability of the GT3X? What sample frequency do you use?</p> <p>fitness tests: what is the hypothesis and goal of using fitness tests? what is the validity and reliability of the different fitness tests in the broad age range? Why did you measure body height and weight?</p> <p>questionnaires: How did you measure engagement and well-being? Did the parents completed the questionnaires of the youngest children? Why did you measure physical activity with questionnaires since you used accelerometers as the primary method?</p> <p>analysis: 263: what other intra-personal variables do you mean?</p> <p>ethical considerations: it is not clear to me whether parents of primary school children and secondary school children provided passive informed consent or solely parents or primary school children.</p>
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### VERSION 1 – AUTHOR RESPONSE

Reviewer: 1

Reviewer Name Associate Professor Rachael Taylor  
Institution and Country University of Otago  
Dunedin, New Zealand

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

The paper presents an interesting project examining how changes to school playgrounds might affect PA in children of all ages. While it is an interesting study, insufficient information was provided regarding 1) what those changes might be

It is unclear whether the reviewer is referring to the playground changes or what expected change we may see in PA. Therefore, we have addressed both these by adding the following to the text:

“Camden Borough Council is re-designing seven existing school playgrounds (five primary schools and two secondary schools), that are thought not to be conducive to physical activity/ active play, with exciting bespoke features to engage children to become more active. Each school will receive a unique playground design, for example displayed in Figure 1. Example features include new Astroturf games pitches, climbing frames, trampolines, monkey bars, and outdoor gyms, which have been designed based on themes (eg, ancient ruins, volcanoes, clouds etc) emerging from qualitative work with children and teachers in each school. The research team did not carry out the qualitative work nor did they provide input into the design of the playgrounds.” Page 7; lines 125 - 132

“We hypothesise that the new play grounds will increase young peoples’ time spent in both light and moderate-to-vigorous physical activity and reduce sedentary behaviour during break time, and consequently improve levels of general fitness (eg, grip and leg strength, peak flow and adiposity).” Page 7; lines 139 - 142

and 2) the limitations of the design. Nowhere do the authors acknowledge that this is a weaker study design for the lack of control groups - this must be added. Why not recruit 7 additional schools to act as controls - it obviously can't be an RCT but is Camden large enough to be able to find 7 similar schools? It would provide a much stronger study given that 1) the authors are only looking for a small effect size and 2) being involved in interventions often changes behaviour - which can be accounted for if control groups are included.

The study design has been through a robust peer-review process at the stage of applying for funding. However, based on the reviewer’s comments we have incorporated one control school into the study design (owing to time, funding and resources it is only feasible to have a single control school) from which we plan to recruit approximately 100 students. The following has now been incorporated into the paper:

“In addition to the seven experimental schools one control school will be recruited into the study. This school will be located in the London Borough of Camden and it will not be receiving a new playground design, moreover, it will not differ from experimental schools based on student demographics or school policy. Owing to resources it is only feasible to collect data from a single control school. The authors acknowledge that an equal number of controls to experimental schools would indeed allow for a more robust experimental design.” Page 9; lines 168 - 173

Specific comments:

1. I was surprised in some way at this comment "Children spend approximately 60% of their weekday in school where physical activity levels are at their lowest" in the introduction - I had thought the prevailing view was that much of the MVPA children participate in takes place at school? You seem to be suggesting that children are very inactive at school?

Indeed in the UK very little of children’s MVPA is accumulated during the school day. We have amended the text so it is now specific to the UK.

“In the UK, Children spend approximately 60% of their weekday in school where physical activity levels, particularly in girls, are low.[10,11]” page 5; lines 98 - 99

2. It would be useful to (very) briefly summarise any interventions that have tried to change the playgrounds. The authors only include two studies - but there is quite a body of work that has included changes to playgrounds within a wider intervention - and this should be summarised (eg. Am J Pub Health 2010;100:1672, JPAH 2010;7:167, J Phys Act health 2008;5:319, Advances in Nutrition 2011;2:171S, Preve Med 2005;41:828 etc).

