

## REVIEW

## Pediatric Body Weight / Policy

# A systematic review of economic evaluations of interventions targeting childhood overweight and obesity

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## Summary

This systematic review critically appraised and synthesized evidence from economic evaluations of interventions targeting childhood excess weight. We conducted systematic searches in 11 databases from inception to April 19, 2023. Studies were eligible if they evaluated interventions targeting children up to 18 years and the study intervention(s) targeted childhood excess weight or sought to improve diet or physical activity, regardless of the type of economic evaluation or the underpinning study design. We synthesized evidence using narrative synthesis methods. One-hundred fifty-one studies met the eligibility criteria and were classified into three groups based on the intervention approach: prevention-only (13 studies), prevention and treatment (100 studies), and treatment-only (38 studies). The predominant setting and study design differed considerably between the three groups of studies. However, compared with usual care, most interventions were deemed cost-effective. The study participants' ages, sex, and socioeconomic status were crucial to intervention cost-effectiveness. Interventions whose effects were projected beyond childhood, such as bariatric surgery, lower protein infant formula, and home-based general practitioner consultations, tended to be cost-effective. However, cost-effectiveness was sensitive to the assumptions underlying the persistence and intensity of such effects. Our findings can inform future recommendations on the conduct of economic evaluations of interventions targeting childhood overweight and obesity, as well as practice and policy recommendations.

## KEYWORDS

childhood overweight and obesity, cost-effectiveness, economic evaluation, systematic review

**Abbreviations:** %BMI, percent over BMI; BMI, body mass index; CBA, cost-benefit analysis; CCA, cost-consequences analysis; CEA, cost-effectiveness analysis; CEAC, Cost-effectiveness acceptability curves; CHEERS, Consolidated Health Economic Evaluation Reporting Standards; CHU-9D, Child Health Utility 9Dimension; CMA, cost-minimization analysis; CUA, cost-utility analysis; DALY, disability-adjusted life year; EQ-5D, EuroQol 5Dimension; EQ-5D-Y, EuroQol 5Dimension Youth version; GP, general practitioner; HFSS, high in fat, sugar, and salt; HUI, Health Utilities Index; ICER, incremental cost-effectiveness ratio; LAGB, laparoscopic adjustable gastric banding; LMIC, low and middle-income countries; MET, metabolic equivalent; MVPA, minutes of moderate to vigorous physical activity; NICE, National Institute for Health and Care Excellence; QALY, quality-adjusted life years; RCT, randomized controlled trial; RYGB, laparoscopic Roux-en-Y gastric bypass; SES, socioeconomic status; SG, laparoscopic Sleeve Gastrectomy; SSB, sugar-sweetened beverage; SWiM, Synthesis Without Meta-analysis; WC, waist circumference; WHtR, waist-to-height ratio; WTP, willingness to pay.

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## 1 | INTRODUCTION

Childhood excess weight, a collective term for childhood overweight and obesity, is defined as age- and sex-specific body mass index (BMI) above the 85th and 95th centiles, respectively.<sup>1,2</sup> The worldwide prevalence of childhood excess weight has increased dramatically over the past 40 years, rising from under 4% in 1975 to over 18% in 2016 among children aged 5 years and over.<sup>3</sup> Globally, 39 million children under the age of 5 were reported to be overweight in 2020.<sup>4</sup> These estimates underscore public health concerns since childhood excess weight is a recognized precursor to obesity and non-communicable diseases in adult populations.<sup>5</sup> The short-term impacts of childhood excess weight translate into poorer health and educational outcomes for affected children and increased healthcare expenditure and indirect costs imposed on society that, consequently, impact human capital development.<sup>5–7</sup>

Over recent years, the range of interventions and programs that prevent or treat childhood excess weight has expanded into new areas across various settings such as schools, communities, homes, and clinics. However, adoption of new interventions and policies requires evaluation of their cost-effectiveness, that is, an assessment of costs and consequences relative to alternatives through one or more economic evaluation frameworks. Evidence from health economic evaluation, defined by Drummond et al.<sup>8</sup> as “the comparative analysis of alternative courses of action in terms of both their costs and consequences” is crucial for informing investment decisions that maximize population health and social well-being in the context of constrained healthcare resources.

A recent systematic review of economic evaluations of interventions targeting childhood excess weight by Zanganeh et al.<sup>9</sup> was prompted by several limitations of previous reviews in this field. Identified gaps include omission of relevant databases<sup>10–13</sup>; inadequately reported search strategies<sup>14</sup>; absence of quality assessment for included studies<sup>12,14</sup>; and exclusion of studies conducted in developing countries.<sup>13</sup> The review by Zanganeh et al.<sup>9</sup> identified and summarized evidence from 39 relevant studies. However, it excluded surgical interventions. Our updated searches, as part of a structured review,<sup>15</sup> identified 31 additional studies since the systematic review by Zanganeh et al.<sup>9</sup> Furthermore, two other recent systematic reviews were either focused solely on school-based interventions<sup>16</sup> or preventive interventions with dietary components only,<sup>17</sup> highlighting the need for a systematic review of the evidence that is broader in reach.

This study provides a comprehensive review of economic evaluations encompassing all interventions, programs, and policies designed to prevent and/or treat childhood excess weight. Our study summarizes the methodological characteristics and results of cost-effectiveness for individual studies and includes an assessment of the quality of their reporting. Ultimately, we aim to assess the evidence of cost-effectiveness across intervention groups and draw conclusions on methods that would better inform practice and policy on childhood excess weight.

