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Primary School-Based Interventions to Promote a Healthy Urban Environment for Children Aged 5 to 12 years: a Ten-years Systematic Review and Meta-analyses

Work package 9 - Task 9.2 - Subtask 9.2.3 - Deliverable 9.4

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1. Objective of the respective Subtask 9.4

ISGlobal will focus the systematic review on the evaluation of interventions targeting children in school settings with the aim to improve their exposures and behaviours related to the urban environment. According to the LifeCycle Deliverable 9.1: "Report on strategies for identifying potential interventions focused on modification of early-life stressors" (December 2018), the reviews should consider exposures or early-life stressors that occur in the first 1000 days of life. However, in the case of urban environment, no sufficient literature could be found on interventions targeting this population. Therefore, we choose to focus on primary school-aged children with interventions in school settings located in Europe and higher-income countries.

We will focus on stressors that are known to have effects in early development and can be influenced through interventions or define special target groups. Therefore, in the general population, the following factors were defined: outdoor air quality, noise, active travel to school, and green spaces. The outcomes of the interventions might relate to a change in exposure level (e.g. indoor air quality, any air quality + noise + travel mode) or in behaviours (e.g. physical activity or health outcomes) (Figure 1).

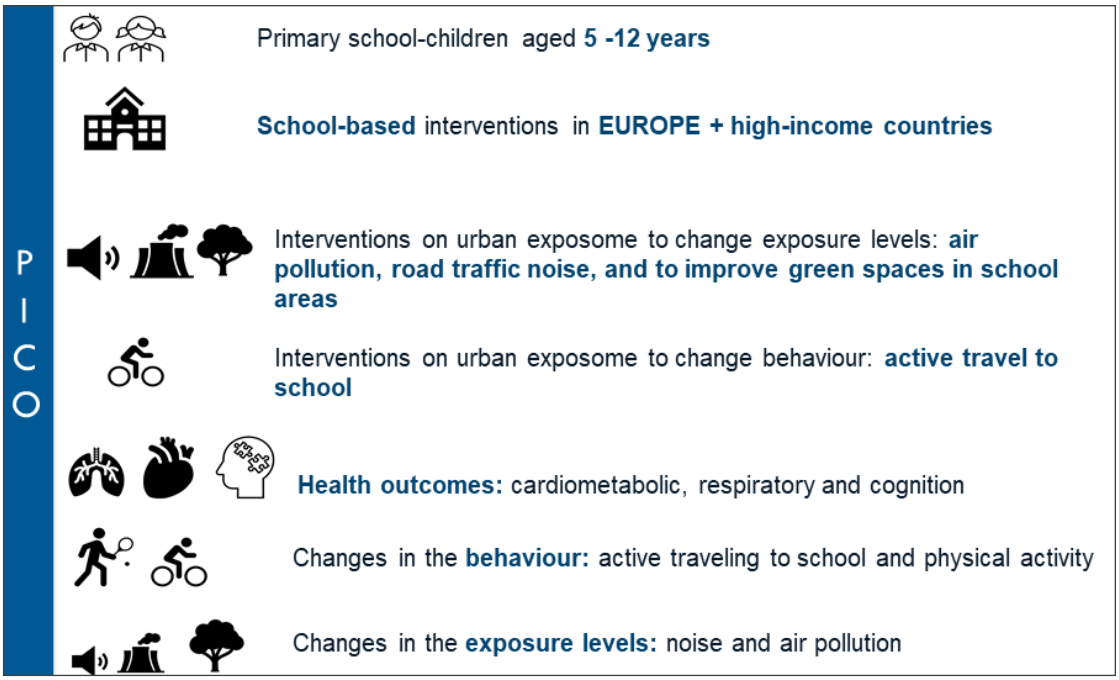


Figure 1: Primary School-based Interventions to Promote a Healthy Urban Environment for Children Aged 5 to 12 years: a 10-years Systematic Review and Meta-analyses

2. Review question

What is the effectiveness of primary school-based interventions to promote a healthy urban environment and to mitigate urban stressors in children aged 5 to 12 years?