Thank you. We have included the following revised text: “A recent meta-analysis found that the effects of interventions to increase physical activity in children have been, at best, modest, and concluded that alternative approaches are required.[9] In the UK, children spend approximately 60% of their weekday in school where physical activity levels, particularly in girls, are low.[10,11] Environments both facilitate and provide the arena for physical activity [13]. Interventions that target the school environment may offer great opportunity to increase physical activity levels. However, there is little robust empirical evidence concerning the effect of changing the physical environment on activity levels in children. Emerging data has suggested that a positive perception of the school play environment was associated with higher levels of moderate-vigorous physical activity (MVPA) during playtime.[14] Moreover, the number of permanent play facilities in school playgrounds has been found to be associated with higher physical activity levels (Taylor). A recent review (Broekhuizen 2014) on the value of playgrounds for children’s physical activity identified 13 experimental studies, which have produced mixed findings, likely owing to differences in intervention design. For example, the review identified that reducing playground density increased physical activity levels, but the provision of play equipment produced mixed effects, whereas no effects were found on the provision of playground markings and promotion of physical activity by teachers. Just one study investigated the impact of “major” playground reconstruction on children’s physical activity behaviour (Brink) and concluded renovated schoolyards to promote physical activity may increase the number of children who are physically active and may reduce sedentary behaviours. However, physical activity data was collected using direct observation during the school day, only. This limits the ability to examine carry over effects outside the school environment (ie, at weekends and during evenings). Taken together, the emerging evidence suggests that the physical environment could play an important role in children’s physical activity behaviour, but more robust evidence is required.” Pages 5-6; lines 96 - 121

3. More information on the qualitative work in each school which led to redesign of the playgrounds would be an advantage - perhaps this could be summarised fairly easily as a table?

The research team did not carry out the qualitative work nor did they provide input into the design of the playgrounds. This is now clarified in the revised paper.

Page 11 - what intensity cutoffs will be used given your wide age range? What are your data reduction procedures ie. minimum hours, non-wear time etc 5. If fasting conditions for BIA are not possible (which I assume they aren't) this should be clearly stated. Are any guidelines being followed? eg voiding before measurement etc 6. The GEMS study did not include children as young as 5 (think they were 8-10) so what procedures will be put in place to ensure that 5 year olds understand the questionnaire? This would seem unlikely to me knowing some of these questions.

We intend to follow methods used in the International Children’s Accelerometry Database study that incorporated children aged 4-18 yrs old (Ekelund et al. JAMA 2012). Briefly, data files will be reintegrated to a 60-second epoch and non-wear time defined as 60 minutes of consecutive zeros, allowing for 2 minutes of nonzero interruptions. All children with at least 1 day with at least 500 minutes of measured monitor wear time between 7 AM and midnight will be included. Total physical activity will be expressed as total counts, including sedentary minutes, divided by measured time per day (counts/min, cpm). Time spent sedentary will be defined as all minutes showing less than 100 cpm and MVPA time as minutes showing more than 3000 cpm. This is now clarified in the main document. This is now clarified in the main document. Page 14; lines 284 – 292.

Fasting conditions will not be used.

We agree that administering the questionnaire to 5 year olds is problematic. Teaching assistants and research staff will support all children through the completion of the survey. This has now been

incorporated into the main document. Page 12; lines 245 – 246

7. More information is required on the assessment of playground policy - will only 1 head teacher per school assess this? This only provides of course a sample of 7. What other questions are included? How will this data be used. Will it also be assessed at all time points?

