

# Blueprint for halving obesity: rapid review

School-based physical activity lessons  
as an intervention for reducing  
childhood obesity



Author: Katherine Parkin

# Contents

<b>Summary table</b>	<b>2</b>
<b>Rapid umbrella review</b>	<b>5</b>
Background	5
Objectives	5
Methods	5
Results	7
<b>Appendices</b>	<b>14</b>

## Summary table

<b>Title</b>	<a href="#">School-based physical activity programs for promoting physical activity and fitness in children and adolescents aged 6 to 18</a>	<a href="#">Comparative effectiveness of school-based interventions targeting physical activity, physical fitness or sedentary behaviour on obesity prevention in 6- to 12-year-old children: A systematic review and meta-analysis</a>
<b>Author and year</b>	Neil-Sztramko, Caldwell and Dobbins (2021)	Podnar et al. (2021)
<b>Type of study</b>	Cochrane Review (systematic review and meta-analysis)	Systematic review and meta-analysis
<b>Outcome variable</b>	<p>Primary outcomes</p> <ul style="list-style-type: none"> <li>• Proportion of students meeting recommendations for moderate to vigorous physical activity (MVPA)</li> <li>• Duration of MVPA</li> <li>• Sedentary time</li> </ul> <p>Secondary outcomes</p> <ul style="list-style-type: none"> <li>• Physical fitness</li> <li>• Body mass index (BMI) and BMI z-score</li> <li>• Health-related quality of life</li> <li>• Adverse events</li> </ul>	BMI, BMI z-score, % body fat (%BF)

<p><b>Treatment</b></p>	<p>School-based physical activity lessons (sometimes with inclusion of additional interventions in the home, community, local theatre, or after-school programmes, or via the computer)</p>	<p>Primary prevention of obesity; interventions that targeted sedentary behaviours or physical activity (PA) or physical fitness</p>
<p><b>Control</b></p>	<p>All studies included a control group that represented a school or a group of schools from a different community, city, or state that did not receive the school-based intervention. However, in some studies, control schools received other physical activity promotion interventions provided through other health organisations or venues or by a standard PE curriculum.</p>	<p>Inclusion criteria specified: randomised or non-randomised control trial, controlled before and after study or natural experiment.</p>
<p><b>Magnitude of effect (Children)</b></p>	<p>BMI mean difference: -0.07kg/m<sup>2</sup> [95% CI: -0.15 to 0.01]</p> <p>BMI z-scores mean difference: -0.06 [95% CI: -0.09 to -0.02]</p> <p><b>Differential effects:</b></p> <p>Of note, the results suggest that effects are greater in younger children. [see original review for details]</p>	<p><b>Pooled effects:</b></p> <p>BMI mean difference: BMI = -0.16kg m<sup>-2</sup> [95% CI: -0.25 to -0.07]</p> <p>BMI z-scores mean difference: -0.07 [95% CI: -0.10 to -0.05]</p> <p><b>Differential effects:</b></p> <p>Of note, the positive effect is stronger in girls than boys, when impact is separated by sex instead of pooled.</p>

<b>Magnitude of effect (Children) (continued)</b>		<p>Girls: BMI = <math>-0.21\text{kg m}^{-2}</math> [95% CI: <math>-0.28</math> to <math>-0.14</math>]  Boys: BMI = <math>-0.01\text{kg m}^{-2}</math> [95% CI: <math>-0.08</math> to <math>0.05</math>]</p> <p>Some evidence of impact on health inequalities for disadvantaged groups too [see details in text]</p>
<b>Magnitude of effect (Adults)</b>	Not applicable to review question	Not applicable to review question
<b>Notes</b>	For modelling the impact of this policy, the review highlighted in the <b>green column</b> was used.	

---

# Rapid umbrella review

---

## Background

School-based education is a commonly used method to promote behaviour change in children and adolescents, particularly as it allows good coverage of children with diverse backgrounds. It has been identified as a potential method to reduce the prevalence of obesity and overweight via physical activity and nutritional lessons. Assessing the longer-term outcomes of children exposed to such education sessions offers an opportunity to identify if such interventions are effective in reducing obesity and overweight prevalence at a population level. This report covers school-based physical activity education alone. However, school-based nutrition education and school-based nutrition combined with dietary education is covered in a [separate report](#).