3. Eligibility criteria

3.1. Participants/population

Population: Targeted participants are school-aged children of 5 to 12 years old enrolled in primary schools from urban areas of Europe and high-level income countries in the rest of the world.
Inclusion criteria: all healthy children in the age range whether they were overweight, obese, or not.
Exclusion criteria: (i)children aged 4 years or less at the start of the intervention (ii) interventions that exclusively targeting children with a critical illness (e.g. including mental, physical, or respiratory diseases) or comorbidity (e.g. diabetes).

3.2. Interventions

Interventions taking place in a primary school setting that target one or more of the following to improve child's health or modify urban environmental stressors: (i) changes in the exposure level of noise, air pollution, green spaces OR (ii) behaviours related to active travel to school.

General inclusion criteria: (i) studies focused on changes to the school indoor and outdoor environment (e.g barriers against air pollution, synthetic components of building materials, for example, synthetic carpet and pressed wood may emit toxic or respiratory irritant chemicals such as formaldehyde incorporating earthquake reinforcement strategies in areas that have active fault lines, air purifiers); (ii) encourage the use of specific locations (e.g. green prescription schemes or allotments); (iii) encourage the use a specific feature of built environment (e.g. cycle loan schemes, walking buses); (iv) greening in playgrounds during school hours); (v) creation of, or enhanced access to, places (e.g. changing opening hours, new bridges to improve physical access; traffic restrictions); (vi) creation of new facilities (e.g. bicycle lanes or walking paths)[2,4];

General exclusion criteria: (i) exclusively behavioural interventions (including education and/or skills and/ or behaviour change) without a target in the urban environment (e.g

behaviour interventions to increase physical activity without a focus on use of urban green spaces); (ii) interventions exclusive focused on changes to the home, neighborhood or community environment targeted to the wider public.

(i) changes in the exposure level

A) Air Pollution

Definition

(i) Air pollution (MeSH term): the presence of contaminants or pollutant substances in the air (AIR POLLUTANTS) that interfere with human health or welfare or produce other harmful environmental effects. The substances may include GASES; PARTICULATE MATTER.

(ii) Air pollutants concentrations of = PM OR NO2 OR black carbon OR PM10 OR PM2.5 OR coarse PM OR soot OR black smoke (BS) OR elemental carbon (EC) OR absorption of PM (a measure of soot) OR CO; CO2; SO2; NOx; O3; ultrafine particles (UFP) OR particles with an average aerodynamic diameter smaller than 0.1 micrometers, or 100 nanometres (measured as particle number concentration);[5,6]

Specific inclusion criteria: We will include interventions where exposure assessment to ambient air pollution is conducted as a part of a primary-school based intervention using direct or indirect measures (ie: personal exposures; fixed stations) during school hours, within, around or along the school road path: (i) those interventions aimed at reducing ambient stemming from school environment; (ii) those interventions aimed at reducing ambient air pollutants originating from any vehicular source, traffic load and density surrounding the school or in the path to the school; (iii) we also included interventions aimed at reducing traffic and/or congestion that also resulted in changes in ambient air pollutants concentrations surrounding the school or in the path to the school; (iv) those interventions aimed at reducing ambient air pollutants originating from multisource, which could include any of the above-listed sources; (v) interventions focused on changes to the school environment of collective protection (e.g. filtration systems)

Specific exclusion criteria: (i) interventions focused on forms of personal protection (e.g masks);

B) Noise[7]

Definition

(i) Noise (MeSh term) = Any sound which is unwanted or interferes with HEARING other sounds.

(ii) Noise, Transportation (MeSH term) = Noise associated with transportation, particularly aircraft and automobiles.

