

## The JBI Evidence Synthesis

### Title Page

**Title: Association of built environment constructs and physical activity among children and adolescents in Africa: a systematic review and meta-analysis**

**Authors:**

Busola Adebusoye<sup>1</sup>

Kaushik Chattopadhyay<sup>1,2</sup>

Winifred Ekezie<sup>3</sup>

Revati Phalkey<sup>4</sup>

Jo Leonardi-Bee<sup>1,2</sup>

1. Division of Epidemiology and Public Health, School of Medicine, University of Nottingham, Nottingham, United Kingdom
2. The Nottingham Centre for Evidence-Based Healthcare: A Joanna Briggs Institute Centre of Excellence.
3. Diabetes Research Centre, University of Leicester, United Kingdom
4. **Climate Change and Health Unit**, Public Health England

**Corresponding Author:** Busola Adebusoye

busola.adebusoye@nottingham.ac.uk

# **Association of built environment constructs and physical activity among children and adolescents in Africa: a systematic review and meta-analysis**

## **Abstract**

### Objective:

The objective of this review was to synthesize the association between built environment constructs and physical activity among children and adolescents in Africa.

### Introduction:

Previous reviews have found several built environment constructs, such as residential density, crime safety, and availability of physical activity facilities and infrastructure, are associated with physical activity in children and adolescents; however, these have tended to focus on non-African countries. Therefore, this systematic review synthesized the association between the built environment and physical activity among children and adolescents in Africa.

### Inclusion criteria:

This systematic review included comparative observational studies which assessed the relationship between built environmental constructs on physical activity among children and adolescents (between the ages of five and 19 years) in Africa.

### Methods:

Comprehensive electronic searches of MEDLINE, EMBASE, Web of Science, CINAHL, and five further databases from inception to 22 October 2021 were conducted to identify relevant published and unpublished studies. Two reviewers independently screened papers, assessed the quality of the included studies using the JBI standard critical appraisal tool, and extracted data using a pre-piloted form. Where possible, data were synthesized using random effects meta-analyses, with effect sizes reported as mean differences (MD) with 95% confidence intervals (CI). Grading of Recommendations Assessment, Development and Evaluations (GRADE) was used to assess the certainty of the findings.

### Results:

Of the 10706 identified records, six cross-sectional studies were included which comprised of 4628 children and adolescents. Three of the studies had a high-quality score of  $\geq 7$  out of 8. Seven built environment constructs were reported within the included studies namely, residential density, street connectivity, crime safety, availability of physical activity facilities and infrastructure, walkability, aesthetics, and traffic safety. Three of the constructs were assessed with objective measures. Results from individual studies found significant associations between physical activity and objective measure of traffic safety (MD 2.63 minutes; 95% CI 0.16 to 5.1; 1 study) and an objective measure of crime safety (MD 2.72 minutes; 95% CI 0.07 to 5.37; 1 study). No significant associations were found between active transportation and any of the built environment constructs. The GRADE evidence for all of the assessed constructs was either low (the built environment constructs may lead to little or no difference in physical

activity or active transportation) or very low (it was uncertain whether the built environment constructs affect physical activity).

Conclusion:

In African settings, the evidence base for the association between built environment constructs and physical activity is limited, with no consistent evidence of an association. Therefore, further high-quality studies should be conducted before firm conclusions can be drawn.

Systematic review registration number: PROSPERO CRD42019133324.

Keywords:

Africa; child; environment design; exercise; systematic review

Abstract word count: 423

Summary of findings:

## Association of built environment constructs and physical activity among children and adolescents in Africa: a systematic review and meta-analysis

**Population:** Children and Adolescents in Africa

**Exposure:** Built environment constructs

**Outcome:** Physical activity

Outcomes	Impact	N <sub>e</sub> of participants (studies)	Certainty of the evidence (GRADE)
Built environment construct: perceived residential density			
Physical activity	Perceived residential density may lead to little or no difference on physical activity. MD 0.01 minutes (95% CI -0.11 to 0.12).	(1 observational study)	⊕⊕○○ Low
Built environment construct: perceived street connectivity			
Physical activity	Perceived street connectivity may lead to little or no difference on physical activity. MD -0.01 minutes (95% CI -0.11 to 0.10).	(1 observational study)	⊕⊕○○ Low
Built environment construct: perceived crime safety			
Physical activity	Perceived crime safety may lead to little or no difference on physical activity. MD 0.03 minutes (95% CI -0.18 to 0.24).	(2 observational studies)	⊕⊕○○ Low
Built environment construct: objective crime safety			
Physical activity	It is uncertain whether objective crime safety improves physical activity. MD 2.72 minutes (95% CI 0.07 to 5.37).	(1 observational study)	⊕○○○ Very low <sup>a</sup>
Built environment construct: perceived availability of physical activity facilities and infrastructure			
Physical activity	Perceived availability of physical activity facilities and infrastructure may lead to little or no difference on physical activity. MD 0.13 minutes (95% CI -0.04 to 0.31).	(2 observational studies)	⊕⊕○○ Low
Built environment construct: objective availability of physical activity facilities and infrastructure			
Physical activity	It is uncertain whether objective availability of physical activity facilities and infrastructure improves physical activity. MD -0.03 minutes (95% CI -0.44 to 0.38)	(1 observational study)	⊕○○○ Very low <sup>b</sup>
Built environment construct: perceived walkability			

Summary of findings:

## Association of built environment constructs and physical activity among children and adolescents in Africa: a systematic review and meta-analysis

**Population:** Children and Adolescents in Africa

**Exposure:** Built environment constructs

**Outcome:** Physical activity

Outcomes	Impact	N <sub>e</sub> of participants (studies)	Certainty of the evidence (GRADE)
Physical activity	Perceived walkability may lead to little or no difference on physical activity. MD 0.04 minutes (95% CI -0.15 to 0.23).	(2 observational studies)	⊕⊕○○ Low
Built environment construct: perceived esthetics			
Physical activity	Perceived esthetics may lead to little or no difference on physical activity. MD 0.00 minute (95% CI -0.13 to 0.13).	(1 observational study)	⊕⊕○○ Low
Built environment construct: perceived traffic safety			
Physical activity	It is uncertain whether perceived traffic safety decreases physical activity. MD -0.32 minutes (95% CI -1.69 to 1.05).	(1 observational study)	⊕○○○ Very low <sup>b</sup>
Built environment construct: objective traffic safety			
Physical activity	It is uncertain whether objective traffic safety increases physical activity. MD 2.63 minutes (95% CI 0.16 to 5.10).	(1 observational study)	⊕○○○ Very low <sup>a</sup>
Built environment construct: perceived residential density			
Active transportation	Perceived residential density may lead to little or no difference in active transportation. MD 0.00 minute (95% CI -0.06 to 0.07)	(1 observational study)	⊕⊕○○ Low
Built environment construct: perceived street connectivity			
Active transportation	Perceived street connectivity may lead to little or no difference in active transportation. MD 0.00 minute (95% CI -0.05 to 0.06)	(1 observational study)	⊕⊕○○ Low
Built environment construct: perceived crime safety			
Active transportation	Perceived crime safety may lead to little or no difference in active transportation. MD 0.00 minute (95% CI -0.10 to 0.10)	(1 observational study)	⊕⊕○○ Low

Summary of findings:

## Association of built environment constructs and physical activity among children and adolescents in Africa: a systematic review and meta-analysis

**Population:** Children and Adolescents in Africa

**Exposure:** Built environment constructs

**Outcome:** Physical activity

Outcomes	Impact	N <sub>e</sub> of participants (studies)	Certainty of the evidence (GRADE)
Built environment construct: perceived availability of physical activity facilities and infrastructure			
Active transportation	Perceived availability of physical activity facilities and infrastructure may lead to little or no difference in active transportation. MD -0.00 minute (95% CI -0.08 to 0.07)	(1 observational study)	⊕⊕○○ Low
Built environment construct: perceived walkability			
Active transportation	Perceived walkability may lead to little or no difference in active transportation. MD 0.10 minute (95% CI -0.11 to 0.31)	(1 observational study)	⊕⊕○○ Low
Built environment construct: perceived esthetics			
Active transportation	Perceived esthetics may lead to little or no difference in active transportation. MD -0.00 minute (95% CI -0.08 to 0.08)	(1 observational study)	⊕⊕○○ Low

CI: confidence interval; MD: mean difference

### GRADE Working Group grades of evidence

**High certainty:** we are very confident that the true effect lies close to that of the estimate of the effect.

**Moderate certainty:** we are moderately confident in the effect estimate: the true effect is likely to be close to the estimate of the effect, but there is a possibility that it is substantially different.

**Low certainty:** our confidence in the effect estimate is limited: the true effect may be substantially different from the estimate of the effect.

**Very low certainty:** we have very little confidence in the effect estimate: the true effect is likely to be substantially different from the estimate of effect.

## Explanations

- a. Downgraded because of imprecision, the 95% confidence interval is wide and the sample size is 258.
- b. Downgraded because of imprecision, the sample size is 258.

## Introduction

The built environment refers to the surroundings created by humans and used for human activity.<sup>1</sup> Examples of the built environment attributes include residential density, walkability, pleasant neighborhoods as well as crime and traffic safety.<sup>2,3</sup> These components of the built environment play a vital role in determining individuals' physical activity behaviors across domestic, occupational, transportation and leisure time physical activity domains.<sup>2</sup> The built environment has the potential to affect the long-term health of children and adolescents by increasing the daily physical activity they experience through independent mobility and play.<sup>4,5</sup> Proximate recreational facilities appear to predict older children and adolescents' physical activity levels,<sup>4</sup> there is evidence that the presence of physical activity facilities close to home is positively associated with walking and moderate-to-vigorous physical activity (MVPA) in adolescents.<sup>6</sup> Perceived neighborhood safety has also been associated with physical activity in adolescents.<sup>7</sup> Conflicting reports have been reported for residential density, a study reported no significant association with children's physical activity;<sup>8</sup> another study has reported negative association with physical activity in adolescents;<sup>9</sup> while another study reported significant associations with weekend day MVPA in adolescents.<sup>10</sup> As regards street connectivity, a study reported inverse association between adolescents out of school physical activity and higher street connectivity.<sup>11</sup> Neighborhoods with higher walkability, density and accessibility are reported to be associated with active transportation for children and adolescents. Also, installation of traffic calming features and improvements of sidewalks are associated with active transportation in children and adolescents.<sup>12,13</sup> For younger children, the impact of the built environment is influenced by the decision-making of parents as gatekeepers of their behavior.<sup>4</sup> As children develop and are given more independent mobility, the design of neighborhoods becomes a determinant of whether children are able, and are permitted by their parents, to walk and use destinations locally particularly in terms of proximity and connectivity to local destinations, including schools and shopping centers, and the presence of footpaths.<sup>4</sup> It is indicated that more time playing outdoors is significantly associated with increased physical activity in children and adolescents.<sup>14,15</sup> Conversely, inaccessible or non-existent sidewalks or bicycle paths contribute to sedentary habits.<sup>16</sup>

Regular physical activity improves body composition, cardiorespiratory and muscular fitness, bone health, and levels of metabolic health biomarkers amongst children and adolescents,<sup>17</sup> and is associated with psychological benefits in adolescents by improving their control over symptoms of anxiety and depression. Regular physical activity assists in social development by providing opportunities for self-expression, building self-confidence, social interaction, and integration.<sup>18</sup> It improves cognitive outcomes (academic performance, executive function).<sup>19</sup> Furthermore, physical activity in children and adolescents has been shown to track into adulthood and thus influences individual and public health in the adult population.<sup>20</sup> Given the immediate and future health benefits of regular physical activity, the World Health Organization (WHO) recommends at least 60 minutes of MVPA in children and adolescents daily.<sup>21,22</sup>

Countries in Africa are currently undergoing rapid socio-economic developments and urbanization, which have resulted in shifts in habitual and occupational physical activity from high-energy expenditure



activities (e.g. active transport, manual labor) to low-energy expenditure activities (e.g. motorized transport).<sup>23,24</sup> While urbanization and the shaping of the built environment have provided a number of socioeconomic benefits,<sup>1</sup> the transition to lower levels of physical activity have brought about a more sedentary life with negative health consequences, particularly non-communicable diseases (NCDs).<sup>23,24</sup> 2.1 billion children were affected with NCDs in 2017.<sup>25</sup> In 2016, only 13.8% of adolescents reached the recommended level in sub-Saharan Africa.<sup>26</sup> This is lower to the proportion of adolescents that reached the recommended level globally (19%). A rapidly urbanizing world creates challenges, and there is a need to maintain, upgrade and develop urban areas that support and promote public health.<sup>27</sup> In the present-day society, a sedentary lifestyle has become the norm, hence the need to actively encourage more physical activity especially play, incidental physical activity, and transport-related walking or cycling at an early age to be sustained through adulthood.<sup>4</sup>

Given the reported associations between the built environment and physical activity in children and adolescents, and the specific built environment features in Africa that are different from other countries,<sup>28</sup> it is imperative to synthesize the findings across Africa. Previous systematic reviews have synthesized associations between the built environment and PA in children and adolescents, but these studies have focused mostly on countries outside of Africa.<sup>5,29-39</sup> Understanding the potential influence that the built environment can have on children's and adolescents' physical activity can be pivotal. This will present evidence to key stakeholders such as urban planners and transportation officials on what built environment construct to invest in to support and promote habitual physical activity among children and adolescents in Africa.

### **Review objective**

The objective of this systematic review was to synthesize the association between built environment constructs and physical activity in children and adolescents in Africa.