We have added the following: "Each school has one Head Teacher. Head Teachers (n=8) will be asked to complete a questionnaire to allow for an understanding of differences between schools on "playground policy." Questions include, "During what type of weather are children not allowed to go outside during scheduled breaks (i.e. rain/ snow)?" "Are any sections of the current playground out of use during bad weather (i.e. school field when raining), if yes please specify?" "When children cannot go outside on scheduled breaks, owing to bad weather, where do they spend their break?" and "Are there any current initiatives/programs to promote physical activity and/or healthy lifestyles in your school, if yes please specify?" Head teachers will be asked to complete an identical survey at follow-up to allow for the assessment of changes in "playground policy" between each time point." Page 13; lines 259 – 269

8. What loss to follow-up do you expect over the course of this study?

To date, response rate has been exceptionally high (>98%). We expect minimal loss to follow-up as we will be returning to collect data during a normal school day. Other studies using a similar design, such as East of England Healthy Hearts Study, demonstrated minimal loss to follow up over a 2 year follow up. Based on the current baseline data collection we anticipate data loss in the region of 5-10% owing to equipment (Actigraph) failure or failure to return devices.

9. The abstract does not appear to be conventional

This abstract is conventional for a protocol paper please see other protocols published in BMJ Open (eg, Smith et al. 2013 doi:10.1136/bmjopen-2013-004103 and Struzzo et al. 2013 doi:10.1136/bmjopen-2013-002669).

This is a protocol paper outlining a proposed project. While the project itself is interesting I felt insufficient detail was provided in terms of background and methods given not results or discussion is included. My recommendation is because I felt in its current form it was not of great interest to the BMJ readership. However, with expansion of the intro/methods it could be suitable for publication.

Reviewer: 2

Reviewer Name Sanne de Vries

Institution and Country The Hague University of Applied Sciences, Research group Healthy Lifestyle in a Supporting Environment, The Hague, The Netherlands

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

This papers describes the protocol to evaluate a playground intervention on children's physical activity level.

Abstract: according to the abstract the primary aim of the study is to discover how playground design influences children's PA. The term HOW suggests you examine working mechanisms. This is not the case in this study.

This comment is now redundant, owing to the below comment relating to the aim in the abstract.

Please mention the lack of control-group in the abstract and specify the age range of the study population and whether you focus on PA in general or during recess or both.

We have amended the abstract accordingly: (note: based on comments from reviewer one we have now included one control school in the study)

“This project will use a longitudinal quasi-experimental design. Seven experimental schools and one control school will take part. One baseline data collection session and two follow-ups will be carried out. Between baseline and follow-up the experimental school playgrounds will be re-designed. At baseline, a series of fitness tests, anthropometric and questionnaire measurements, and 7 day objective physical activity monitoring (Actigraph accelerometer) will be carried out on children (aged 5 to 16 years). This will be repeated at follow-up. Changes on overall physical activity levels and levels during different times of the day (eg, school breaks) will be examined. Multilevel regression modelling will be used to analyse the data.” Page 3; lines 49 - 57

Given the aim of the study it is not clear why fitness tests and anthropometric measurements are conducted. Can you explicitly mention the use of (ActiGraph) accelerometers in the abstract?

Improving physical activity levels is a vehicle to improve health outcomes. Thus, although PA is our primary outcome, we are still interested in health markers, such as physical function and body composition.

We have now explicitly mentioned the Actigraph.

“...and 7 day objective physical activity monitoring (Actigraph accelerometer) will be carried out on children (aged 5 to 16 years)”

Introduction: There is ample empirical evidence on the effects of playground interventions on children's physical activity level. Please refer to reviews as Broekhuizen (2014), Escalante (2013) and Parrish (2013) and change the strengths and the blind spots that this study addresses accordingly.