***Specific inclusion criteria**:* (i) Direct or indirect exposure assessment to urban noise exposure will be accepted, but only interventions related to noise from transport sources will be included; (ii) We will include interventions aimed to reduce road traffic, railways, or air traffic noise within, around, or along the path to school (i) during school hours (ii) including interventions on motor vehicle source limit regulations, or of limits on aircraft noise emission.

Specific exclusion criteria: (i) interventions to reduce/relate to music or electronic devices or listening devices or headphone or festival or disco or recreation or leisure) or recreation or leisure activities (ii) intervention through the construction of a noise barrier near a roadway at the school (because the change in the level immediately behind the barrier may not result in a change in exposure levels for some affected population)[7] (iii) interventions focused exclusively on education to change knowledge and risk avoidance behaviours to reduce exposure to the noise sources;

C) Green Spaces

Definition:

(i) Green spaces[free-text term keyword**]=** smaller green space features (such as street trees and roadside vegetation); green spaces not available for public access or recreational use (such as green roofs and facades, or green space on private grounds); and larger green spaces that provide various social and recreational functions (such as parks, playgrounds or greenways)[4]

(ii) within and around primary school= the area describing students' experience of nature at school. This includes not only the school building but also the 25 m buffer around the school[9], green spaces (e.g. parks or playgrounds) used during school hours; or along the path to go to school (eg. green trails). This larger area represents the viewshed in which students may visually or physically access green space during the school day[9].

Specific inclusion criteria: We will include urban green interventions that report at least one objective measure of green spaces focused on: (i) modify green space availability and features; OR (ii) creating new green spaces; OR (iii) changing or improving green space characteristics, use and functions; OR (iv) removing/replacing green space; OR (v) aesthetic-based interventions such as the greening of vacant lots, typically involving removing rubbish, planting trees, provision of street trees:

(a) within the school; (b) 25 m buffer around the school property c) within parks, playgrounds, green spaces use during school hours OR (iii) in the path to school (eg. creation or change in greenways/trails);

(b) (vi) also, those interventions aimed to increase children's exposure to green spaces during school hours (e.g. lay in wooded areas during recess; use of a naturalized habitat for science and writing lessons; and involvement in gardening);

(c) (vii) green spaces use and/or exposure could be self-reported by children, their parents, or obtained by observation or GPS; (viii) Green spaces should be measured objectively by use of a satellite system, land cover maps, or an assessment by trained auditors using a consistent tool. [10]

Specific exclusion criteria: interventions that solely involved an awareness or promotion program with no target to the physical environment;

⇒ Potential adverse health effects of green spaces (e.g. allergies exacerbations symptoms) will be detailed.

3.3. Comparator

Another intervention, a non-exposed control group or less exposed control groups., standard or currently existing interventions in schools.

3.4. Primary outcomes

At a minimum to be eligible, studies need to include outcomes (primary or secondary) in children using standardized and validated tools on either:

(i) Health outcomes: clinical cardiometabolic and respiratory measures, medical diagnostic assessment, medical reporting severity of symptoms, self-report of parents/ child of symptoms exacerbation, computerized testing, psychometric and neuropsychological tests administered by psychologists/physicians answered by the parents or child, biosensors OR

(ii) Behaviour: physical activity or active travel to school OR (iii) Change in exposure level: air quality (indoor and outdoor), lower levels of noise (indoor and outdoor), green spaces

(i) Health outcomes

a) Cardiometabolic outcomes

- Inclusion criteria:

⇒ Anthropometry/body composition: body mass index, body fat percentage (Child's DXA fat mas Child's DXA lean mass, Child's % body fat from bioimpedance) waist circumference

OR

⇒ Blood markers laboratory parameters (Child's glucose, Child's hemoglobin, Child's HbA1c, Child's insulin, Child's CRP, Child's IL-6, Child's adiponectin, Child's leptin, Child's fatty acid profiles, Child's total cholesterol, Child's HDLc, Child's LDLc, Child's vLDLc, Child's triglycerides)