### **Inclusion criteria**

#### *Participants*

Children and adolescents between five and 19 years of age in Africa were eligible for inclusion. The lower age limit of five was chosen because evidence suggests that MVPA begins to decline from approximately five years of age in children,<sup>40</sup> and 19 years of age is the upper limit because it is consistent with the WHO's cut-off for adolescence.<sup>41</sup>

#### *Exposure*

Any built environment construct including but was not limited to walkability, availability of playgrounds, traffic safety, residential density, land use mix, green spaces, and crime-related safety. Both objective and perceived measures of the built environment constructs were considered. All settings (neighborhood and school-based) were eligible for inclusion. Neighborhoods and school-based setting are of particular importance because neighborhoods in which children live are important settings for health promoting actions and policy,<sup>36</sup> and schools represent a unique setting for the promotion of lifelong physical activity during critical development stages of life.<sup>42</sup>

### *Outcome*

We included all domains of physical activity, including leisure-time, transportation, domestic and occupational. Any measure of physical activity levels including but was not limited to the total time spent undertaking physical activity per week or per day and length of time undertaking MVPA per week or per day. Outcomes could be measured either subjectively using self-reported (or parent/teacher/guardian reported) questionnaires, or objectively using accelerometers or pedometers.

### *Types of studies*

Eligible study designs included experimental designs (including randomized controlled trials), quasi-experimental designs (including non-randomized controlled trials), and comparative analytical observational designs (including prospective and retrospective cohort studies, case-control studies, and cross-sectional studies).

### **Methods**

This systematic review was conducted in accordance with an *a priori* published protocol<sup>43</sup> and was prospectively registered in PROSPERO (CRD42019133324). The authors followed the Joanna Briggs Institute (JBI) systematic review of etiology and risk guideline<sup>44</sup> and the Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) guideline.<sup>45</sup>

### *Search strategy*

The search strategy was developed in two steps. An initial limited search was carried out in MEDLINE (OVID) to identify relevant articles. The text words contained in the titles and abstracts of the relevant articles and the index terms used to describe the articles were used to develop a full search strategy for MEDLINE in consultation with a librarian. This search strategy was adapted for each included database. The following databases were searched for published studies: MEDLINE (OVID) (1946 – 22 October 2021), EMBASE (OVID) (1974 – 22 October 2021), CINAHL (EBSCO) (1958 – 22 October 2021), Web of Science (1900 - 22 October 2021), PsycINFO (OVID) (1806 – 22 October 2021), Scopus (electronic resource) (1788 - 22 October 2021) and SPORTDiscus (EBSCO) (1974 – 22 October 2021). EThOS (electronic resource) (2009 – 22 October 2021), ProQuest dissertations and Theses (electronic resource) (1975 – 22 October 2021) were searched for unpublished studies. No language restriction was applied, and the search strategy for each database is listed in Appendix I. The reference lists of all the included studies and relevant systematic reviews were also screened for additional studies.

### *Study selection*

All identified citations were collated and uploaded into EndNote X8.2 (Clarivate Analytics, PA, USA) and the duplicates were removed. Two reviewers (BA and CI) independently screened the titles and abstracts for eligibility against the inclusion criteria. Studies identified as potentially eligible were retrieved in full. Two reviewers (BA and WE) independently screened the full text of the studies in detail against the inclusion criteria. Full text studies that did not meet the inclusion criteria were excluded, and

reasons for their exclusion are provided in Appendix II. Any disagreements that arose between the reviewers were resolved through discussion or with a third reviewer (JLB) if consensus was not reached.

#### *Assessment of methodological quality*

Two reviewers (BA and WE) independently appraised the included studies using the standardized critical appraisal tool for experimental,<sup>46</sup> quasi-experimental,<sup>46</sup> and comparative analytical observational studies.<sup>47</sup> Any disagreements that arose between the reviewers were resolved through discussion or with a third reviewer (JLB) if consensus was not reached. The methodological quality scores of the included studies were computed as a percentage of those being assigned a 'Yes' rating for each domain and overall. All studies meeting the inclusion criteria were included in the review, irrespective of their methodological quality score.

#### *Data extraction*

An excel template was developed, piloted, and used for data extraction by two reviewers (BA and WE) independently. Any disagreements that arose between the reviewers were resolved through discussion or with a third reviewer (JLB) if consensus was not reached. The following information was extracted: title, author, study period, study design, country, population characteristics, inclusion and exclusion criteria, sample size, recruitment method, data collection procedure and tool, built environment construct and definition, mode of measurement for both built environment construct and physical activity, data analysis technique, results, and authors' conclusions. The association between physical activity and built environment constructs was extracted, as adjusted effect estimates, or where not reported, as the crude estimate or raw data. Effect estimates were extracted as either mean differences (MDs) or odds ratios (ORs) together with 95% confidence intervals (CIs). Where raw data were extracted, crude effect estimates (MD or OR) with 95% CIs were estimated. For outcome measures expressed as categories, the OR was estimated from raw data, and the highest quantile was compared to the combination of the other quantiles.

#### *Data synthesis*

A narrative synthesis was initially used in this review to systematically look at the data. First, a general description of the characteristics of the included studies was performed, and second, random effects meta-analyses<sup>48</sup> were conducted for each built environment construct using Cochrane Review Manager RevMan V5.4 (Copenhagen: The Nordic Cochrane Centre, Cochrane). Pooled results are expressed as pooled MD or pooled OR, with 95% CIs. Where outcomes were only reported for different time points, the timing related to after-school were used in preference for the meta-analysis to aid consistency in the pooled data. Where studies reported both objective and perceived measures of built environment constructs, both measures were presented in the meta-analyses, however, not pooled. Heterogeneity was quantified using  $I^2$ . Where studies could not be included in the meta-analysis due to insufficient reporting of results, the findings from these studies were reported narratively using p-values as reported by the studies. We were unable to formally explore reasons for heterogeneity between studies using subgroup analysis and sensitivity analysis due to insufficient studies; however, where possible we reported findings whether there was evidence of an interaction by socioeconomic status (SES) using p

values from tests of interaction as reported in the paper. We were also unable to conduct formal investigations of publication bias due to the insufficient studies in the meta-analyses.

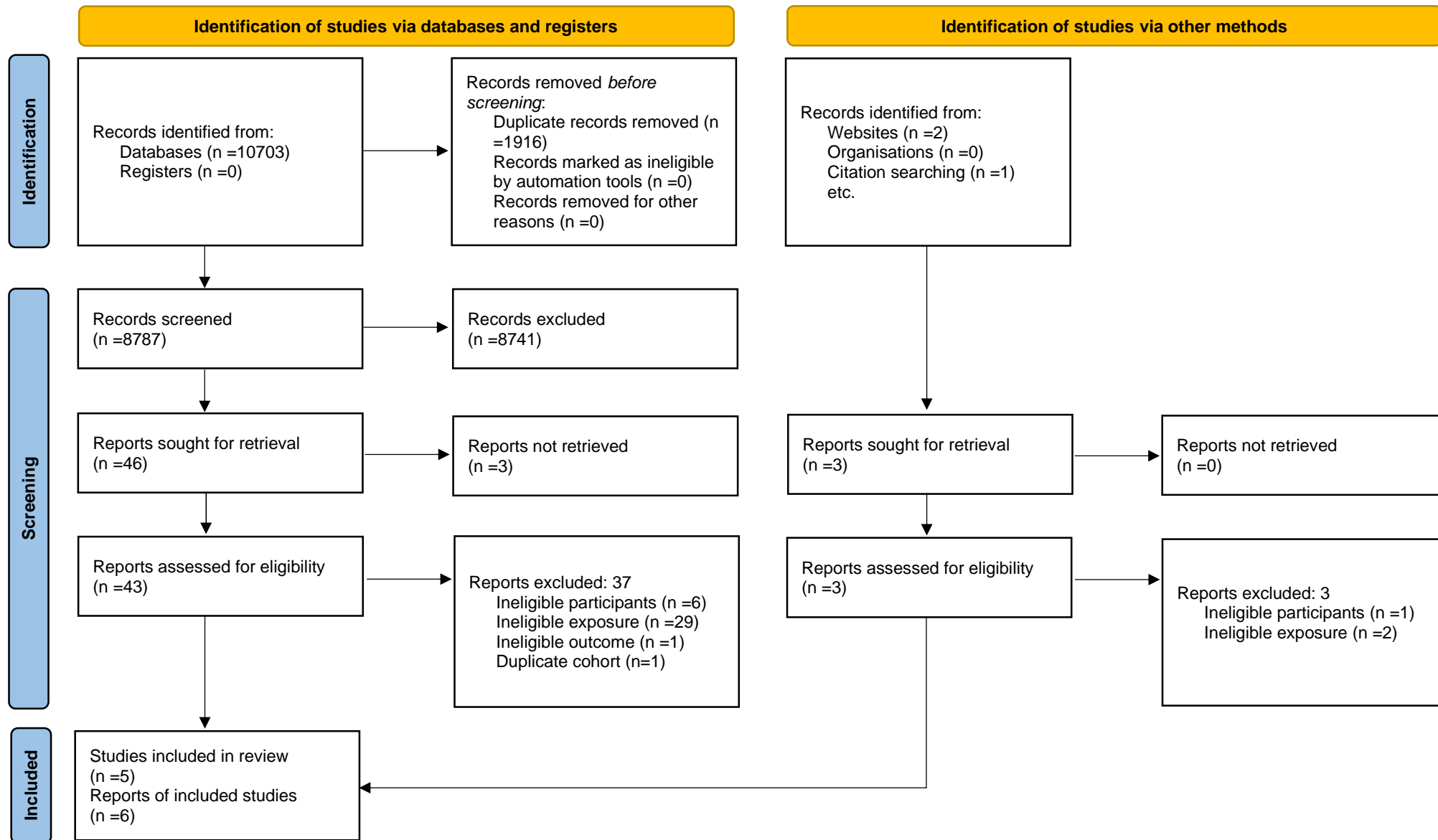
#### *Assessing certainty in the findings*

The Grading of Recommendations Assessment, Development and Evaluation (GRADE) approach was used<sup>49</sup> to determine the certainty of the evidence for each finding related to the built environment constructs, using synthesized findings from meta-analyses or findings from the narrative syntheses where pooled results were not available. A summary of Findings (SoF) was created using GRADEPro GDT (McMaster University, ON, Canada). This was undertaken by two independent reviewers (BA and JLB). Findings were initially ranked as low and were downgraded to very low if there was evidence of any of the following: risk of bias, imprecision, inconsistency of evidence, and indirectness. Findings were upgraded based on the magnitude of association, evidence of a dose-response association, and where all plausible residual confounders or biases would reduce the demonstrated effect or suggest a spurious effect when the results show no effect.

## **Results**

#### *Study inclusion*

10706 records were identified from the database search. After removing duplicates, 8787 papers were screened based on their titles and abstracts, and 49 studies were screened at the full-text stage. Six studies were included in the review<sup>28,50-54</sup> (Figure 1). The reasons for the exclusion of the 43 studies evaluated at the full-text screening stage were either ineligible participants (n=7), ineligible exposure (n=31), ineligible outcome (n=1), duplicate cohort (n=1), or full-texts were not available (n=3) (Appendix II).



**Figure1: Prisma flowchart of the study selection process<sup>45</sup>**

### Methodological quality

Overall, half of the included studies had scores of at least 70%<sup>28,50,53</sup> with the remaining studies having lower scores of either 50%<sup>51</sup> or 62.5%<sup>52,54</sup> (Table 1). Studies which had lower scores were due to either not measuring exposure in a valid and reliable way, not using objective standard criteria for the measurement of the condition, not identifying confounders, not stating strategies to deal with confounding, or not using appropriate statistical methods.

**Table 1: Critical appraisal of included studies**

Author (year)	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Total %
Manyanga et al.(2019) <sup>50</sup>	Y	Y	Y	Y	Y	Y	Y	Y	100
Moges et al.(2018) <sup>51</sup>	Y	Y	Y	N	N	N	Y	N	50
Muthuri et al.(2016) <sup>52</sup>	Y	Y	Y	Y	N	N	Y	N	62.5
Oyeyemi et al.(2014) <sup>28</sup>	Y	Y	Y	N	Y	Y	Y	Y	87.5
Siiba (2021) <sup>54</sup>	Y	Y	N	N	Y	Y	N	Y	62.5
Uys et al.(2016) <sup>53</sup>	Y	Y	Y	Y	Y	Y	Y	Y	100
Total (%) Yes	100	100	83.3	50	66.7	66.7	83.3	66.7	

Y, yes; U, unclear; N, no. Critical appraisal questions Q1- Were the criteria for inclusion in the sample clearly defined? Q2- Were the study subjects and the setting described in detail? Q3- Was the exposure measured in a valid and reliable way? Q4- Were objective, standard criteria used for measurement of the condition? Q5- Were confounding factors identified? Q6- Were strategies to deal with confounding factors stated? Q7- Were the outcomes measured in a valid and reliable way? Q8- Was appropriate statistical analysis used?