Thank you. We have now included the most recent review and amended the text as follows: “A recent meta-analysis found that the effects of interventions to increase physical activity in children have been, at best, modest, and concluded that alternative approaches are required.[9] In the UK, children spend approximately 60% of their weekday in school where physical activity levels, particularly in girls, are low.[10,11] Environments both facilitate and provide the arena for physical activity [13]. Interventions that target the school environment may offer great opportunity to increase physical activity levels. However, there is little robust empirical evidence concerning the effect of changing the physical environment on activity levels in children. Emerging data has suggested that a positive perception of the school play environment was associated with higher levels of moderate-vigorous physical activity (MVPA) during playtime.[14] Moreover, the number of permanent play facilities in school playgrounds has been found to be associated with higher physical activity levels (Taylor). A recent review (Broekhuizen 2014) on the value of playgrounds for children's physical activity identified 13 experimental studies, which have produced mixed findings, likely owing to differences in intervention design. For example, the review identified that reducing playground density increased physical activity levels, but the provision of play equipment produced mixed effects, whereas no effects were found on the provision of playground markings and promotion of physical activity by teachers. Just one study investigated the impact of “major” playground reconstruction on children's physical activity behaviour (Brink) and concluded renovated schoolyards to promote physical activity may increase the number of children who are physically active and may reduce sedentary behaviours. However, physical activity data was collected using direct observation during the school day, only.

This limits the ability to examine carry over effects outside the school environment (ie, at weekends and during evenings). Taken together, the emerging evidence suggests that the physical environment could play an important role in children's physical activity behaviour, but more robust evidence is required." Page 5 – 6; lines 96 - 121

line 117: the line of reasoning does not make sense. can you add a sentence like children are not very active at school, changes are needed/much profit is to be made at schools, the school environment offers a great opportunity...

"In the UK, children spend approximately 60% of their weekday in school where physical activity levels, particularly in girls, are low.[10,11] Environments both facilitate and provide the arena for physical activity [13]. Interventions that target the school environment may offer great opportunity to increase physical activity levels." Pages 5 – 6; lines 98 - 101

Aim: 147: encompasses?, 149-151: can you copy this aim in the abstract. Why do you expect an effect of the new playgrounds on children's fitness level and wellbeing? What are your hypotheses + references? This has not been discussed at all in the introduction. What do you mean by wellbeing, engagement?

Improving physical activity levels is a vehicle to improve health and fitness outcomes. Thus, although PA is our primary outcome, we are still interested in health markers, such as physical function and body composition.

The following has now been included in the abstract:

"The primary aim of this project is to evaluate the impact of the re-designed playgrounds on children's physical activity, wellbeing, engagement, and physical function/fitness." Page 3; lines 45 - 46

"We hypothesise that the new play grounds will increase young peoples' time spent in both light and moderate-to-vigorous physical activity and reduce sedentary behaviour during break time, and consequently improve levels of general fitness." Page 7; lines 139 - 142

Participant inclusion criteria:

Why did you choose to include such a broad age range? If you want to perform subgroup analyses this sample size is too small. Are boys and girls also evenly distributed?

This is a natural experiment evaluating the impact of new playground design on children's physical activity levels and fitness in the school environment. The schools and age range of children taking part in this study is beyond the control of the research team, although the sample is representative of school age children. This is a common limitation of natural experiments. The design of the study has been through a robust peer-review process at the stage of funding.

Recruitment: It is not clear to me how the seven school haven been selected. What were the inclusion criteria? What does the intervention/ redesign contains, only changes in play equipment or also surface, organized activities, supervision and so on?

The schools were selected by Camden council and are broadly representative in terms of the geographical layout of the borough. This selection process was again beyond the control of the research team. We were awarded funding to evaluate the impact of these redesigns.

We have incorporated the following text to better explain what the new playgrounds contain:



“Camden Borough Council is re-designing seven existing school playgrounds (five primary schools and two secondary schools), that are thought not to be conducive to physical activity/ active play, with exciting bespoke features to engage children to become more active. Each school will receive a unique playground design. Example features include new Astroturf games pitches, climbing frames, trampolines, monkey bars, and outdoor gyms, which have been designed based on themes (eg, ancient ruins, volcanoes, clouds etc) emerging from qualitative work with children and teachers in each school. The research team did not carry out the qualitative work nor did they provide input into the design of the playgrounds. This is a physical environmental intervention and no other measures are being put in place at the schools to encourage playground use.” Page 7; Lines 125 - 132

182-184: to what extent do you think that the provision of information influences the expectations of the students and teachers and thereby the self-reported outcomes?