OR

⇒ Cardiovascular measures: systolic and diastolic blood pressures (Child's peripheral blood pressure, Child's pulse rate Child's central (i.e. aortic) blood pressure (Child's carotidradial pulse wave velocity Child's carotid femoral pulse wave velocity Child's carotid intima-media thickness)

Specific Exclusion criteria: (i) Studies where the outcome was not measured in human subjects (e.g. menu offerings, food prices without measuring consumer purchases, store inventories or animal studies); (ii) self-report measures of cardiometabolic parameters; (iii)changes on diet behaviours such as dietary intake as the unique outcome.

b) Respiratory-immune outcomes: Lung function tests (spirometry) OR Current diagnosis asthma or current respiratory symptoms: wheezing, nocturnal coughing, and dyspnoea OR Allergies or Inhalant allergy, Inhalant allergic sensitization OR SPT Inahalant allergic OR Inhalant allergic sensitization[14,15].

c) Mental health: studies must include health outcomes related to cognition OR behaviour OR neurodevelopmental disorders[13]: global IQ OR executive functions OR memory OR academic skills OR visual-motor abilities OR Autism spectrum disorder OR

Attention deficit hyperactivity disorder OR behaviour problems[17] OR Strengths and Difficulties related to emotional and behavioural characteristics.

(ii) Behaviour outcomes:

a) Physical activity (PA)[17]: The rate of PA could be assessed through self-report or using accelerometers during both school or non-school (or both) time.[2]:

- Rates of moderate to vigorous physical activity during the school day, time engaged in moderate to vigorous physical activity during the school day.
- Maximal oxygen uptake (VO2max)
- Changes in total PA level.

b) Active travel to school: changes of travel mode to walk or bike OR improve domain-specific PA travel levels OR counts of active transport. ***Specific Exclusion criteria:*** studies were outcome was the number of injures or accidents or crashes (eg: "Road traffic safety measures motor vehicle crash data to assess the effectiveness of Safe Routes to School interventions in reducing school-aged pedestrian injury).

3.5. Secondary outcomes

Change in exposure level

We will include additional outcomes any changes in the exposure levels of urban stressors included in the review scope, defined as environmental outcomes.

- Objective (direct or indirect) or subjective (eg self-report such as diaries, interviews) exposure assessments of changes in exposure levels will be accepted:

(i) Increase indoor or outdoor air quality: studies were reported the reduction of personal exposure or reduction of air pollutant levels.

(ii) Reduction of noise levels from roadways/railways (e.g: dB)

(ii) Relevant environmental outcomes mitigate by green spaces: reduction of noise pollution OR Air pollution.

3.6. Context

Primary school settings (within, around, or in the road path to primary schools) in urban areas of Europe and high-income countries in the rest of the world regardless of who delivered the intervention:

(i) interventions which were either exclusively delivered with school settings, or where a substantial component was delivered within school settings;

(ii) interventions were delivered to a whole class or school.

Specific Exclusion criteria: (i) studies when the intervention was conducted entirely outside of the school setting out of school hours or activities (e.g. community setting, public place, recreation facility, physician office, camp setting). (ii)Studies using schools as the source of recruitment but where the intervention was not school-based were excluded.