### Characteristics of included studies

The six included studies were conducted in Ghana,<sup>54</sup> Ethiopia,<sup>51</sup> Kenya,<sup>52</sup> Mozambique,<sup>50</sup> Nigeria,<sup>28</sup> and South Africa<sup>53</sup> (Table 2). All the included studies used an analytical cross-sectional study design and were published between 2014 and 2021. The sample sizes ranged from 258 to 1276 participants, and ages ranged from 9 to 19 years. All studies included boys and girls as participants. An objective measure of physical activity levels was used in three studies,<sup>50,52,53</sup> whereas the remaining three used self-reported measures based on questionnaires.<sup>28,51,54</sup> Two studies reported the proportion of participants meeting the guidelines of  $\geq 60$  minutes per day of MVPA.<sup>50,52</sup> One study reported the length of time undertaking MVPA as minutes per day based on specific time points of before school, after school, and at the weekend.<sup>53</sup> One study reported the length of time undertaking MVPA as minutes per week based only on leisure (sports participation) time and the minutes per week of active transportation to school.<sup>28</sup> Another study categorized the length of time conducting any physical activity as low (<30 minutes/day), moderate (30-59 minutes/day), or high ( $\geq 60$  minutes/day).<sup>51</sup> The sixth study reported the usual travel modes of their participants and how frequently they used it in a typical school week.<sup>54</sup>

Five studies reported on perceived measures of built environment constructs within neighborhoods,<sup>28,50,52-54</sup> focusing on the following: residential density,<sup>28</sup> street connectivity,<sup>28,52</sup> traffic safety,<sup>53,54</sup> crime safety,<sup>28,50,52-54</sup> walkability,<sup>28,52-54</sup> availability of physical activity facilities and infrastructure,<sup>28,51,53,54</sup> and esthetics.<sup>28,52</sup> Two studies reported on built environment constructs using objective measures.<sup>51,53</sup> One of these reported three objectively assessed built environment constructs – availability of physical activity facilities, neighborhood safety, and traffic safety,<sup>53</sup> while the other study focused on an objective measure of the availability of physical activity facilities and infrastructure using the size of the playground at schools.<sup>51</sup>



**Table 2: Characteristics of included studies**

Authors Publicat ion year	Country	Setting	Sample size	Character istics (age range, % female)	Categorized built environment construct	Definition of the built environment construct	Mode of measurement of built environment construct	Measure ment of physical activity	Mode of measurement of physical activity
Manyan ga et al. 2019 <sup>50</sup>	Mozamb ique	Neighbo rhood	683	9-11 years, 52.9% female	A. Crime safety	A. Crime rate in the neighborhood (ref: crime not a problem)	Perceived (by parents) using ISCOLE questionnaire	≥60 minutes/day of total MVPA	Objectively using an accelerometer
Moges et al. 2018 <sup>51</sup>	Ethiopia	School	1276	10-19 years, 50% female	Facilities and infrastructure	Size of playground ≥1092 m <sup>2</sup> (ref:< 1092 m <sup>2</sup> )	Objectively (based on national requirement)	≥60 minutes/day of any physical activity	Self-reported using a questionnaire (GPAQ)
Muthuri et al. 2019 <sup>52</sup>	Kenya	Neighbo rhood	563	9-11 years, 53.5% female	A. Social cohesion  B. Street connectivity  C. Crime safety  D. Traffic safety  E. Esthetics  F. Walkability	A. (i) People around my neighborhood are willing to help their neighbors, (ii) People in my neighborhood can be trusted.  B. (i) There are not many dead-end streets, (ii) There are many different routes for getting from place to place.  C. (i) I am afraid of my child being taken or hurt by a stranger on local streets, (ii) I'm afraid of my child being taken or hurt by a stranger in a local park, (iii) I am afraid of my child being taken or hurt by a stranger in my yard, driveway, or common area, (iv) I am afraid of my child being taken or hurt by a known "bad" person (adult or child) in my neighborhood, (v) There is a high crime rate.  D. (i) The speed of traffic on most streets is usually slow (30 mph or less), (ii) Most drivers go faster than the posted speed limits, (iii) The traffic	Perceived (by parents) using ISCOLE questionnaire – exposure categorized as present if responders reported agree or strongly agree with the statements	≥60 minutes/day of total MVPA	Objectively using an accelerometer and perceived (child self-report)

makes it difficult or unpleasant for my child to walk.

E. (i) There are many interesting things to look at while walking in my neighborhood, (ii) Streets have good lighting at night.

F. (i) There is a bus, transit/stage, or train stop within walking distance from my home, (ii) There are crosswalks and signals on busy streets, (iii) There are shops, stores, markets, and places to buy things I need within easy walking distance of my home/house, (iv) There are sidewalks on most streets, (v) There are many places to go within easy walking distance of the home.

Oyeyemi et al. 2014 <sup>28</sup>	Nigeria	Neighborhood	1006	12-19 years, 50.4% female	<p>A. Residential density</p> <p>B. Walkability</p> <p>C. Street connectivity.</p> <p>D. Facilities and Infrastructure.</p> <p>E. Esthetics,</p> <p>F. Crime safety</p>	<p>A. Types of housing in the neighborhood, options ranged from: (i) Detached single bungalows and duplexes, (ii) Mix of bungalows, duplexes, and apartments with shared facilities, (iii) Apartments with shared facilities, or flats of 1-2 stories, (iv) Blocked apartment with multiple households per plot or flats of 3 or more stories.</p> <p>B. (i) Many places such as shops, stores, and markets to buy things I need are within easy walking distance of my home, (ii) It is within easy walking distance from my home to access public buses, and taxis in my neighborhood, (iii) There are many non-residential places such as schools, hospitals, workplaces etc to go within easy walking distance of my home.</p> <p>C. There are many cross junctions in my neighborhood.</p> <p>D. (i) My neighborhood has several places such as open field, school playground, parks, public space and gymnasium to exercise and play sports (ii) There are separated pedestrian pathways on most of the streets in my neighborhood, (iii) It could be safe to bicycle in or near my neighborhood because there is little traffic, (iv)</p>	Perceived using PANES-N questionnaire	<p>Minutes per week of leisure (sports participation) time MVPA (transformed using square root)</p> <p>Minutes per week of active transportation (transformed using square root)</p>	Self-reported using AQuAA questionnaire
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The walk and foot pathways in my neighborhood are unobstructed and good for walking.

E. (i) There are many beautiful things such as architectural design, shade trees, building varieties and attractive landscaping to look at while walking in my neighborhood, (ii)

My neighborhood is generally free from unattended domestic animals like goats, cattles, dogs etc (iii) My neighborhood is generally free from garbage, stagnant water and offensive odors.

F. (i) Walking is dangerous in my neighborhood during the day because of inadequate security from molestation, crime and harassment from hooligans, rascals and drug addicts, (ii) Walking is dangerous in my neighborhood during the night because of inadequate security from molestation, crime and harassment from hooligans, rascals and drug addicts, (iii) Walking is dangerous in my neighborhood because of the speed of traffic and aggressive driving.

Siiba 2021 <sup>54</sup>	Ghana	Neighborhood	842	6-16 years, 53% female	<p>A. Facilities and infrastructure</p> <p>B. Crime safety</p> <p>C. Traffic safety</p> <p>D. Walkability</p>	<p>A. There are limited dedicated walking and cycling paths in my neighborhood</p> <p>B. (i) I think that my neighborhood is not safe for my child to walk/cycle to school, (ii) Stranger danger is a concern to me.</p> <p>C. (i) I am concerned about dangerous traffic en route to school, (ii) I think drivers too fast on the streets of this neighborhood, (iii) I am concerned my child might be injured in a road accident while walking to school, (iv) There is too much traffic in my neighborhood, (v) Bicycling/walking to school would mean my child has to negotiate dangerous road junctions.</p>	Perceived using a questionnaire	Active travellers were defined as those who made more than half of their total weekly school trips via walking or cycling.	Self-reported using a questionnaire
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D. There is no direct route for my child to walk/cycle to school.

Uys et al.2016 <sup>53</sup>	South Africa	Neighborhood	258	9-11 years, 56.2% female	<p>A. Facilities and infrastructure</p> <p>B. Crime safety</p> <p>C. Traffic safety</p> <p>D. Walkability</p>	<p>A. Parents estimated the length of time it took to walk from home to the nearest sporting venues, recreational facilities and parks by selecting one of the six options: 1-5 minutes, 6-10 minutes, 11-20 minutes, 21-30 minutes, &gt; 30 minutes and don't know.</p> <p>B. (i) There is a high crime rate, (ii) Streets have good lighting at night, (iii) I am afraid of my child being taken or hurt by a stranger on local streets, (iv) I am afraid of my child being taken or hurt by a stranger in my yard, driveway or common area, (v) I am afraid of my child being taken or hurt by a stranger in a local park, (vi) I am afraid of my child being taken or hurt by a known bad person in my neighborhood.</p> <p>C. (i) The speed of traffic on most streets is usually slow (50 kph or less), (ii) Most drivers go faster than the posted speed limits, (iii) The traffic makes it difficult or unpleasant for my child to walk, (iv) There are crosswalks and robots (traffic lights) on busy streets</p> <p>D. (i) There are shops, stores, markets and places to buy things I need within easy walking distance of my home/house, (ii) There is a bus, taxi, or train stop within walking distance from my home, (iii) There are sidewalks on most streets, (iv) There are many different routes for getting from place to place, (v) There are many interesting things to look at while walking in my</p>	Objectively and perceived (by parents) using ISCOLE questionnaire	Minutes/day of MVPA reported at three time points: before school, after school and weekend MVPA.	Objectively using an accelerometer
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neighborhood, (vi) There are many places to go  
within easy walking distance from my home

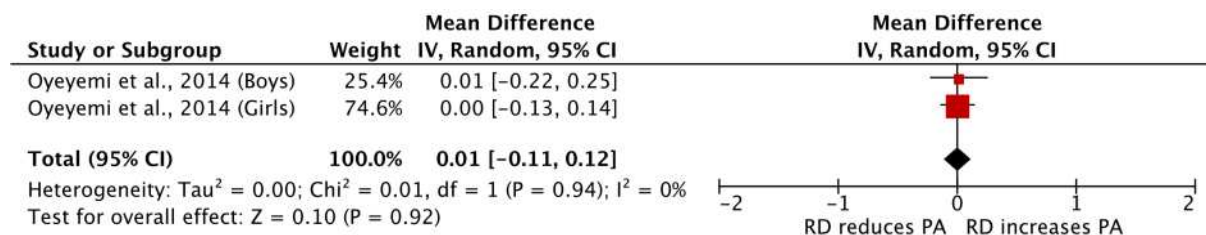
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ISCOLE; International Study of Childhood Obesity Lifestyle and the Environment, PANES-N; Physical Activity Neighborhood Environment Scale in Nigeria, MVPA; Moderate-to-vigorous physical activity, GPAQ; Global Physical Activity Questionnaire AQuAA; Activity Questionnaire for Adults and Adolescents.

## Physical activity

### Residential density

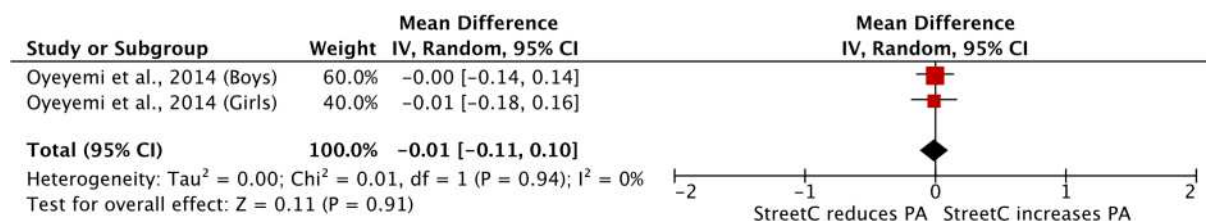
One study assessed perceived residential density which was operationalized by the main type of housing in the neighborhoods with options ranging from detached single houses to blocked apartments with multiple households.<sup>28</sup> This study found that perceived residential density may lead to little or no difference in physical activity (MD 0.01 minutes, 95% CI -0.11 to 0.12;  $I^2 = 0\%$ ; Figure 2; low certainty). The study investigated whether there was evidence of an interaction with SES but found no significant SES interaction (Girls:  $p=0.86$ , Boys:  $p=0.43$ ).