This is an interesting point but beyond the scope of our study. Our main outcome is an objective measure, thus we hope that such expectations will not influence the results.

procedures: 195: shouldn't this be 12 months?

We thank the reviewer for highlighting this mistake this has now been corrected to 12 months.

accelerometer: can you add information on the size, validity and reliability of the GT3X? What sample frequency do you use?

The validity of the Actigraph device has been very well documented (see lines 215-23). We now clarified that a sampling frequency of 30 hz will be employed. Page 11; line 225

fitness tests: what is the hypothesis and goal of using fitness tests? what is the validity and reliability of the different fitness tests in the broad age range? Why did you measure body height and weight?

Improving physical activity levels is a vehicle to improve health and fitness outcomes. Thus, although PA is our primary outcome, we are still interested in health markers, such as physical function and body composition. The tests have been used extensively in other cohort studies of children, eg, see: The European Youth Heart Study; East of England Healthy Hearts Study: The Child Heart and Health Study in England (CHASE).

questionnaires: How did you measure engagement and well-being? Did the parents completed the questionnaires of the youngest children? Why did you measure physical activity with questionnaires since you used accelerometers as the primary method?

The Strengths and Difficulties questionnaire that is completed by the teachers provides a measure of engagement and well-being. This is now highlighted in the text.

“Teachers will be asked to complete the validated Strengths and Difficulties questionnaire;[21] this questionnaire provides a measure of children’s behaviour, mental health, engagement and well-being and takes approximately five minutes to complete per child.” Pages 12 – 13; Lines 255 to 258

Teaching assistants and research staff will support all children with the completion of the survey. This has now been incorporated into the main document. Page 12; 245 - 246

Accelerometers provide an objective count of physical activity but do not provide context of physical activity behaviour. The survey will allow us to observe changes in specific physical activity

behaviours, if they exist. The following has been incorporated into the text to clarify this:

“The Girls Health Enrichment Multi-Studies (GEMS) physical activity survey has been embedded within the questionnaire to give a subjective measure of physical activity and provide an understanding of which specific physical activity behaviours are influenced by the playground redesign, if any.” Page 12; 247 - 250

analysis: 263: what other intra-personal variables do you mean?

We thank the reviewer for this comment and have adjusted the text accordingly:

“change in Strength and Difficulties scores.”

ethical considerations: it is not clear to me whether parents of primary school children and secondary school children provided passive informed consent or solely parents or primary school children. We have now clarified this:

“Next, if parents (of primary and secondary school children) do not want their child(ren) to take part in the study they will be given the option to “opt-out” their child(ren), instructions to parents on how to opt-out their child(ren) are provided in the parent study information sheet.” Page 15; lines 307 – 308

#### VERSION 2 – REVIEW

<b>REVIEWER</b>	Associate Professor Rachael Taylor University of Otago, Dunedin, New Zealand
<b>REVIEW RETURNED</b>	22-Jul-2014

<b>GENERAL COMMENTS</b>	<p>The authors have addressed most of the issues raised in my previous review. I still believe the paper would benefit from a brief limitations paragraph however. Two minor points:</p> <ol style="list-style-type: none"> <li>1. Details of WHO undertook the qualitative work should be provided if it was not the researchers (page 7, line 131).</li> <li>2. I think your loss to follow-up is considerably under-estimated at 5-10%. Successful 7-day accelerometry data is never obtained in 100% of children - I would estimate perhaps 80-90% (with 4 valid days). By the time you add in the number of children who move from school to school each year (at least 10-20% in NZ), you are well over 5-10%. Actual drop-outs ie. don't want to be in the study anymore might be this low, but the other types of loss still count.</li> </ol>
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<b>REVIEWER</b>	de Vries, Sanne The Hague University of Applied Sciences, Healthy Lifestyle in a Supporting Environment
<b>REVIEW RETURNED</b>	21-Jul-2014