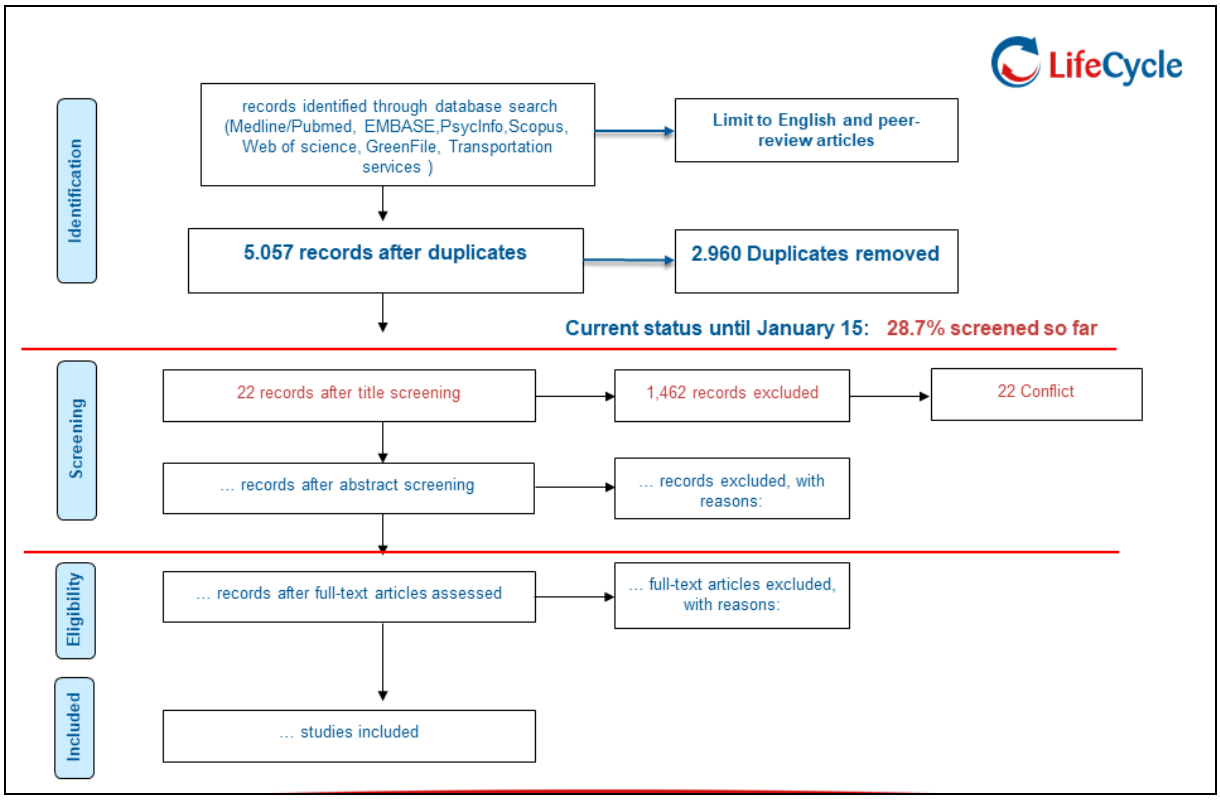
Interventional studies implemented in Europe as defined by the United Nations:
Eastern Europe = Belarus, Bulgaria, Czechia, Hungary, Poland, Republic of Moldova, Romania, Russian Federation, Slovakia, Ukraine
Northern Europe= Åland Islands
Channel Islands= Guernsey, Jersey, Sark, Denmark, Estonia, Faroe Islands, Finland, Iceland, Ireland, Isle of Man, Latvia, Lithuania, Norway, Svalbard and Jan Mayen Islands, Sweden, United Kingdom of Great Britain and Northern Ireland
Southern Europe = Albania, Andorra, Bosnia and Herzegovina, Croatia, Gibraltar, Greece, Holy See, Italy, Malta, Montenegro, North Macedonia, Portugal, San Marino, Serbia, Slovenia, Spain
Western Europe= Austria, Belgium, France, Germany, Liechtenstein, Luxembourg, Monaco, Netherlands, Switzerland

OR high-income countries (as defined by the World Bank*), targeting socioeconomically disadvantaged families will be included.
*These countries are the following: Andorra, Antigua, Barbuda, Australia, Austria, Bahamas, Bahrain, Barbados, Belgium, Brunei, Canada, Chile, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Israel, Italy, Japan, Kuwait, Latvia, Liechtenstein, Lithuania, Luxembourg, Malta, Monaco, Netherlands, New Zealand, Norway, Oman, Palau, Panama, Poland, Portugal, Puerto Rico, Qatar, Saint Kitts and Nevis, San Marino, Saudi Arabia, Seychelles, Singapore, Slovakia, Slovenia, South Korea, Spain, Sweden, Switzerland, Trinidad, Tobago, United Arab Emirates, United Kingdom, United States, Uruguay.