**Figure 1: Forest plot for the association of residential density with physical activity (RD, residential density; PA, physical activity)**

### Street connectivity

Two studies assessed perceived street connectivity which was operationalized as the availability of many cross-junctions in neighborhoods, not many dead-end streets, and the availability of different routes for getting from place to place.<sup>28,52</sup> One study showed that perceived street connectivity may lead to little or no difference in physical activity (MD -0.01 minutes, 95% CI -0.11 to 0.10;  $I^2 = 0\%$ ; Figure 3; low certainty).<sup>28</sup> Similarly, the other study, which could not be included in the meta-analyses due to only reporting  $p$  values, found no significant association between physical activity and having many different routes from place to place ( $p=0.25$ ); however, this latter study did find a significant association between physical activity and not having many dead-end streets ( $p=0.004$ ).<sup>52</sup> One of the studies investigated whether there was evidence of an interaction by SES but found no significant SES interaction (Girls:  $p=0.15$ , Boys:  $p=0.30$ ).<sup>28</sup>

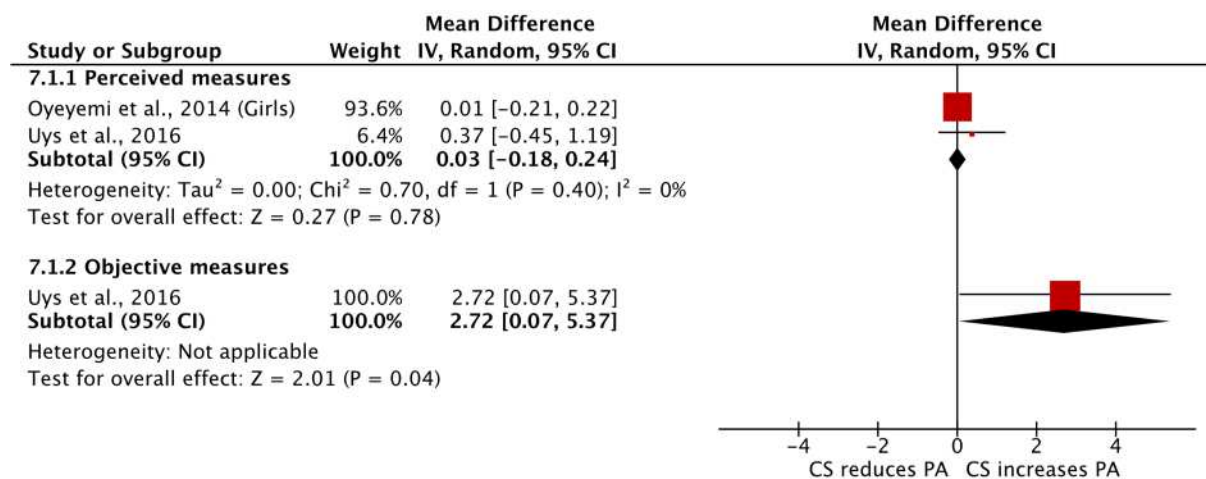


**Figure 2: Forest plot for the association of perceived street connectivity with physical activity (StreetC, street connectivity; PA, physical activity)**

### Crime safety

Four studies assessed perceived safety which was generally operationalized as feeling safe in the neighborhoods.<sup>28,50,52,53</sup> A pooled analysis of two studies found that perceived crime safety may lead to little or no difference in physical activity (pooled MD 0.03 minutes, 95% CI - 0.18 to 0.24;  $I^2 = 0\%$ ; Figure 4; low certainty).<sup>28,53</sup> Similarly, two further studies which were not included in the meta-analysis due to either reporting the effects using an OR<sup>50</sup> or only presenting p values,<sup>52</sup> found perceived crime safety was not significantly associated with physical activity (crime safety: OR 1.54, 95% CI 0.85 to 2.78;<sup>50</sup> crime rate:  $p=0.40$ <sup>52</sup>). The latter study assessed found no significant association with other measures of crime safety: being afraid of one's child being taken or hurt by a stranger either on a local street ( $p=0.77$ ), or in a local park ( $p=0.55$ ), or in a yard, driveway or common area ( $p=0.06$ ), or by a known bad person in the neighborhood ( $p=0.43$ ).<sup>52</sup> Conversely, when crime safety was assessed as an objective measure using crime rates,<sup>53</sup> a significant association was seen with physical activity (MD 2.72 minutes, 95% CI 0.07 to 5.37; Figure 4; very low certainty). Out of the four studies, two studies investigated whether there was evidence of an interaction by SES.<sup>28,53</sup> The first study found, in boys, a stronger association between perceived crime safety and physical activity was seen in those living in the high-income neighborhood compared to those living in low-income neighborhoods ( $p=0.01$ ) however, no interaction was seen in girls ( $p=0.43$ ).<sup>28</sup> Also, the second study found a significant interaction between those in lower SES groups, who were less active in unsafe neighborhoods, compared to those in higher SES groups for an objective measure of crime safety ( $p=0.02$ ), but no significant interaction was seen when a perceived measure of crime safety was used ( $p=0.65$ ).<sup>53</sup>

<Insert Figure 4 here>

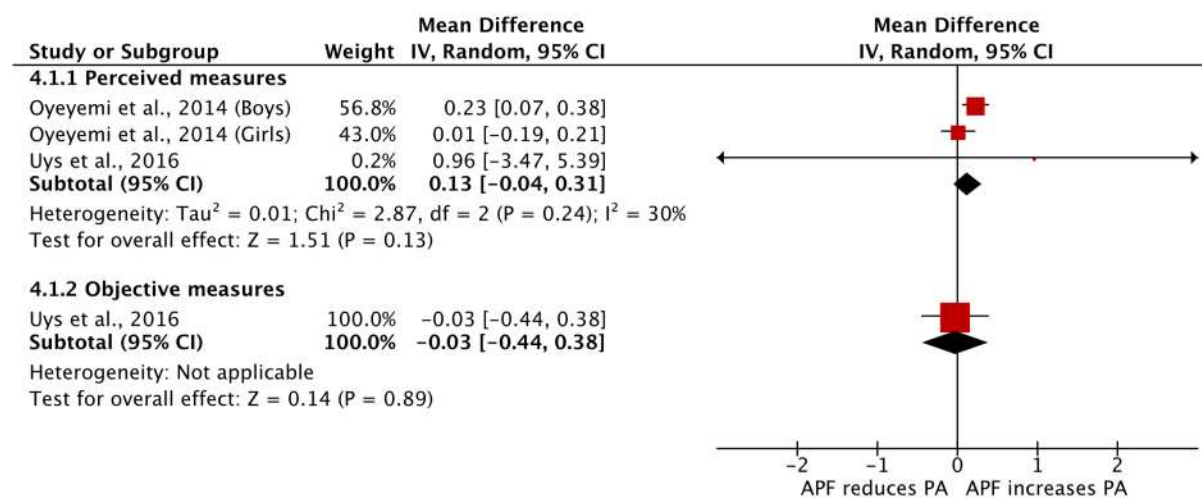


**Figure 3: Forest plot for the association of perceived safety with physical activity (CS, crime safety; PA, physical activity)**

### Availability of physical activity facilities and infrastructure

Three studies assessed this construct which was operationalized as the availability of physical activity facilities and infrastructure which included the presence of facilities, proximity to facilities, presence of separated pedestrian and bicycle pathways, and adequate size of the playground.<sup>28,51,53</sup> A pooled analysis of two studies found that perceived availability of physical activity facilities and infrastructure may lead to little or no difference in physical activity (pooled MD 0.13 minutes, 95% CI -0.04 to 0.31;  $I^2$

= 30%; Figure 5; low certainty).<sup>28,53</sup> Two studies reported objective measures of the construct.<sup>51,53</sup> The first study,<sup>51</sup> which could not be included in the meta-analyses due to reporting the effect as an OR, found a significant association was found between the construct (larger playgrounds at school) and increased physical activity (OR 1.68, 95% CI 1.35 to 2.10); however, the other study found no significant association with physical activity (MD -0.03 minutes, 95% CI -0.44 to 0.38; Figure 5; very low certainty).<sup>53</sup> Out of the three studies, two studies investigated whether there was evidence of an interaction by SES, with none finding a significant interaction (Oyeyemi et al. 2014:<sup>28</sup> Girls: p=0.24, Boys: p=0.31; Uys et al. 2016:<sup>53</sup> perceived measure: p=0.93, objective measure: p=0.29).

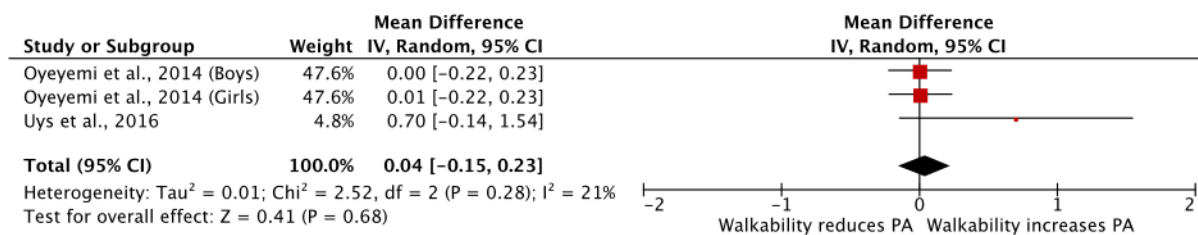


**Figure 4: Forest plot for the association of perceived availability of physical activity facilities with physical activity. (APF, availability of physical activity facilities; PA, physical activity)**

### Walkability

Walkability was assessed in three studies and was operationalized as the accessibility of the different services such as stores, buses, non-residential places including schools and hospitals; the presence of sidewalks on streets.<sup>28,52,53</sup> A pooled analysis of two studies found that perceived walkability may lead to little or no difference in physical activity (pooled MD 0.04, 95%CI -0.15 to 0.23; I<sup>2</sup>= 21% Figure 6; low certainty).<sup>28,53</sup> Similarly, the remaining study which was not included in the meta-analysis due to only reporting p values, found physical activity was not significantly associated with three measures of walkability (having services within easy walking distance of home, p=0.63; having sidewalks on most streets, p=0.62; or having many places to go within walking distance of homes, p=0.14). However, significant associations were seen with whether public transport was within easy walking distance of the home (p<0.001) and having crosswalks and signals on busy streets (p=0.05).<sup>52</sup> Two studies investigated whether there was evidence of an interaction by SES, with none finding a significant interaction (Oyeyemi et al. 2014:<sup>28</sup> Girls: p=0.09, Boys: p=0.24; Uys et al. 2016:<sup>53</sup> p=0.14).

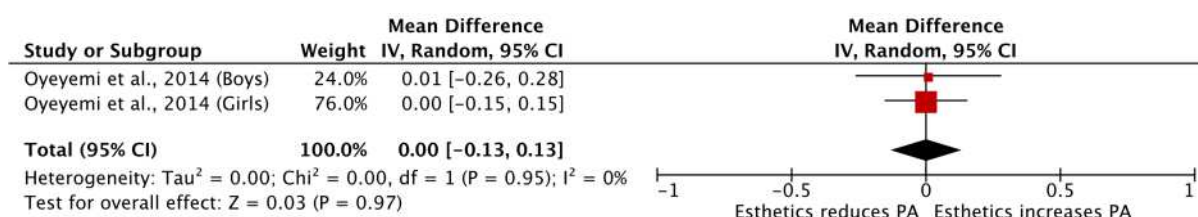




**Figure 5: Forest plot for the association of walkability with physical activity (PA, physical activity)**

### Esthetics

Two studies assessed perceived esthetics which was operationalized as the many interesting/beautiful things to look around within the neighborhood or the neighborhoods being free from unattended animals and garbage, stagnant water, and offensive odors.<sup>28,52</sup> One study found that perceived esthetics may lead to little or no difference in physical activity (MD 0.00, 95% CI -0.13 to 0.13; I<sup>2</sup> = 0%; Figure 7; low certainty).<sup>28</sup> Similarly, another study which could not be included in the meta-analysis due to only reporting p values, did not find a significant association with two measures of esthetics (having many interesting things to look at, p=0.46; streets having good lighting at nights, p=0.44).<sup>52</sup> One study investigated whether there was evidence of an interaction by SES but found no evidence of an interaction (Girls: p=0.78, Boys: p=0.98).<sup>28</sup>

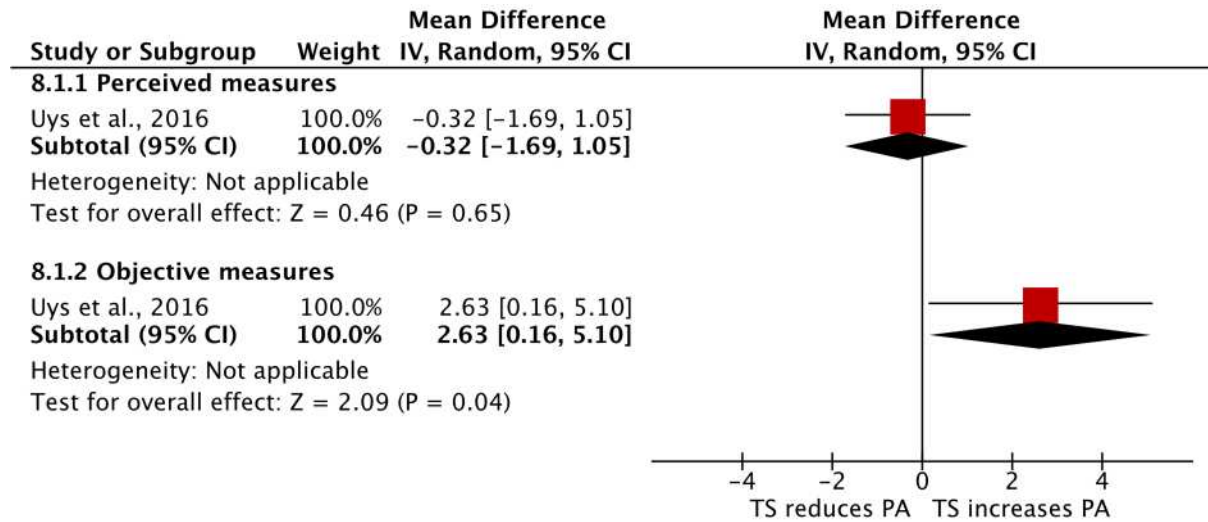


**Figure 7: Forest plot for the association of esthetics with physical activity (PA, physical activity)**

### Traffic safety

Two studies assessed perceived traffic safety, which was operationalized as the adherence to speed limits and availability of crosswalks and traffic lights on busy streets.<sup>52,53</sup> One study found that it is uncertain whether perceived traffic safety decreases physical activity (MD -0.32 minutes, 95% CI -1.69 to 1.05; Figure 8; very low certainty).<sup>53</sup> Similarly, the other study which could not be included in the meta-analysis due to only reporting p values, found no significant association when assessed as three measures of perceived traffic safety (speed of traffic is usually low, p=0.67; most drivers go faster than the speed limit, p=0.52; traffic makes it difficult for my child to walk, p=0.54).<sup>52</sup> Conversely, when traffic safety was assessed as an objective measure using motor vehicle accidents, a significant association with physical activity was seen (MD 2.63 minutes, 95% CI 0.16 to 5.10; Figure 8; very low certainty).<sup>53</sup> One study investigated whether there was evidence of an interaction by SES, a significant interaction was seen for the objective measure of traffic safety (p=0.05), where children in lower SES groups were

less active in areas with high traffic safety compared to children in higher SES groups but no significant interaction was seen when a perceived measure of traffic safety was used ( $p=0.60$ ).<sup>53</sup>