## Objectives

To summarise the best available evidence for the effect of school-based physical activity education provision on energy intake or body weight of young people.

## Methods

We aim to identify reviews that include quantitative research synthesis (ie, meta-analysis) of the effectiveness of school-based physical activity education provision outcomes relevant to calorie consumption, energy intake, weight loss or obesity. If more than one review is identified that answers our research question, we aim to identify the review that is reflective of the best evidence, based on (a) year published and (b) best fit to the research question.

## Eligibility criteria

*Types of review.* To be eligible for inclusion, articles were required to use systematic review methodology (ie, use of systematic search and inclusion strategy to identify all available studies) and include quantitative data synthesis (ie, meta-analysis) of multiple studies that examined the effect of school-based physical activity

education on outcomes of interest. If the search did not identify any studies where a meta-analysis had been conducted due to heterogeneity of outcomes of interest, we intended to include reviews with narrative syntheses. We did not set inclusion criteria on the number or type of databases searched.

*Participants.* To be eligible for inclusion, articles had to examine the effect of interventions on children of school-age, including those with or without overweight or obesity.

*Intervention.* Reviews were required to synthesise interventions that provided physical activity education to children in a school setting. Interventions could involve other settings too (eg, home) but were required to take place at least in part at a school.

*Comparator.* No intervention or a different intervention (eg, combined school-based nutrition/dietary education lessons).

*Outcomes.* To be eligible for inclusion, reviews needed to include either clinical (eg, weight, BMI, % fat change, zBMI scores) or behavioural outcomes (including, but not limited to: eating behaviour, food diaries). Reviews that only included measures of intentions/plans for future behaviour were excluded due to evidence about the gap between intended and actual eating behaviour.

## Information sources and article selection

The search strategy was designed to identify syntheses of research evidence such as systematic reviews between the year 2010 and the date of search. Initial keywords were identified via a scoping review of relevant papers and reports as well as via PubMed using the MeSH function. A search was performed in PubMed and the Cochrane Database of Systematic Reviews (see [appendix 1](#) for search strategy). The search was run in October 2023.

## Screening

Due to the rapid nature of the reviews, a single reviewer screened titles and abstracts and discussed any uncertainty with a second reviewer. For relevant titles/abstracts, the full text was retrieved for full text review. One reviewer reviewed the full texts and discussed uncertainties with a second reviewer.

## Data extraction

The JBI Data Extraction Form for Review for Systematic Reviews and Research Syntheses (see [appendix 2](#)) was used to inform data extraction for the final included review.

## Results

We identified a Cochrane Review on the topic of school-based physical activity by [Neil-Sztramko, Caldwell and Dobbins \(2021\)](#), which was an update of a previous review. The review update aimed "to summarise the evidence on effectiveness of school-based interventions in increasing moderate to vigorous physical activity and improving fitness among children and adolescents 6 to 18 years of age", including whether certain combinations, components, or both, of school-based interventions are more effective than others.

In addition, following consultation with our expert advisory group (EAG), we added a further paper which had previously been screened out during full-text screening: [Podnar et al. \(2021\)](#). Of note, the effect sizes of the two included papers are very similar (with trivially small differences) but we included this addition due to its relevance to our research question, and useful commentary on differential effects by sex and level of disadvantage.

Below we first report findings from the Neil-Sztramko, Caldwell and Dobbins (2021) Cochrane Review, followed by findings from the Podnar et al. (2021) systematic review and meta-analysis.

### Neil-Sztramko, Caldwell & Dobbins (2021) paper:

What studies did the review include?

The review included articles if they:

- used randomised controlled trials (RCTs) with a minimum duration of follow up of 12 weeks
- included school-attending children and adolescents (aged 6-18)



- included interventions relevant to public health practice (ie, were not delivered by a clinician), implemented in the school setting, and aiming to increase physical activity among school children for at least 12 weeks
- had a primary aim to increase physical activity or fitness, and the study should use an objective measure of physical activity or fitness. Primary outcomes included proportion of participants meeting physical activity guidelines and duration of moderate to vigorous physical activity and sedentary time (new to this update). Secondary outcomes included measured body mass index (BMI), physical fitness, health-related quality of life (new to this update), and adverse events (new to this update). Television viewing time, blood cholesterol, and blood pressure were removed from this update (contrary to the earlier review this was built on).