<b>GENERAL COMMENTS</b>	<p>In my opinion the authors did a great effort to improve the quality of the submitted manuscript. The majority of my comments have been addressed satisfactorily. However, I do still feel the use of fitness tests and other secondary outcomes are not well argued. Hypotheses and references that describe the possible effects of playground redesign on fitness outcome measurements, well being and anthropometric measures are missing. How much extra time spent in MVPA is needed to expect improvement in fitness levels or</p>
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	<p>anthropometric measures? With only one control school any changes on these outcomes will be difficult to relate to the playground redesign. I know more MVPA might lead to improvements in fitness, but references are missing, as well as for the hypothesized effect of playground redesign on well being and BMI.</p> <p>' Why do you expect an effect of the new playgrounds on children's fitness level and wellbeing? What are your hypotheses + references? This has not been discussed at all in the introduction. What do you mean by wellbeing, engagement?</p> <p>Improving physical activity levels is a vehicle to improve health and fitness outcomes. Thus, although PA is our primary outcome, we are still interested in health markers, such as physical function and body composition.'</p> <p>' fitness tests: what is the hypothesis and goal of using fitness tests? what is the validity and reliability of the different fitness tests in the broad age range? Why did you measure body height and weight?</p> <p>Improving physical activity levels is a vehicle to improve health and fitness outcomes. Thus, although PA is our primary outcome, we are still interested in health markers, such as physical function and body composition. The tests have been used extensively in other cohort studies of children, eg, see: The European Youth Heart Study; East of England Healthy Hearts Study; The Child Heart and Health Study in England (CHASE).'</p>
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## VERSION 2 – AUTHOR RESPONSE

Reviewer Name Sanne de Vries

Institution and Country The Hague University of Applied Sciences, Healthy Lifestyle in a Supporting Environment

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

In my opinion the authors did a great effort to improve the quality of the submitted manuscript. The majority of my comments have been addressed satisfactorily. However, I do still feel the use of fitness tests and other secondary outcomes are not well argued.

Hypotheses and references that describe the possible effects of playground redesign on fitness outcome measurements, well being and anthropometric measures are missing.

How much extra time spent in MVPA is needed to expect improvement in fitness levels or anthropometric measures? With only one control school any changes on these outcomes will be difficult to relate to the playground redesign.

I know more MVPA might lead to improvements in fitness, but references are missing, as well as for the hypothesized effect of playground redesign on wellbeing and BMI.

' Why do you expect an effect of the new playgrounds on children's fitness level and wellbeing? What are your hypotheses + references? This has not been discussed at all in the introduction. What do you mean by wellbeing, engagement?

Improving physical activity levels is a vehicle to improve health and fitness outcomes. Thus, although

PA is our primary outcome, we are still interested in health markers, such as physical function and body composition.'

We thank the reviewer for these comments, the term "engagement" has now been removed, and we have incorporated the following text into the introduction:

"Increasing physical activity levels is well established as a way to improve fitness and health outcomes in young people. Strong's et al. (2005) review identified 17 experimental studies that aimed to increase levels of physical activity, and these all found improvements in aerobic fitness. Two experimental studies implemented programs of moderately intense exercise 30 to 60 minutes in duration, 3 to 7 days per week, and this led to a reduction in total body adiposity in overweight young people. Interestingly, the review also identified three longitudinal and two experimental studies in young people that showed physical activity or strength training improved muscular strength and endurance. It is plausible to assume that an increase in movement and a decrease in sedentary behaviour may result in an increase in hamstring flexibility. This is important as maintaining hamstring flexibility may prevent acute and chronic musculoskeletal injuries (ACSM 2000). There is also evidence that physical activity is associated with scores on a scale (The Strengths and Difficulties Questionnaire) measuring mental wellbeing (eg, happiness, behaviour, concentration, self-esteem etc; Brodersen et al. 2005). On this basis we hypothesise that a change in the physical school playground environment which increases levels of physical activity or reduces sedentary behaviour should subsequently improve fitness and health outcomes.