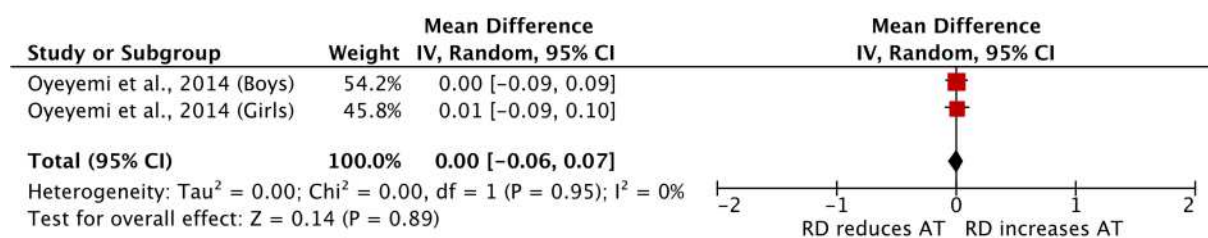


**Figure 8: Forest plot for the association of traffic safety with physical activity (PA, physical activity)**

**Active transportation**

**Residential density**

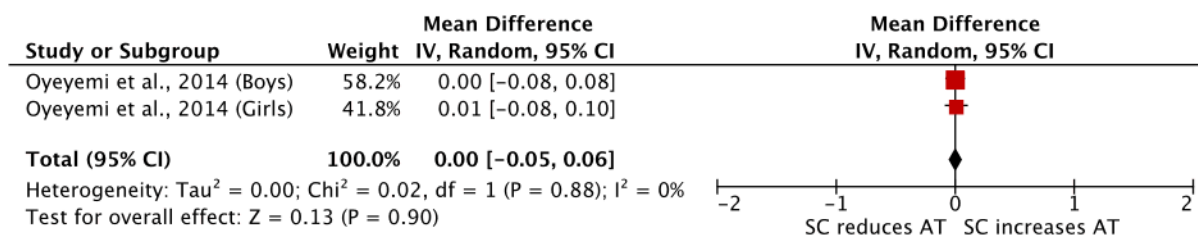
One study assessed the association of perceived residential density with active transportation and found that perceived residential density may lead to little or no difference in active transportation (MD 0.00 minute, 95% CI -0.06 to 0.07;  $I^2 = 0\%$ ; Figure 9; low certainty).<sup>28</sup> The study investigated whether there was evidence of an interaction with SES but found no significant SES interaction (Girls:  $p=0.56$ , Boys:  $p=0.23$ ).



**Figure 9: Forest plot for the association of residential density with active transportation (RD, residential density; AT, active transportation)**

**Street connectivity**

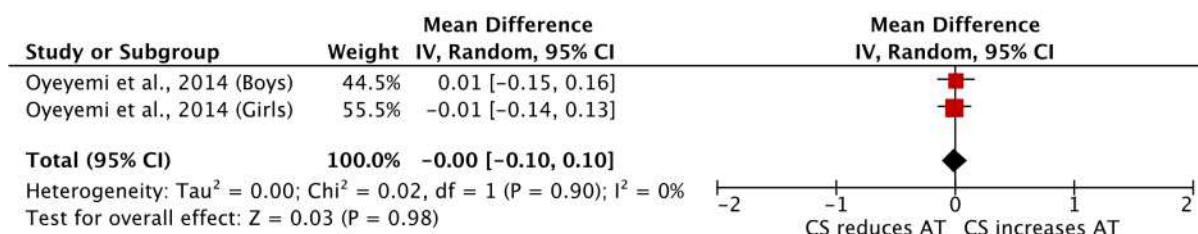
One study assessed the association of perceived street connectivity with active transportation and found that that perceived street connectivity may lead to little or no difference in active transportation (MD 0.00 minute, 95% CI -0.05 to 0.06;  $I^2 = 0\%$ ; Figure 10; low certainty).<sup>28</sup> This study investigated whether there was evidence of an interaction by SES but found no significant SES interaction (Girls:  $p=0.55$ , Boys:  $p=0.15$ ).<sup>28</sup>



**Figure 10: Forest plot for the association of street connectivity with active transportation (SC,street connectivity; AT, active transportation)**

### Crime safety

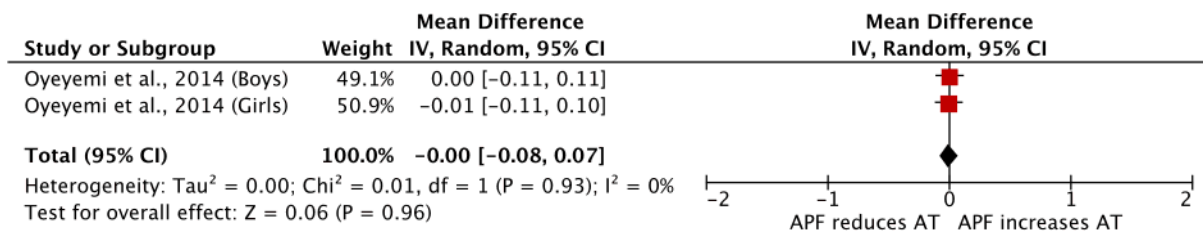
Two studies assessed the association of perceived safety with active transportation.<sup>28,54</sup> One of the studies found that perceived crime safety may lead to little or no difference in active transportation (MD 0.00 minute, 95% CI -0.10 to 0.10; I<sup>2</sup> = 0%; Figure 11; low certainty).<sup>28</sup> The other study which could not be included in the meta-analysis due to reporting ORs found no significant association with two measures of safety: I think that my neighborhood is not safe for my child to walk/cycle to school, (OR 1.06, 95%CI 0.99 to 1.14) and stranger danger is a concern to me, (OR 1.13, 95%CI 0.93 to 1.36). One of the two studies investigated whether there was evidence of an interaction by SES and found no significant interaction (Girls: p=0.90, Boys: p=0.81).<sup>28</sup>



**Figure 11: Forest plot for the association of crime safety with active transportation (CS,crime safety; AT, active transportation)**

### Availability of physical activity facilities and infrastructure

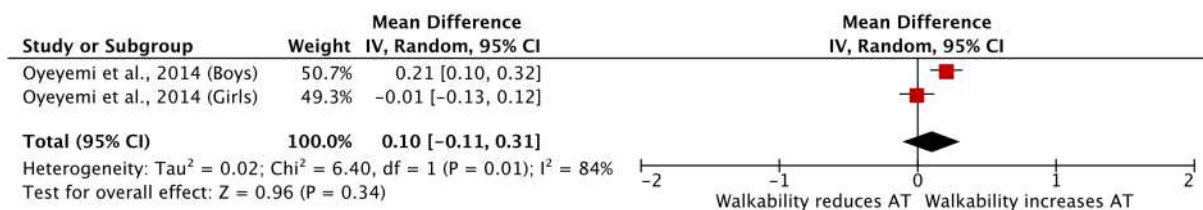
Two studies assessed the association of perceived availability of physical activity facilities and infrastructure with active transportation.<sup>28,54</sup> One of the studies found that perceived availability of physical activity facilities and infrastructure may lead to little or no difference in active transportation (MD -0.00 minute, 95% CI -0.08 to 0.07; I<sup>2</sup> = 0%; Figure 12; low certainty).<sup>28</sup> The other study which could not be included in the meta-analysis due to reporting OR found no significant association with one measure: there are limited dedicated walking and cycling paths in my neighbourhood (OR 0.85, 95%CI 0.75 to 1.03). One of the two studies investigated whether there was evidence of an interaction by SES and found no significant interaction (Girls: p=0.09, Boys: p=0.26).<sup>28</sup>



**Figure 12: Forest plot for the association of perceived availability of physical activity facilities with active transportation. (APF, availability of physical activity facilities; AT, active transportation)**

### Walkability

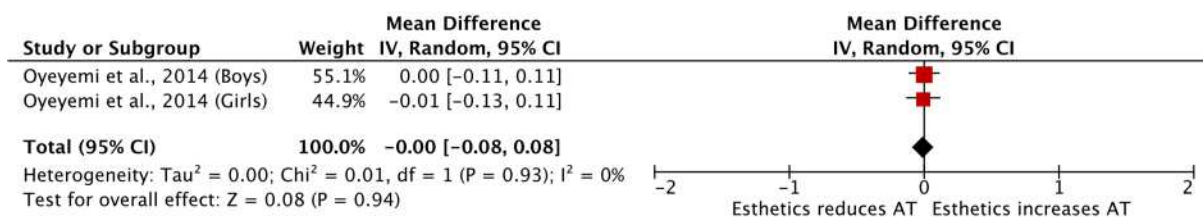
Two studies assessed the association of perceived walkability with active transportation.<sup>28,54</sup> One study found that that perceived walkability may lead to little or no difference in active transportation (MD 0.10 minutes, 95% CI -0.11 to 0.31; I<sup>2</sup> = 84%; Figure 13; low certainty).<sup>28</sup> While the other study which reported OR found no significant association with there is no direct route for my child to walk/cycle to school, (OR 0.89, 95% CI 0.76 to 1.03). One study investigated whether there was evidence of an interaction by SES but found no significant SES interaction (Girls: p=0.62, Boys: p=0.66).<sup>28</sup>



**Figure 13: Forest plot for the association of perceived walkability with active transportation. (AT, active transportation)**

### Esthetics

One study assessed the association of perceived esthetics with active transportation and found that that perceived esthetics may lead to little or no difference in active transportation (MD -0.00 minute, 95% CI -0.08 to 0.08; I<sup>2</sup> = 0%; Figure 14; low certainty).<sup>28</sup> This study investigated whether there was evidence of an interaction by SES but found no significant SES interaction (Girls: p=0.36, Boys: p=0.42).<sup>28</sup>



**Figure 14: Forest plot for the association of perceived esthetics with active transportation. (AT, active transportation)**

## **Traffic safety**

One study assessed the association of perceived traffic safety with active transportation.<sup>54</sup> This study reported no significant associations with five measure of traffic safety : I think drivers drive too fast on the streets of this neighbourhood (OR 0.75, 95%CI 0.57 to 1.02), I am concerned about dangerous traffic en route to school (OR 0.99, 95%CI 0.96 to 1.03), I'm concerned my child might be injured in a road accident while walking to school (OR 0.78, 95%CI 0.57 to 1.06), there is too much traffic in my neighborhood (OR 0.86, 95%CI 0.69 to 1.07), bicycling/walking to school would mean my child has to negotiate dangerous road junctions (OR 0.97, 95%CI 0.93 to 1.01).

## **Discussion**

This is the first systematic review assessing the association between built environment and physical activity among children and adolescents in Africa. The certainty of the evidence from the findings of six cross-sectional studies was either low or very low. Three of the studies were deemed as high quality, however, meta-analyses were limited due to the different methodological approaches employed by the studies.

### **Residential density**

The GRADE evidence for perceived residential density in this review was low, with no significant association between residential density and physical activity or active transportation. Our finding is similar to a recent systematic review in five studies from non-African populations which found no consistent significant association between residential density and physical activity or active transportation in children and adolescents.<sup>36</sup> However, another systematic review found consistent significant associations between residential density and physical activity in both children and adolescents, but only when residential density was measured objectively.<sup>38</sup> Two other systematic reviews reported inverse associations between higher residential density and physical activity in children and adolescents.<sup>29,33</sup> High residential density (measured as either high-density living or urban sprawl) has the potential to precipitate increased opportunities for social interaction between neighbors, which could translate to subsequent health benefits,<sup>27</sup> and potentially greater density of proximate amenity and services. However, high residential density may also constrain opportunities for physical activity due to the lack of private and public indoor and outdoor space, which could limit the ability to play.<sup>55</sup> There is still little understanding about the optimum density to promote social contact while mitigating other urban exposure, particularly in more vulnerable and low-income populations.<sup>27</sup>

### **Street connectivity**

The GRADE evidence for perceived street connectivity in this review was low, with no evidence of a significant association between street connectivity and physical activity or active transportation. Two previous systematic reviews reported inconsistent associations between street connectivity and physical activity in children and adolescents;<sup>38,56</sup> while another one suggested a positive association with physical activity and active transportation.<sup>31</sup> The inconsistent associations reported for street connectivity might be attributed to traffic safety concerns;<sup>56,57</sup> where some areas with low street

connectivity may also be areas with low traffic thus providing safer locations for children's outdoor play.<sup>38</sup> Street connectivity might be more related to active transportation than leisure time physical activity, because better street connectivity provides a more walkable environment, especially for children and adolescents.<sup>31</sup> However, this was not clear in our review. Adjusting for the presence of certain built environment features such as traffic calming barriers, speed limits and segregated pedestrian lanes may make possible associations between street connectivity and physical activity or active transportation more substantial.