Of note, they excluded studies in which participants received a physical activity intervention as part of a treatment regimen for a specific critical illness or comorbidity (eg, diabetes), studies in which the intervention was conducted entirely outside the school setting (eg, community setting, public place, recreation facility, physician office, camp setting), and studies in which the intervention could be delivered only by a specific health professional (eg, physician) or fitness expert.

The comparison could be no intervention, usual care, or a concomitant intervention. Concomitant interventions had to be the same in both intervention and comparator groups to establish fair comparisons.

What were the systematic review methods?

Neil-Sztramko, Caldwell and Dobbins searched CENTRAL, MEDLINE, Embase, CINAHL, PsycINFO, BIOSIS, SPORTDiscus, and Sociological Abstracts to 1 June 2020, without language restrictions.

Two independent review authors used standardised forms to assess each study for relevance, to extract data, and to assess risk of bias. When discrepancies existed, discussion occurred until consensus was reached. Certainty of evidence was assessed according to GRADE. A random-effects meta-analysis based on the inverse variance method was conducted with participants stratified by age (children versus adolescents) when sufficient data were reported. Subgroup analyses explored effects by intervention type.

With regards to the measurement of BMI specifically (as our outcome of interest), “Seventy-one studies reported on BMI using objective measures. The most common expression of BMI, reported in 49 studies, was as kg/m<sup>2</sup>. Three studies used country-specific z-scores (England and Germany), and 2 studies used German-specific BMI percentile values. WHO z-scores were used in 2 studies, Centers for Disease Control and Prevention z-scores were used in 3 studies, and percentiles were used in an additional 3 studies. One study used the International Obesity Task Force cutoffs for weight status. Twelve studies used z-scores but did not specify the source, 6 studies did not describe methods, and 1 study reported percentage body fat.”

What did the review find?

This is a non-exhaustive summary of the review findings; please see the [original article](#) for more details. The review included “a total of 89 studies representing complete data for 66,752 study participants. Most studies included children only (n = 56), followed by adolescents only (n = 22), and both (n = 10); one study did not report student age. Multi-component interventions were most common (n = 40), followed by schooltime physical activity (n = 19), enhanced physical education (n = 15), and before and after school programmes (n = 14); one study explored both enhanced physical education and an after school programme. Lack of blinding of participants, personnel, and outcome assessors and loss to follow-up were the most common sources of bias.”...“All studies had intervention components that were delivered in the school setting. Some projects provided additional interventions in the home, community, local theatre, or after school programmes, or via the computer. The duration of interventions varied greatly from a minimum of 12 weeks to 6 years, with 10 studies reporting intervention periods of 3 years or longer.”

“Results show that school-based physical activity interventions probably result in little to no increase in time engaged in moderate to vigorous physical activity (mean difference (MD) 0.73 minutes/d, 95% confidence interval (CI) 0.16 to 1.30; 33 studies; moderate-certainty evidence) and may lead to little to no decrease in sedentary time (MD -3.78 minutes/d, 95% CI -7.80 to 0.24; 16 studies; low-certainty evidence). School-based physical activity interventions may improve physical fitness reported as maximal oxygen uptake (VORmax) (MD 1.19 mL/kg/min, 95% CI 0.57 to 1.82; 13 studies; low-certainty evidence). School-based physical activity interventions may

result in a very small decrease in BMI z-scores (MD -0.06, 95% CI -0.09 to -0.02; 21 studies; low-certainty evidence) and may not impact BMI expressed as kg/m<sup>2</sup> (MD -0.07, 95% CI -0.15 to 0.01; 50 studies; low-certainty evidence). We are very uncertain whether school-based physical activity interventions impact health-related quality of life or adverse events." Figure 1 below presents the authors' summary of findings.