A recent study found that engaging in 40% of moderate-intensity physical activity during school playtime equated to 34 minutes of daily MVPA (Ridgers et al. 2005). This exceeds the minimum recommendation of 30 minutes of at least moderate-intensity physical activity for children's good health (Biddle et al. 1998). It has been suggested that this guideline is a realistic target for children to achieve during school playtime (Ridgers et al. 2006), especially if a playground has been modified to encourage physical activity." Pages 6-7; lines 122-144

' fitness tests:

what is the hypothesis and goal of using fitness tests?

This comment has been addressed under the above comments.

what is the validity and reliability of the different fitness tests in the broad age range?

We have now incorporated the following text:

"A series of fitness tests will be carried out, following Standard Operating Procedure Forms, on all children taking part in the study. Four fitness tests will be carried out to measure aspects of general fitness: participants will be asked to perform the hand held Dynamometer test to assess grip strength, the standing horizontal jump test to assess leg power, the peak flow test to assess lung function, and the sit-and-reach test to assess flexibility. Participants' weight and body composition will be measured using the Tanita SC-330 Body Composition Analyser (Tanita Inc, IL, USA) and height will be measured using the Leicester Height Measure, from which BMI will be calculated kg/m<sup>2</sup>. These tests have been extensively used in previous cohort studies of young people (eg, <http://www.chasestudy.ac.uk/study-measurement>) and have shown good validity and reliability in young people across broad age groups (eg, Ruiz et al. 2010, Ortega et al. 2008, Kirkby et al. 2008, <http://www.chasestudy.ac.uk/study-measurement>)." Pages 12-13; lines 252-263

Why did you measure body height and weight?

We have incorporated the following text:

“Participants’ weight and body composition will be measured using the Tanita SC-330 Body Composition Analyser (Tanita Inc, IL, USA) and height will be measured using the Leicester Height Measure, from which BMI will be calculated kg/m<sup>2</sup>.” Page 13; lines 257-259

The measurement of BMI has now been justified in the introduction.

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Please state any competing interests or state ‘None declared’: None declared

The authors have addressed most of the issues raised in my previous review. I still believe the paper would benefit from a brief limitations paragraph however. Two minor points:

We thank the reviewer for these comments and, as suggested, have incorporated a brief limitation section into the manuscript:

#### “LIMITATIONS

It is not possible to carry out a multicentre cluster randomised-controlled-trial. Key limitations of this study include a quasi-experimental design with non-randomly selected control participants and the recruitment of one control school.” Page 16; lines 330-332

1. Details of WHO undertook the qualitative work should be provided if it was not the researchers (page 7, line 131).

The following has now been incorporated into the text:

“The research team did not carry out the qualitative work nor did they provide input into the design of the playgrounds. The qualitative work and the design of the playgrounds were carried out by two private organisations specialising in playground design.” Page 8; lines 154-156

2. I think your loss to follow-up is considerably under-estimated at 5-10%. Successful 7-day accelerometry data is never obtained in 100% of children - I would estimate perhaps 80-90% (with 4 valid days). By the time you add in the number of children who move from school to school each year (at least 10-20% in NZ), you are well over 5-10%. Actual drop-outs ie. don't want to be in the study anymore might be this low, but the other types of loss still count.

We thank the reviewer for this comment and fully take on board the point.

Re-revision probably not required for these minor comments.