### Crime safety

The GRADE evidence for perceived crime safety in this review was low and very low for perceived and objectively measured crime safety respectively. We however found a significant association for objective measures of crime safety and physical activity in our review. A similar association was seen in a systematic review of studies from countries with established market economies, where an objective measure of crime safety (low crime incidence) was associated with physical activity.<sup>39</sup> Additionally, further systematic reviews reported discrepant findings with one systematic review finding higher crime safety was associated with outdoor physical activity in children but not in adolescents, this study however reported associations between higher safety and active travel.<sup>36</sup> A systematic review of studies across three continents found no evidence of association between crime safety and active transportation to school or during leisure.<sup>12</sup> Another systematic review found no significant association between features of neighborhood safety and physical activity in children.<sup>55</sup> Current evidence suggest that there is a consistent association in the hypothesized direction between perceived crime and physical activity in children from high-income countries but such associations are less consistent and not in the hypothesized direction in lower-income countries, where most African countries fall.<sup>58</sup> This difference is said to be due to physical activity being largely optional in high income countries but obligatory in countries of lower levels of economic development, children in the latter countries may therefore accumulate high levels of physical activity despite high perception of crime rates.<sup>59</sup>

### Walkability

The GRADE evidence for perceived walkability in this review was low, with no significant association between walkability and physical activity or active transportation to school. Research has found that walkability and taking part in organized sports was the most frequently investigated construct;<sup>36</sup> however, no consistent association appears evident with physical activity, but this review reported more significant positive associations with active transportation. One systematic review found objective measures of walkability was associated with physical activity in children<sup>38</sup> but another systematic review reported only a trivial to a moderate positive effect of an objective measure of walkability on physical activity in children and adolescents.<sup>5</sup> Another review also reported a convincing association between walkability and active transportation to school.<sup>12</sup> We however found a significant association with active transportation to school but only in boys in one of the included studies.<sup>28</sup> This association could be because the different parameters that were used to assess walkability which included access to different

destinations, closeness to bus stops may be more suited to foster active transportation more than physical activity.

#### Availability of physical activity facilities and infrastructure

The GRADE evidence for perceived availability of physical activity facilities and infrastructure in this review was low for perceived measures and very low for an objective measure of the construct. Similarly, a systematic review assessing the association found no significant association in 17 out of the 20 studies reporting the association.<sup>39</sup> Conversely, two systematic reviews found children's participation in physical activity was associated with objectively measured and perceived measures of the construct.<sup>38,56</sup> However, one systematic review found inconsistent evidence between the availability of facilities and parks and physical activity in adolescents.<sup>38</sup> As regards active transportation to school, a review reported an evidence of a possible positive association.<sup>12</sup> Another review found consistent significant associations that reflected that shorter distances to facilities increased active transportation but longer distances reduced active travel behavior.<sup>36</sup> One of the studies included in our review reported a positive significant association with physical activity with boys but not with girls and this might be because of the differences seen between adolescent boys and girls; in which boys are more likely to participate in leisure time physical activity than girls.<sup>60,61</sup> The lack of association seen in the other study could be because of the ages of the participants involved; they are aged nine to 11 years and it is possible that their participation in physical activity in parks is dependent on the availability of their parents or guardians to take them to the parks. The significant association observed in one of the included studies<sup>51</sup> in this review with regards to adolescents in schools with larger playgrounds being at increased odds of reaching the recommended level compared to those with smaller playgrounds is similar to the findings from a study where school playgrounds were renovated and led to children being more physically active.<sup>62</sup>

#### Esthetics

The GRADE evidence for esthetics in this review was low, with no significant association between esthetics and physical activity or active transportation. Similar findings were also seen in a systematic review of non-African populations, where the majority of studies reported no significant association with either physical activity or active transportation.<sup>36</sup> However, an umbrella review found that increased access to esthetically pleasing recreational space was associated with active transportation among adolescents.<sup>30</sup>

#### Traffic safety

The GRADE evidence for both objective and perceived traffic safety in this review was very low, where a significant association was only seen for an objective measure of traffic safety and physical activity but no consistent significant association with active transportation. Two further systematic reviews found heavy traffic was consistently unrelated to physical activity in children,<sup>39</sup> or found no association.<sup>55</sup> As regards active transportation, results from a systematic review of non-African countries found that the majority of studies reported a significant association between transport related physical activity and an objective measure of traffic speed/safety in children,<sup>38</sup> but no consistent association was seen in

adolescents. Similarly, another systematic review found that increased traffic exposure reduced active transportation and even the presence of traffic calming barriers in places of high traffic did not improve active transportation;<sup>36</sup> while another reported some evidence of a possible positive association between traffic safety and active transportation to school.<sup>12</sup> Although we found a significant result with physical activity from our review, this is representative of only one study (n=258), therefore, our interpretation of this significant association is with caution as it cannot be generalized to the whole African population.

### **Strengths and weaknesses**

This systematic review has notable strengths due to the comprehensive search strategy employed, which provides reassurance that all eligible studies were identified; the use of double screening, data extraction, and critical appraisal to minimize errors; the utilization of meta-analysis to provide pooled estimates of the association between the built environmental construct and physical activity; and the use of GRADE to assess the certainty of the findings rather than solely relying on whether associations were significant. Additionally, we considered both perceived and objective measures of built environment constructs and objective and subjective measures of physical activity since it was anticipated that differences in associations may be seen. Objective measures of built-environment settings and physical activity have fewer biases and therefore may enhance the precision and credibility of findings.<sup>5,63</sup> Also, as there is evidence of a poor agreement between perceptions of the built environment and the objectively measured environment in adolescents,<sup>64,65</sup> it is important that both are considered in the analyses. There are some evidence that environmental perceptions are stronger correlates of activity among adolescents than objective measures;<sup>64,66</sup> this is said to be due to a higher familiarity of the neighborhood among residents but objective measures may not capture accurately the relationship that exists between resident's physical activity and the environment.<sup>66</sup>

However, there are some limitations to the systematic review. We were unable to explore heterogeneity based on clinical (age, ascertainment of physical activity) and methodological (adjustment for confounders) factors due to the small number of studies included in the systematic review. There were differences in the operationalization of the constructs, which made it difficult to compare similar constructs from different studies, which could have impacted on the findings of this review. Additionally, we were unable to fully explore the different domains of physical activity due to the studies predominantly focusing on combined measures of MVPA. We included studies from Northern and sub-Saharan Africa due to shared similarities, such as comparable Gross Domestic Products (GDPs);<sup>58</sup> however, we were unable to assess whether there were differences due to no studies being identified from Northern Africa. Also, only two studies provided sufficient data to be included in the meta-analyses, which limited the synthesis including the ability to estimate between study heterogeneity.

### **Conclusion and Recommendations**

The evidence for the association between built environment constructs and physical activity in children and adolescents in Africa is either low or very low; which limits the ability to draw firm conclusions. This suggests the need to conduct further high-quality studies in Africa, where both perceived and objective



measures of built environment constructs are assessed. Furthermore, current evidence from the Active Healthy Kids Global Alliance suggest that countries with the most active children and adolescents have their physical activity being driven by pervasive cultural norms. For such countries, being active is not just a choice but a way of life.<sup>67</sup> This supports the need for African countries to use the evidence to build cities that promote habitual physical activity in children and adolescents.

### **Recommendations for practice**

The certainty of the evidence for the association between the built environment and physical activity in children and adolescents in Africa was low and very low, respectively thereby making it difficult to make recommendations for practice. This systematic review however calls the attention of city planners, transportation officials, local government officers, and other stakeholders across Africa to begin to consider how their decisions and actions could influence public health.

### **Recommendations for research**

It was noted that the included studies analysed their data using different approaches, which did not permit the inclusion of some studies in meta-analyses. This underscores the need for consistency in the protocols used in Africa, which will aid the comparability of the studies and improve the quality of evidence generated. There appeared to be some differences in the associations based on whether objective or perceived measures of built environment constructs were used; therefore, it is recommended that both measures should be included in future studies. Also, future studies in Africa should consider investigating associations between built environment and other domains of physical activity, and to consider using natural experiments or longitudinal studies to assess the associations.

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### **Conflicts of interest**

JLB is a Senior Associate Editor for the JBI Evidence Synthesis journal. The other authors declare no conflict of interest.

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## Appendix I

### MEDLINE (OVID) (1946 - 22 October 2021) - 2022 results

#	Searches	Results
1	exp Physical Fitness/	33417
2	exp Running/	21967
3	exp Walking/	60113
4	exp Exercise/	218722
5	exp Gardening/	1067
6	exp Sports/	197781
7	exp "Sports and Recreational Facilities"/	5738
8	exp Dancing/	3158
9	exp "Physical Education and Training"/	13828
10	exp Motor Activity/	316113
11	exp Yoga/	3224
12	exp Fitness Centers/	619
13	exp "play and playthings"/	15552
14	exp Recreation/	225121
15	exp Sedentary Behavior/	11617
16	(physical adj5 (fit* or train* or activit* or inactivit* or endur* or exercis*)).mp. [mp=title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]	217027
17	((leisure or fitness) adj5 (centre* or center* or facilit*)).mp. [mp=title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]	1868

18	(swim*1 or swimming).mp. [mp=title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]	46440
19	(exercis*3 adj5 aerobic).mp. [mp=title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]	14468
20	(active adj (travel*4 or transport* or commut*)).mp. [mp=title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]	21277
21	(exercise* or sport* or sedentariness).mp. [mp=title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]	505036
22	(sedentary adj (lifestyle or behavio\$r)).mp. [mp=title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]	16994
23	("use" adj3 stair*).ti,ab.	250
24	or/1-23	845430
25	exp Child/	2014290
26	exp Adolescent/	2129235
27	exp Students/	144771
28	exp Pupil/	9859
29	exp Youth Sports/	535
30	exp Minors/	2682
31	(boy or boys or boyhood).mp. [mp=title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word,	153563

	organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]	
32	girl*.mp.	158748
33	(child* or adolescen* or student* or minor* or kid* or teen* or preteen* or youth* or young* or juvenil*).mp. [mp=title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]	5825544
34	or/25-33	5861578
35	exp Environment/	1386740
36	exp Built Environment/	904
37	exp Environment Design/	7676
38	environment.mp.	657761
39	exp Residence Characteristics/	71535
40	residenc*.mp.	157676
41	exp Crime/	143071
42	street connectivity.mp.	259
43	exp Parks, Recreational/	1654
44	exp Public Facilities/	1289
45	exp Bicycling/	11996
46	exp Social Environment/	121750
47	exp "Conservation of Natural Resources"/	103334
48	exp City Planning/	2375
49	built.ti,ab.	84696
50	communit*.ti,ab.	635053
51	exp Urban Health/	18160
52	exp Cities/	135716



53	(neighbourhood* or neighborhood*).ti,ab.	34969
54	facilit*.ti,ab.	760737
55	amenit*.ti,ab.	1552
56	location*.ti,ab.	438214
57	planning.ti,ab.	227446
58	design*.ti,ab.	2007510
59	sprawl.ti,ab.	447
60	land us*.ti,ab.	17311
61	(aesthetic* or esthetic*).ti,ab.	51988
62	(pavement* or sidewalk*).ti,ab.	2950
63	path*.ti,ab.	3128443
64	trail*.ti,ab.	25442
65	green*.ti,ab.	223101
66	(city or cities).mp.	189512
67	(park or parks or parkland or parklands).mp. [mp=title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]	23226
68	playing field*.mp.	749
69	open space*.mp.	1399
70	outdoor*.mp.	27714
71	walkability.mp. [mp=title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]	1117
72	motor vehicle*.mp.	20716
73	railroads.mp.	3202

74	Automobile Driving/	20490
75	transport*.ti,ab.	560228
76	commut*.ti,ab.	4761
77	(motoring or motorist*1).ti,ab.	681
78	road us*.ti,ab.	1425
79	traffic.ti,ab.	51322
80	travel*4.ti,ab.	70063
81	pedestrian*.ti,ab.	6191
82	(speed hump*1 or speed bump*1).ti,ab.	127
83	or/35-82	8875897
84	Africa.hw,kf,ti,ab,cp.	174821
85	exp Africa/	291272
86	exp Africa, Central/	16759
87	exp Africa, Eastern/	70095
88	exp Africa, Northern/	38742
89	exp "Africa South of the Sahara"/	229473
90	exp Africa, Southern/	70735
91	exp Africa, Western/	70443
92	exp South Africa/	45390
93	sub-saharan africa.mp.	25707
94	(Algeria or Angola or Benin or Botswana or Burkina Faso or Burkina Fasso or Upper Volta or Burundi or Urundi or Cameroon or Cameroons or Cameron or Camerons or Cabo Verde or Central African Republic or Chad or Comoros or Comoro Islands or Comores or Mayotte or Congo or Zaire or Cote d'Ivoire or Ivory Coast or Djibouti or Egypt or United Arab Republic or Equatorial Guinea or Eritrea or Ethiopia or Gabon or Gabonese Republic or Gambia or Ghana or Guinea or Guinea-Bissau or Kenya or Liberia or Madagascar or Malawi or Nyasaland or Mali or Mauritania or Mauritius or Agalega Islands or Morocco or Ifni or Mozambique or Namibia or Niger or Nigeria or	610099

	Rwanda or Ruanda or Sao Tome or Seychelles or Sierra Leone or Somalia or South Africa or Sudan or Swaziland or Tanzania or Togo or Togolese Republic or Tunisia or Uganda or Zambia or Zimbabwe or Rhodesia).hw,kf,ti,ab,cp.	
95	or/84-94	680047
96	24 and 34 and 83 and 95	2022

#### EMBASE (OVID) (1980 - 22 October 2021) –3949 results

#	Searches	Results
1	exp physical activity/	462229
2	exp fitness/	37485
3	exp sport/	180436
4	exp recreation/	81882
5	exp exercise/	364703
6	exp physical education/	11219
7	exp training/	90484
8	exp physical inactivity/	7020
9	exp sedentary lifestyle/	16513
10	(physical adj5 (fit* or train* or activit* or inactivit* or endur* or exercis*)).mp. [mp=title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword heading word, floating subheading word, candidate term word]	300984
11	(exercise* or sport* or sedentariness).mp. [mp=title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword heading word, floating subheading word, candidate term word]	668989
12	(active adj (travel*4 or transport* or commut*)).mp. [mp=title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword heading word, floating subheading word, candidate term word]	16329