**Summary of findings 1. School-based physical activity programmes for promoting physical activity and fitness in children and adolescents aged 6 to 18 years**

<b>School-based physical activity programmes for promoting physical activity and fitness in children and adolescents aged 6 to 18 years</b>				
<b>Population:</b> children and adolescents aged 6 to 18 years				
<b>Settings:</b> primarily within the school setting				
<b>Intervention:</b> educational, health promotion, counselling, and management strategies focused on promotion of physical activity and fitness				
<b>Comparison:</b> standard, currently existing physical education programmes in schools				
Outcomes	Anticipated effects (95% CI)		No. of participants (trials)	Certainty of the evidence (GRADE)
	Risk with control	Risk with Intervention		
<b>% of participants physically active</b> [follow-up: 12 weeks to 12 months]	% physically active ranged from 2% to 50%	% physically active ranged from 1.11% lower to 12.22% higher.	6,068 (5)	⊕⊕⊕⊕ <b>very low<sup>a</sup></b>
<b>Moderate to vigorous physical activity</b> (minutes/d) [follow-up: 12 weeks to 3 years]	-3.63 (-5.03 to -2.23)	MD 0.73, 95% CI 0.16 to 1.30	20,614 (33)	⊕⊕⊕⊖ <b>moderate<sup>b</sup></b>
<b>Sedentary time</b> (minutes/d) [follow-up: 12 weeks to 28 months]	27.77 (-21.34 to 76.88)	MD -3.78, 95% CI -7.80 to 0.24	11,914 (16)	⊕⊕⊕⊖ <b>low<sup>c</sup></b>
<b>Physical fitness</b> (VO <sub>2</sub> max, mL/kg/min) [follow-up: 12 weeks to 1 year]	-1.00 (-1.59 to -0.41)	MD 1.19, 95% CI 0.57 to 1.82	3,980 (13)	⊕⊕⊕⊖ <b>low<sup>d</sup></b>
<b>BMI</b> (z-score) [follow-up: 12 weeks to 4 years]	-0.01 (-0.08 to 0.06)	MD -0.06, 95% CI -0.09 to -0.02	22,948 (21)	⊕⊕⊕⊖ <b>low<sup>e</sup></b>
<b>BMI</b> (kg/m <sup>2</sup> ) [follow-up: 12 weeks to 4 years]	-0.35 (-1.06 to 0.36)	MD -0.07, 95% CI -0.15 to 0.01	34,337 (50)	
<b>Health-related quality of life</b> [follow-up: 15 weeks to 12 months]	Not estimable; insufficient data reported within studies		4,687 (7)	⊕⊕⊕⊖ <b>very low<sup>f</sup></b>
<b>Adverse events</b> [follow-up: 12 weeks to 3 years]	Not estimable; only 3 studies reported any adverse events		11,698 (16)	⊕⊕⊕⊖ <b>very low<sup>g</sup></b>

**BMI:** body mass index; **CI:** confidence interval; **MD:** mean difference; **min/d:** minutes per day; **VO<sub>2</sub>max:** maximal oxygen uptake.

Figure 1: Summary of findings (Figure reproduced from [Neil-Sztramko, Caldwell & Dobbins, 2021](#))

### BMI results for children specifically

"School-based physical activity interventions for children may decrease BMI z-scores; MD -0.06 (95% CI -0.11 to -0.01; 16 studies; substantial heterogeneity of 88%; Analysis 1.11 ; low-certainty evidence). These interventions may also result in a small decrease in BMI (MD -0.11 kg/m<sup>2</sup>, 95% CI -0.19 to -0.02; 38 studies; substantial heterogeneity of 84%; Analysis 1.13; low-certainty evidence)."

### BMI results for adolescents specifically

"School-based physical activity interventions for adolescents may not decrease BMI z-scores (MD -0.03, 95% CI -0.05 to -0.00; 5 studies;  $I^2 = 0\%$ ; Analysis 1.11 low-certainty evidence) nor BMI (MD 0.05 kg/m<sup>2</sup>, 95% CI -0.16 to 0.25; 12 studies;  $I^2 = 88\%$ ; Analysis 1.13 low certainty evidence)."

### Other results

Additional results on BMI specifically can be found in the [original report on page 23 onwards](#). In particular, this includes results broken down by type ie, before and after school programmes; enhanced physical education; multicomponent interventions; schooltime physical activity.

### Quality of papers

In terms of methodological quality, Neil-Sztramko, Caldwell and Dobbins presented a 'Risk of bias' graph (see Figure 2 below from original paper) with review authors' judgements about each 'Risk of bias' item presented as percentages across all included RCTs.