4. Search strategy and databases

Medline/Pubmed, EMBASE, PsycInfo, Scopus, Web of science, GreenFile, Transportation services

5. Flow chart



6. Data extraction

All papers (title and abstracts) identified from the search process were imported into Endnote software and duplicates removed into a duplicate folder. Two reviewers have been working independently, screening titles and abstracts of studies retrieved using the search strategy on free software Rayyan QCRI. The next step will be proceeding with the snowballing approach, to identify interventions that meet the inclusion criteria (study design, population, the content of the intervention, outcomes).

Full texts of relevant articles will then be retrieved and assessed for eligibility by two authors and any disagreement over the eligibility of studies will be resolved through discussion with Martine Vrijheid and Rosie McEachan. Excluded studies will be grouped and reasons for exclusion will be recorded.

Information extracted will include type of school, year of the study, country, study design, and methodology, enrolment and recruitment details, population and participant demographics, baseline characteristics, intervention details according to TIDieR guidelines, control conditions (if any), outcomes (measures and times of measurement) and length of follow-up, adherence and acceptability to users. The same two reviewers will independently extract data from included studies, discrepancies will be identified and resolved through discussion (with Martine Vrijheid and Rosie McEachan where necessary). Study authors will be contacted via email, if necessary, for missing information.

7. Risk of bias assessment

Internal validity: two reviewers will independently assess the risk of bias in included studies using Version 2 of the Cochrane risk-of-bias tool for randomized trials (RoB 2), which focuses on different aspects of trial design, conduct, and reporting. Alternatively, we are planning to use either the 'Effective Public Health Practice Project – Quality Assessment Tool (Thomas et al, 2004) or the Cochrane risk of bias tool: for Non-Randomized Studies of Interventions (ACROBAT- NRSI). The risk of bias score in each of these domains will be assigned and presented in the final paper and overall risk of bias will be reported for each study. Disagreements will be resolved through discussion, with a third reviewer to the validity of the studies. Quality assessments will be undertaken by one researcher. A second researcher will assess an overlapping sample (20%) of the studies to establish reliability. Studies will not be excluded from the review based on quality ratings.

8. Results

The 22 papers included so far, two are related to air quality interventions; one to mitigate noise level, seven to promote active travel to school by safe routes interventions, and 12 involve interventions targeting green spaces by schoolyard renovations or improving exposure to green space in school time (green breaks, natural play, outdoor classes).

9. Conclusion and next steps

Urban exposome impact on child health is a relatively new topic. Our review embraces three main exposures at once. The same which were assigned for Lifecycle cohorts. Because of that our review will provide comprehensive evidence on modifiable factors affecting children's cognition, cardiometabolic, and respiratory outcomes. On the other hand, this approach makes more complex all the systematic review steps. For example, looking at many and overlapping research concepts increased the time spent to build a concise and also comprehensive search strategy. The bias risk assessment will be a challenge since one paper usually includes many primary and secondary outcomes. Also, the fact that a target exposure (improving green spaces) may affect a secondary outcome (reduction of air pollution exposure) increase the potential outcomes to be assessed. Be mindful of that, the decision to reduce the review period to the last ten years make it feasible and informative once we will have update interventions studies.

The next steps include:

(i) finalise screening process and proceed with the snowballing approach – February 2021
(ii) extraction of papers information- March 2021
(iii) A priori, bias assessment will take more time since we will assess the risk for each primary and secondary outcome in each paper – by May 2021.
(iv) Meta-analysis and final report – by July 2021

10. References

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