13	(sedentary adj (lifestyle or behavior)).mp. [mp=title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword heading word, floating subheading word, candidate term word]	22489
14	(Physical Education and Training).mp. [mp=title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword heading word, floating subheading word, candidate term word]	4428
15	1 or 2 or 3 or 4 or 5 or 6 or 7 or 8 or 9 or 10 or 11 or 12 or 13 or 14	1241856
16	exp child/	2640141
17	exp adolescent/	1571429
18	exp student/	275763
19	exp "minor (person)"/	749
20	exp juvenile/	3485752
21	(child* or adolescen* or student* or minor* or kid* or teen* or preteen* or youth* or young* or juvenil*).mp. [mp=title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword heading word, floating subheading word, candidate term word]	6175426
22	or/16-21	6668427
23	exp environment/	7895765
24	exp environmental planning/	15644
25	exp neighborhood/	11723
26	exp recreational park/	3598
27	exp social environment/	546333
28	exp city planning/	2668
29	exp urban health/	1362
30	exp "traffic and transport"/	219666
31	exp traffic safety/	9328
32	public facilities.mp.	1061

33	(facilit* or design* or land us* or walkability or street connectivity).mp. [mp=title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword heading word, floating subheading word, candidate term word]	3483650
34	or/23-33	10594370
35	exp Africa/	353501
36	exp "Africa south of the Sahara"/	266462
37	exp Central Africa/	1575
38	exp North Africa/	46628
39	exp South Africa/ or Africa/	108445
40	(Algeria or Angola or Benin or Botswana or Burkina Faso or Burkina Fasso or Upper Volta or Burundi or Urundi or Cameroon or Cameroons or Cameron or Camerons or Cabo Verde or Central African Republic or Chad or Comoros or Comoro Islands or Comores or Mayotte or Congo or Zaire or Cote d'Ivoire or Ivory Coast or Djibouti or Egypt or United Arab Republic or Equatorial Guinea or Eritrea or Ethiopia or Gabon or Gabonese Republic or Gambia or Ghana or Guinea or Guinea-Bissau or Kenya or Liberia or Madagascar or Malawi or Nyasaland or Mali or Mauritania or Mauritius or Agalega Islands or Morocco or Ifni or Mozambique or Namibia or Niger or Nigeria or Rwanda or Ruanda or Sao Tome or Seychelles or Sierra Leone or Somalia or South Africa or Sudan or Swaziland or Tanzania or Togo or Togolese Republic or Tunisia or Uganda or Zambia or Zimbabwe or Rhodesia).hw,ti,ab,cp.	559384
41	or/35-40	612590
42	15 and 22 and 34 and 41	3949

**PsycINFO (OVID) (1806 - 22 October 2021) – 173 results**

#	Searches	Results
1	exp Physical Fitness/	4549
2	exp Physical Activity/	46440
3	exp Running/	2167
4	exp Walking/	6114

5	exp Exercise/	28663
6	exp Aerobic Exercise/	2052
7	exp Leisure Time/	9599
8	exp Sports/	36554
9	exp Training/	81421
10	exp Athletic Training/	1829
11	exp Physical Education/	4830
12	exp Dance/	2531
13	exp Recreation/	71091
14	exp Sedentary Behavior/	1920
15	(physical adj5 (fit* or train* or activit* or inactivit* or endur* or exercis*)).mp. [mp=title, abstract, heading word, table of contents, key concepts, original title, tests & measures, mesh]	58624
16	(active adj (travel*4 or transport* or commut*)).mp. [mp=title, abstract, heading word, table of contents, key concepts, original title, tests & measures, mesh]	919
17	(exercise* or sport* or sedentariness).mp. [mp=title, abstract, heading word, table of contents, key concepts, original title, tests & measures, mesh]	122860
18	(sedentary adj (lifestyle or behavio\$r)).mp. [mp=title, abstract, heading word, table of contents, key concepts, original title, tests & measures, mesh]	3249
19	or/1-18	273792
20	exp Students/	279874
21	(child* or adolescen* or student* or minor* or kid* or teen* or preteen* or youth* or young* or juvenil*).mp. [mp=title, abstract, heading word, table of contents, key concepts, original title, tests & measures, mesh]	1880887
22	20 or 21	1882435
23	exp Environment/	213631
24	exp Built Environment/	1121

25	exp School Environment/	16265
26	exp Urban Environments/	26190
27	exp Neighborhoods/	9176
28	exp Recreation Areas/	1688
29	exp Social Environments/	172409
30	exp Home Environment/	14934
31	exp Facilities/	118491
32	exp School Facilities/	23894
33	exp Community Facilities/	15203
34	exp Crime/	126263
35	exp Transportation/	13811
36	exp Urban Planning/	718
37	Residence Characteristics.mp.	8475
38	street connectivity.mp.	116
39	or/23-38	450855
40	Africa.mp.	25993
41	(Algeria or Angola or Benin or Botswana or Burkina Faso or Burkina Fasso or Upper Volta or Burundi or Urundi or Cameroon or Cameroons or Cameron or Camerons or Cabo Verde or Central African Republic or Chad or Comoros or Comoro Islands or Comores or Mayotte or Congo or Zaire or Cote d'Ivoire or Ivory Coast or Djibouti or Egypt or United Arab Republic or Equatorial Guinea or Eritrea or Ethiopia or Gabon or Gabonese Republic or Gambia or Ghana or Guinea or Guinea-Bissau or Kenya or Liberia or Madagascar or Malawi or Nyasaland or Mali or Mauritania or Mauritius or Agalega Islands or Morocco or Ifni or Mozambique or Namibia or Niger or Nigeria or Rwanda or Ruanda or Sao Tome or Seychelles or Sierra Leone or Somalia or South Africa or Sudan or Swaziland or Tanzania or Togo or Togolese Republic or Tunisia or Uganda or Zambia or Zimbabwe or Rhodesia).mp. [mp=title, abstract, heading word, table of contents, key concepts, original title, tests & measures, mesh]	53201
42	40 or 41	60803

43	19 and 22 and 39 and 42	173
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**CINAHL (EBSCO) (1958 - 22 October 2021) – 2631 results**

#	Searches	Results
S1	(MH "Physical Fitness+")	19,866
S2	(MH "Running+")	14,137
S3	(MH "Walking+")	33,662
S4	(MH "Exercise+")	122,798
S5	(MH "Sports+")	86,576
S6	(MH "Sports Facilities")	199
S7	(MH "Dancing+")	4,056
S8	(MH "Physical Education and Training+")	4,321
S9	(MH "Motor Activity+")	12,785
S10	(MH "Yoga+")	10,017
S11	(MH "Fitness Centers")	1,799
S12	(MH "Play and Playthings+")	17,718
S13	(MH "Recreation+")	32,180
S14	(MH "Life Style, Sedentary+")	9,309
S15	"(physical fitness OR physical training OR physical activity OR physical inactivity OR physical endurance OR physical exercise))."	5,370
S16	(MH "Swimming")	4,624
S17	(MH "Aerobic Exercises+")	45,419
S18	(MH "Leisure Activities+") OR (MH "Human Activities+")	445,467
S19	S1 OR S2 OR S3 OR S4 OR S5 OR S6 OR S7 OR S8 OR S9 OR S10 OR S11 OR S12 OR S13 OR S14 OR S15 OR S16 OR S17 OR S18	474,786
S20	(MH "Child+")	712,458



S21	(MH "Adolescence+")	563,156
S22	(MH "Students+")	150,322
S23	(MH "Pupil")	1,086
S24	(MH "Minors (Legal)")	749
S25	TX child* or adolescen* or student* or minor* or kid* or teen* or preteen* or youth* or young* or juvenil*	2,368,868
S26	S20 OR S21 OR S22 OR S23 OR S24 OR S25	2,372,945
S27	(MH "Environment+")	147,043
S28	(MH "Built Environment")	251
S29	(MH "Environment and Public Health+")	1,412,445
S30	"Environment Design"	178
S31	(MH "Residence Characteristics+")	137,289
S32	(MH "Crime+")	111,972
S33	TX street connectivity	240
S34	TX Parks, Recreational	348
S35	(MH "Public Facilities+")	1,669
S36	(MH "Cycling")	9,448
S37	(MH "Social Environment+")	58,988
S38	(MH "Conservation of Natural Resources+")	4,695
S39	(MH "Urban Areas")	22,658
S40	(MH "Urban Health")	3,891
S41	(MH "Environmental Health")	7,914
S42	S27 OR S28 OR S29 OR S30 OR S31 OR S32 OR S33 OR S34 OR S35 OR S36 OR S37 OR S38 OR S39 OR S40 OR S41	1,606,831
S43	(MH "Africa+")	90,233
S44	(MH "Africa, Central+")	3,201

S45	(MH "Africa, Eastern+")	23,279
S46	(MH "Africa, Northern+")	7,127
S47	(MH "Africa South of the Sahara+")	75,401
S48	(MH "Africa, Southern+")	29,398
S49	(MH "Africa, Western+")	18,640
S50	TX Algeria or Angola or Benin or Botswana or Burkina Faso or Burkina Fasso or Upper Volta or Burundi or Urundi or Cameroon or Cameroons or Cameron or Camerons or Cabo Verde or Central African Republic or Chad or Comoros or Comoro Islands or Comores or Mayotte or Congo or Zaire or Cote d'Ivoire or Ivory Coast or Djibouti or Egypt or United Arab Republic or Equatorial Guinea or Eritrea or Ethiopia or Gabon or Gabonese Republic or Gambia or Ghana or Guinea or Guinea-Bissau or Kenya or Liberia or Madagascar or Malawi or Nyasaland or Mali or Mauritania or Mauritius or Agalega Islands or Morocco or Ifni or Mozambique or Namibia or Niger or Nigeria or Rwanda or Ruanda or Sao Tome or Seychelles or Sierra Leone or Somalia or South Africa or Sudan or Swaziland or Tanzania or Togo or Togolese Republic or Tunisia or Uganda or Zambia or Zimbabwe or Rhodesia	209,783
S51	S43 OR S44 OR S45 OR S46 OR S47 OR S48 OR S49 OR S50	216,682
S52	S19 AND S26 AND S42 AND S51	2,631

#### Scopus (electronic resource) (1788- 22 October 2021) – 7 results

#	Searches	Results
1	( TITLE-ABS-KEY ( ( physical AND fitness OR physical AND education OR physical AND training OR physical AND activit* OR physical AND inactivit* OR exercise* OR sport* OR ordinariness OR sedentary AND lifestyle OR sedentary AND behavio* ) ) AND TITLE-ABS-KEY ( ( child* OR adolescen* OR student* OR minor* OR kid* OR teen* OR youth* OR young OR juvenile* ) ) AND TITLE-ABS-KEY ( ( environment OR built AND environment OR environment AND design OR residence AND characteristics OR crime OR street AND connectivity OR parks OR social AND environment OR neighbourhood ) ) AND TITLE-ABS-KEY ( ( africa OR africans ) ) )	7

#### Web of Science (1900 - 22 October 2021) - 1358 results

#	Searches	Results
1	TS=((physical fitness OR physical education OR physical training OR physical activit* OR physical inactivit* OR exercise* OR sport* OR sedentariness OR sedentary lifestyle OR sedentary behavio*))	999,220
2	TS=((child* OR adolescen* OR student* OR minor* OR kid* OR teen* OR youth* OR young OR juvenile*))	5,041,630
3	TS=((Environment OR Built Environment OR Environment Design OR Residence Characteristics OR Public Facilities OR Parks OR Urban Health))	2,485,908
4	TS=((AFRICA OR AFRICAN OR Algeria or Angola or Benin or Botswana or Burkina Faso or Burkina Fasso or Upper Volta or Burundi or Urundi or Cameroon or Camerouns or Cameron or Camerons or Cabo Verde or Central African Republic or Chad or Comoros or Comoro Islands or Comores or Mayotte or Congo or Zaire or Cote d'Ivoire or Ivory Coast or Djibouti or Egypt or United Arab Republic or Equatorial Guinea or Eritrea or Ethiopia or Gabon or Gabonese Republic or Gambia or Ghana or Guinea or Guinea-Bissau or Kenya or Liberia or Madagascar or Malawi or Nyasaland or Mali or Mauritania or Mauritius or Agalega Islands or Morocco or Ifni or Mozambique or Namibia or Niger or Nigeria or Rwanda or Ruanda or Sao Tome or Seychelles or Sierra Leone or Somalia or South Africa or Sudan or Swaziland or Tanzania or Togo or Togolese Republic or Tunisia or Uganda or Zambia or Zimbabwe or Rhodesia))	1,198,023
5	#4 AND #3 AND #2 AND #1	1461

#### SPORTDiscus (EBSCO) (1974 – 22 October 2021) – 279 results

#	Searches	Results
S1	( Physical fitness OR physical education OR physical training OR physical activit* OR physical inactivit* OR exercise* OR sport* OR sedentariness OR sedentary lifestyle OR sedentary behavio* ) AND ( child* OR adolescen* OR student* OR minor* OR kid* OR teen* OR youth* OR young OR juvenile* ) AND ( environment OR built environment OR environment design OR residence characteristics OR crime OR street connectivity OR parks OR social environment OR neighbourhood ) AND ( Africa or Algeria or Angola or Benin or Botswana or	279