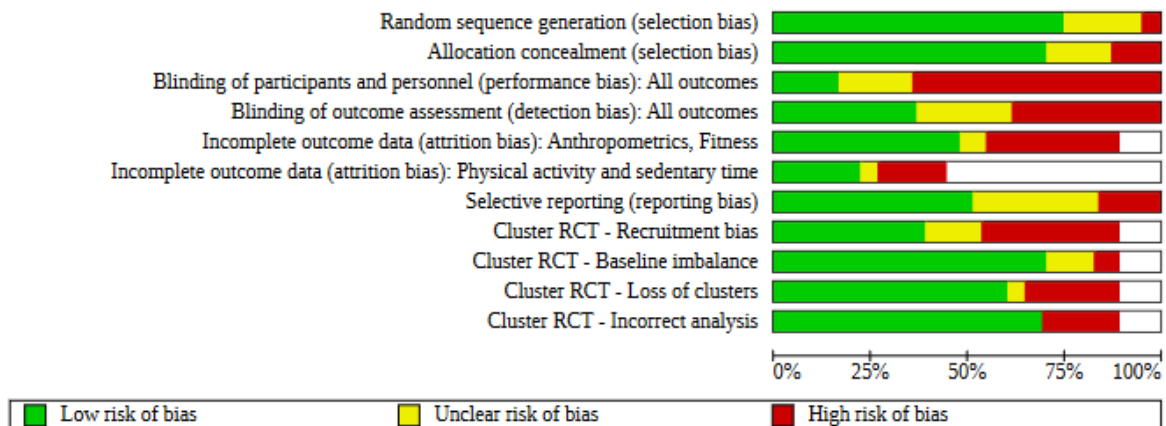


Figure 2: Risk of bias graph: review authors' judgements about each risk of bias item presented as percentages across all included trials (blank cells indicate that the particular outcome was not measured in some trials). (Figure reproduced from [Neil-Sztramko, Caldwell & Dobbins, 2021](#))

Podnar et al. (2021) paper:

What were the review methods?

Podnar et al. (2021) carried out a systematic review and meta-analysis. The paper focused on school-based interventions to target sedentary behaviours or physical activity (PA) or physical fitness, aimed at primary prevention of obesity, for young people aged 6 to 12 years.

What did the review find?

They found 146 reports for meta-analysis. More specifically, the authors note: "After we excluded studies that did not provide standard errors, those that did not provide results at baseline (or pre-intervention) and those that did not provide information related to control group, we combined, by meta-analysis, studies that assessed the following outcomes: BMI (102 studies, 171 analyses), BMI z-score (56 studies, 119 analyses) and %BF (46 studies, 91 analyses). On the other hand, obesity prevalence/incidence and waist circumference were found to be unsuitable for meta-analyses because of large heterogeneity in reporting, and other outcome measures were not included frequently enough to deserve meta-analysis."

“All in all, pooled effect sizes indicated that school-based PA interventions favourably affected all three outcomes analysed (BMI =  $-0.16 \text{ kg m}^{-2}$ , 95% CI =  $-0.25$  to  $-0.07$ ; BMI z-score =  $-0.07$ , 95% CI =  $-0.10$  to  $-0.05$ ; %BF  $-0.34\%$ , 95% CI =  $-0.55$  to  $-0.13$ ). Yet it has to be noted that indices of heterogeneity were large for all outcomes and ranged from  $I^2 = 82\%$  to  $I^2 = 92\%$ .”

Additional findings: differential effects (by sex) and potential impact on health inequalities (for disadvantaged groups)

Importantly, they noted differential effects in girls compared to boys. “Overall, the effects tended to be larger in girls than in boys, especially for PA + sedentary behaviour interventions.”... “When only studies that provided effects by gender are examined (n = 22G and 21B for BMI, n = 11G and 12B for BMI z-score, n = 13G and 13B for %BF), it becomes evident that gender is a significant moderator of the effectiveness of interventions analysed here. Specifically, interventions were effective or borderline effective in girls irrespective of the outcome assessed (BMI =  $-0.21 \text{ kg m}^{-2}$ ,  $-0.28$  to  $-0.14$ ; BMI z-score =  $-0.12$ ,  $-0.27$  to  $0.03$ ; %BF =  $-0.68\%$ ,  $-1.08$  to  $-0.29$ ), whereas in boys, null pooled effect was noted for BMI ( $-0.01 \text{ kg m}^{-2}$ ,  $-0.08$  to  $0.05$ ) and BMI z-score ( $-0.01$ ,  $-0.05$  to  $0.06$ ), and only borderline pooled effect was seen for %BF ( $-0.49\%$ ,  $-1.12$  to  $0.15$ ,  $p = 0.13$ ).”

Furthermore, there were important notes on potential health inequalities. “There was some evidence for inequality, as the effects on body mass index were seen when interventions were delivered in the general population (standardized mean difference =  $-0.05$ , 95% CI =  $-0.07$  to  $-0.02$ ), but not in groups of disadvantaged children (standardized mean difference =  $-0.01$ , 95% CI =  $-0.29$  to  $0.19$ ).”

---

# Appendices

---

## Appendix 1: PubMed search strategy

### Concept 1: School

"School" [tw] OR "school based" [tw] OR "school-based" OR "school based intervention\*" [tw] OR "elementary school" [tw] OR "secondary school" [tw] OR ("Schools" [Mesh])

### Concept 2: Education

"Education" [tw] OR "lesson\*" [tw] OR "class\*" [tw] OR "program\*" [tw] OR "tutorial" [tw] OR "session\*" [tw] OR "Education" [Mesh]

### Concept 3: Physical activity

"Physical activity" [tw] OR "physical activity education" [tw] OR "physical education" [tw] OR "physical activity program\*" [tw] OR "exercise" [tw] OR "activity" OR "PE lesson\*" OR "physical fitness" [tw] OR "Motor Activity" [Mesh] OR "Physical Education and Training" [Mesh] OR "Exercise" [Mesh]

### Concept 4: Obesity

"obesity"[tw] OR "overweight"[tw] OR "over-weight"[tw] OR "BMI"[tw] OR "body weight"[tw] OR "bodyweight"[tw] OR "Body mass index"[tw] OR "Body Mass Index" [Mesh] OR "Obesity"[Mesh] OR "Overweight" [Mesh]

### Concept 5: Systematic review

"systematic review"[tiab] OR "systematic\*" [tiab] OR "meta-analys\*" [tiab] OR "narrative synthes\*" [tiab]

### Search query:

"School" [tw] OR "school based" [tw] OR "school-based" OR "school based intervention\*" [tw] OR "elementary school" [tw] OR "secondary school" [tw] OR ("Schools" [Mesh])

AND

"Education" [tw] OR "lesson\*" [tw] OR "class\*" [tw] OR "program\*" [tw] OR "tutorial" [tw] OR "session\*" [tw] OR "Education" [Mesh]

AND

"Physical activity" [tw] OR "physical activity education" [tw] OR "physical education" [tw] OR "physical activity program\*" [tw] OR "exercise" [tw] OR "activity" OR "PE lesson\*" OR "physical fitness" [tw] OR "Motor Activity" [Mesh] OR "Physical Education and Training" [Mesh] OR "Exercise" [Mesh]

AND

"obesity"[tw] OR "overweight"[tw] OR "over-weight"[tw] OR "BMI"[tw] OR "body weight"[tw] OR "bodyweight"[tw] OR "Body mass index"[tw] OR "Body Mass Index" [Mesh] OR "Obesity"[Mesh] OR "Overweight" [Mesh]

AND

"systematic review"[tiab] OR "systematic\*" [tiab] OR "meta-analys\*" [tiab] OR "narrative synthes\*" [tiab]

Filter: from 2010-2023



## Appendix 2: JBI Data Extraction Form for Review for Systematic Reviews and Research Syntheses

Study details
Author/year
Objectives
Participants (characteristics/total number)
Setting/context
Description of interventions/phenomena of interest
Search details
Sources searched
Range (years) of included studies
Number of studies included <i>I</i>
Types of studies included
Country of origin of included studies
Appraisal
Appraisal instruments used
Appraisal rating
Analysis
Method of analysis
Outcome assessed
Results/findings
Significance/direction
Heterogeneity
Comments