<p>Burkina Faso or Burkina Fasso or Upper Volta or Burundi or Urundi or Cameroon or Cameroons or Cameron or Camerons or Cabo Verde or Central African Republic or Chad or Comoros or Comoro Islands or Comores or Mayotte or Congo or Zaire or Cote d'Ivoire or Ivory Coast or Djibouti or Egypt or United Arab Republic or Equatorial Guinea or Eritrea or Ethiopia or Gabon or Gabonese Republic or Gambia or Ghana or Guinea or Guinea-Bissau or Kenya or Liberia or Madagascar or Malawi or Nyasaland or Mali or Mauritania or Mauritius or Agalega Islands or Morocco or Ifni or Mozambique or Namibia or Niger or Nigeria or Rwanda or Ruanda or Sao Tome or Seychelles or Sierra Leone or Somalia or South Africa or Sudan or Swaziland or Tanzania or Togo or Togolese Republic or Tunisia or Uganda or Zambia or Zimbabwe or Rhodesia )</p>	
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**Grey literature**

**ProQuest dissertations and Thesis A&I (electronic resource) (1975 – 22 October 2021) - 179 results**

#	Searches	Results
1	<p>ab(physical fitness OR physical education OR physical training OR physical activit* OR physical inactivit* OR exercise* OR sport* OR sedentariness OR sedentary lifestyle OR sedentary behavio*) AND ab(child* OR adolescen* OR student* OR minor* OR kid* OR teen* OR youth* OR young OR juvenile*) AND ab(environment OR built environment OR physical environment) AND ab(Africa OR Algeria OR Angola OR Benin OR Botswana OR Burkina Faso OR Burkina Fasso OR Upper Volta OR Burundi OR Urundi OR Cameroon OR Cameroons OR Cameron OR Camerons OR Cabo Verde OR Central African Republic OR Chad OR Comoros OR Comoro Islands OR Comores OR Mayotte OR Congo OR Zaire OR Cote d'Ivoire OR Ivory Coast OR Djibouti OR Egypt OR United Arab Republic OR Equatorial Guinea OR Eritrea OR Ethiopia OR Gabon OR Gabonese Republic OR Gambia OR Ghana OR Guinea OR Guinea-Bissau OR Kenya OR Liberia OR Madagascar OR Malawi OR Nyasaland OR Mali OR Mauritania OR Mauritius OR Agalega Islands OR Morocco OR Ifni OR Mozambique OR Namibia OR Niger OR Nigeria OR Rwanda OR Ruanda OR Sao Tome OR Seychelles OR Sierra Leone OR Somalia OR South Africa OR Sudan OR Swaziland OR Tanzania OR Togo OR Togolese Republic OR Tunisia OR Uganda OR Zambia OR Zimbabwe OR Rhodesia)</p>	179

**Ethos (electronic resource - (2009 – 22 October 2021) - 2 results**

#	Searches	Results
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1	Physical activity AND Children OR Adolescents AND Africa.	2
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## Appendix II: Ineligible studies following full-text review

Reference	Reason for exclusion
Essiet IA, Baharom A, Shahar HK, Uzochukwu B. Application of the Socio-Ecological Model to predict physical activity behaviour among Nigerian University students. <i>Pan Afr Med J.</i> 2017;26:110.	Ineligible population
Jones S, Hendricks S, Draper CE. Assessment of physical activity and sedentary behavior at preschools in Cape Town, South Africa. <i>Child Obes.</i> 2014;10(6):501-10.	Ineligible population
Larouche R, Mire EF, Belanger K, Barreira TV, Chaput J-P, Fogelholm M, et al. Relationships Between Outdoor Time, Physical Activity, Sedentary Time, and Body Mass Index in Children: A 12-Country Study. <i>Pediatr Exerc Sci.</i> 2019;31(1):118-29.	Ineligible population
Mowafi M, Khadr Z, Bennett G, Hill A, Kawachi I, Subramanian S. Is access to neighborhood green space associated with BMI among Egyptians? A multilevel study of Cairo neighborhoods. <i>Health Place.</i> 2012;18(2):385-90.	Ineligible population
Oyeyemi AL, Adegoke BOA, Oyeyemi AY, Sallis JF. Perceived Environmental Correlates of Physical Activity and Walking in African Young Adults. <i>Am J Health Promot.</i> 2011;25(5):e10-e9.	Ineligible population
Ryan GJ, Dzewaltowski DA. Comparing the relationships between different types of self-efficacy and physical activity in youth. <i>Health Educ Behav.</i> 2002;29(4):491-504.	Ineligible population
Whitaker KM, Xiao Q, Gabriel KP, Larsen PG, Jacobs Jr DR, Sidney S, et al. Perceived and objective characteristics of the neighborhood environment are associated with accelerometer-	Ineligible population

measured sedentary time and physical activity, the CARDIA Study. <i>Prev Med.</i> 2019;123:242-9.	
Amosun SL, Reddy PS, Kambaran N, Omardien R. Are students in public high schools in South Africa physically active? Outcome of the 1st South African National Youth risk behaviour survey. <i>Can J Public Health.</i> 2007;98(4):254-8.	Ineligible exposure
Aounallah-Skhiri H, Ben Romdhane H, Maire B, Elkhdim H, Eymard-Duvernay S, Delpeuch F, et al. Health and behaviours of Tunisian school youth in an era of rapid epidemiological transition. <i>East Mediterr Health J.</i> 2009;15(5):1201-14.	Ineligible exposure
Bonnema J, Coetzee D, Lennox A. Effect of a three-month HOPSports Brain Breaks® intervention programme on the attitudes of Grade 6 learners towards physical activities and fitness in South Africa. <i>J Phys Educ Sports.</i> 2020;20(1):196-205.	Ineligible exposure
El-Gilany A, Badawi K, El-Khawaga G, Awadalla N. Physical activity profile of students in Mansoura University, Egypt. <i>East Mediterr Health J.</i> 2011;17(8):694-702.	Ineligible exposure
Garnier D, Benefice E. Habitual physical activity of Senegalese adolescent girls under different working conditions, as assessed by a questionnaire and movement registration. <i>Ann Hum Biol.</i> 2001;28(1):79-97.	Ineligible exposure
Garnier D, Ndiaye G, Benefice E. Influence of urban migration on physical activity, nutritional status and growth of Senegalese adolescents of rural origin. <i>Bull Soc Pathol Exot.</i> 2003;96(3):223.	Ineligible exposure
Hamrani A, Mehdad S, El Kari K, El Hamdouchi A, El Menchawy I, Belghiti H, et al. Physical	Ineligible exposure

activity and dietary habits among Moroccan adolescents. Public Health Nutr. 2015;18(10):1793-800.	
Hanson SK, Munthali RJ, Micklesfield LK, Lobelo F, Cunningham SA, Hartman TJ, et al. Longitudinal patterns of physical activity, sedentary behavior and sleep in urban South African adolescents, Birth-To-Twenty Plus cohort. BMC Pediatr. 2019;19.	Ineligible exposure
Harrington DM, Gillison F, Broyles ST, Chaput JP, Fogelholm M, Hu G, et al. Household-level correlates of children's physical activity levels in and across 12 countries. Obesity. 2016;24(10):2150-7	Ineligible exposure
Hosny G, Moloukhia TM, Elsalam GA, Elatif FA. Environmental behavioural modification programme for street children in Alexandria, Egypt. East Mediterr Health J. 2007;13(6):1438-48.	Ineligible exposure
Kubayi N, Surujlal J. Perceived benefits of and barriers to exercise participation among secondary school students. Mediterr J Soc Sci. 2014;5(20):121.	Ineligible exposure
Micklesfield LK, Pedro TM, Kahn K, Kinsman J, Pettifor JM, Tollman S, et al. Physical activity and sedentary behavior among adolescents in rural South Africa: levels, patterns and correlates. BMC Public Health. 2014;14(1):40-.	Ineligible exposure
Minnaar E, Grant CC, Fletcher L. Physical activity of children from a small rural town, South Africa. S Afr Fam Pract (2004). 2016;58(2):68-73.	Ineligible exposure
Mogre V, Aneyire ES, Gyamfi EK. Physical activity and BMI status of school-age children in Tamale, Northern Ghana. Pak J Nutr. 2013;12(5):484-90.	Ineligible exposure



<p>Moselakgomo VK, Monyeke MA, Toriola AL. Relationship between physical activity and risk factors of body weight disorders among south African primary school children. Biomedical Research (India). 2015;26(4):730-8.</p>	<p>Ineligible exposure</p>
<p>Musaiger AO, Al-Mannai M, Tayyem R, Al-Lalla O, Ali EYA, Kalam F, et al. Perceived barriers to healthy eating and physical activity among adolescents in seven arab countries: A cross-cultural study. ScientificWorldJournal. 2013;2013 (no pagination)(232164).</p>	<p>Ineligible exposure</p>
<p>Muthuri SK, Wachira L-JM, Onywera VO, Tremblay MS. Comparative study of physical activity patterns among school children in Kenya and Canada: Results from the ISCOLE Project. Afr J Phys Health Educ Recreat Dance. 2014;20(2.2):765-79.</p>	<p>Ineligible exposure</p>
<p>Muthuri SK, Wachira LJM, Onywera VO, Tremblay MS. Correlates of objectively measured overweight/obesity and physical activity in Kenyan school children: results from ISCOLE-Kenya. BMC Public Health. 2014;14:436.</p>	<p>Ineligible exposure</p>
<p>Muthuri SK, Wachira LJ, Onywera VO, Tremblay MS. Direct and self-reported measures of physical activity and sedentary behaviours by weight status in school-aged children: results from ISCOLE-Kenya. Ann Hum Biol. 2015;42(3):237-45.</p>	<p>Ineligible exposure</p>
<p>Ojiambo RMe. Assessment of physical activity in children and adolescents [Ph.D.]. Ann Arbor: University of Glasgow (United Kingdom); 2012.</p>	<p>Ineligible exposure</p>
<p>Ojiambo RM, Easton C, Casajus JA, Konstabel K, Reilly JJ, Pitsiladis Y. Effect of urbanization on objectively measured physical activity levels, sedentary time, and indices of adiposity in</p>	<p>Ineligible exposure</p>

Kenyan adolescents. <i>J Phys Act Health</i> . 2012;9(1):115-23.	
Ojiambo R, Gibson AR, Konstabel K, Lieberman DE, Speakman JR, Reilly JJ, et al. Free-living physical activity and energy expenditure of rural children and adolescents in the Nandi region of Kenya. <i>Ann Hum Biol</i> . 2013;40(4):318-23.	Ineligible exposure
Olaitan OL, Bakinde ST, Ibraheem TO. Recreational activities and body exercise among secondary school students in Kwara state, Nigeria. <i>Int J Res Ayurveda Pharm</i> . 2012;3(5):690-5.	Ineligible exposure
Oyeyemi AL, Ishaku CM, Oyekola J, Wakawa HD, Lawan A, Yakubu S, et al. Patterns and associated factors of physical activity among adolescents in Nigeria. <i>PLoS One</i> . 2016;11(2):e0150142.	Ineligible exposure
Pienaar AE, Kruger HS, Steyn HS, Naude D. Change over three years in adolescents' physical activity levels and patterns after a physical activity intervention: play study. <i>J Sports Med Phys Fitness</i> . 2012;52(3):300-10.	Ineligible exposure
Phillips JS, Kirenga L, Steyl T, Kagwiza J. Perceived support for physical activity in the school environment. <i>Afr J Phys Health Educ Recreat Dance</i> . 2015:40-7.	Ineligible exposure
Prista A, Nhantumbo L, Saranga S, Lopes V, Maia J, e Seabra A, et al. Physical activity assessed by accelerometry in rural African school-age children and adolescents. <i>Pediatr Exerc Sci</i> . 2009;21(4):384-99.	Ineligible exposure
Senbanjo IO, Oshikoya KA. Physical activity and body mass index of school children and adolescents in Abeokuta, Southwest Nigeria. <i>World J Pediatr</i> . 2010;6(3):217-22.	Ineligible exposure

Takomana G, Kalimbira A. Weight gain, physical activity and dietary changes during the seven months of first-year university life in Malawi. <i>South Afr J Clin Nutr.</i> 2012;25(3):132-7.	Ineligible exposure
Van Biljon A, McKune AJ, Dubose KD, Kolanisi U, Semple SJ. Physical activity levels in urban-based south african learners: A cross-sectional study of 7 348 participants. <i>S Afr Med J.</i> 2018;108(2):126-31.	Ineligible exposure
Walter CM. Promoting physical activity: A low cost intervention programme for disadvantaged schools in Port Elizabeth, South Africa. <i>Afr J Phys Health Educ Recreat Dance.</i> 2014;20(2.1):357-71.	Ineligible exposure
De Wet N, Somefun O, Rambau N. Perceptions of community safety and social activity participation among youth in South Africa. <i>PLoS One.</i> 2018;13(5):e0197549.	Ineligible outcome
Sullivan SM, Broyles ST, Barreira TV, Chaput JP, Fogelholm M, Hu G, et al. Associations of neighborhood social environment attributes and physical activity among 9–11 year old children from 12 countries. <i>Health and Place.</i> 2017;46:183-91.	Duplicate cohort
Kirenga BL, Phillips JS, Steyl T. High school girls' perceptions of environmental and social support for physical activity. <i>Physiotherapy.</i> 2015;1):eS760.	Only abstract was available
Micklesfield L, Pedro T, Twine R, Kinsman J, Pettifor J, Tollman S, et al. Physical activity patterns and determinants in rural South African adolescents. <i>J Sci Med Sport.</i> 2012;15:S251.	Only abstract was available
Pienaar A. After school physical activity intervention: Changes and challenges over a	Only abstract was available

three-year-period. J Sci Med Sport. 2012;15 (SUPPL.1):S117-S8	
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