## 2 | METHODS

### 2.1 | Definitions and taxonomies

We classified interventions into three different groups: (1) “prevention-only” if they only targeted children with healthy weight or if they targeted pregnant women and newborns with the aim of preventing excess weight in the infant or child; (2) “prevention and treatment” if they targeted children with a mixture of healthy weight and excess weight profiles or an undefined population expected to include a mix of children with healthy weight and excess weight; and (3) “treatment-only,” if the interventions solely targeted children with excess weight.

We categorized interventions as (1) behavioral (aimed at changing dietary and/or physical activity behaviors at the individual level); (2) environmental (involving modification of the environment); (3) pharmacological (medication-based); (4) surgical (bariatric surgery aimed at achieving weight loss); or (5) policy (requiring regulations, legislation, fiscal actions, or setting of voluntary targets across local, regional, and national jurisdictions).

The included studies reported economic evaluations applying one or more of five frameworks: (1) cost-benefit analysis (CBA), which expresses the costs and consequences of competing interventions in monetary terms; (2) cost-consequences analysis (CCA), which describes the costs and measures of consequences (effects) separately; (3) cost-minimization analysis (CMA), which seeks to establish the least costly method of achieving given outcomes<sup>18,19</sup>; (4) cost-effectiveness analysis (CEA), which assesses incremental costs and incremental measures of consequences expressed in natural units (e.g., reduction in BMI z scores or life-years gained); and (5) cost-utility analysis (CUA), a variation of CEA where consequences are expressed in metrics combining survival and preference-based health-related quality of life outcomes such as quality-adjusted life years (QALYs) or disability-adjusted life years (DALYs).<sup>8,20,21</sup>

A cost-effectiveness threshold is the upper limit a decision-maker is willing to pay for a unit of a health benefit.<sup>22</sup> An incremental cost-effectiveness ratio (ICER) is often used to summarize the comparison between competing interventions in terms of their costs and benefits. It is a measure of the incremental cost per incremental unit of health benefit produced by an intervention relative to a comparator.<sup>23</sup> A net monetary benefit (NMB) is a summary statistic that expresses the value of an intervention in monetary terms when a cost-effectiveness threshold has been specified.<sup>24</sup>

### 2.2 | Search strategy

This study was registered in the PROSPERO database of systematic review protocols (registration number: CRD42021267540).<sup>25</sup> We conducted systematic searches from the inception of each search engine to August 5, 2021, and updated the searches on April 19, 2023, in the following 11 databases: Medline (OvidSP) (1946–present); Embase (OvidSP) (1974–present); PsycINFO (OvidSP) (1806–present); CINAHL

(EBSCOHost) (1982–present); EconLit (Proquest) (1969–present); Cochrane Database of Systematic Reviews (Cochrane Library, Wiley) (Issue 4 of 12, April 2023); Cochrane Central Register of Controlled Trials (Cochrane Library, Wiley) (Issue 3 of 12, March 2023); NHS Economic Evaluation Database and Health Technology Assessment (via <https://www.crd.york.ac.uk/CRDWeb/>) (up to March 31, 2015); Science Citation Index; Social Science Citation Index; and Conference Proceedings Citation Index–Science (Web of Science Core Collection) (1900–present). The searches were built using title/abstract keywords, subject headings, or MeSH terms, where available, for the following key concepts: obesity/overweight and exercise/dietary interventions and childhood terms and economic/cost terms. An example search strategy is presented in Table S1. No limits to publication date or publication type were applied. All results were exported into Endnote X9 before being transferred to Covidence (<https://app.covidence.org/>) for de-duplication and screening. We documented our findings based on the PRISMA guidelines.<sup>26</sup> We also searched reference lists of included publications or recent systematic reviews for unpublished reports. Our separate gray literature searches involved entering combinations of terms such as “child,” “overweight,” “obesity,” “cost-effectiveness,” and “economic evaluation” in Google Scholar and reviewing the results on the first 15 pages.

## 2.3 | Selection criteria

Studies (including abstracts) identified in our searches were eligible for inclusion if (i) they involved children (defined as extending up to 18 years<sup>27</sup>) at the time of administering the intervention or adult populations (e.g., expectant mothers) if outcomes of the intervention were measured in their offspring during childhood; (ii) the study intervention(s) targeted childhood excess weight or sought to improve diet or physical activity; and (iii) the study was an economic evaluation (CBA, CCA, CMA, CEA, or CUA) regardless of the underpinning study design (e.g., randomized controlled trial, observational study with individual-level data, decision-analytic model, and quasi-experimental design). We included studies where the intervention was hypothetical or studies where hypothetical scenarios of intervention effectiveness were tested if they met the above inclusion criteria. The authors of a previous related systematic review stated that the exclusion of modeling studies of hypothetical interventions was a limitation of their study.<sup>17</sup> Studies of hypothetical interventions or multiple scenarios of treatment effectiveness can serve as the basis for target setting and forecasting. These types of studies can also broaden the discussion on economic modeling approaches within the field of childhood excess weight.

We excluded studies if (i) the intervention was not focused on tackling excess weight or improving diet or physical activity in childhood; (ii) the study was not an economic evaluation; (iii) the title and abstract were not published in the English language; (iv) the study reported a protocol only; or (v) the study was a review article not containing primary research evidence.

Titles and abstracts were screened in duplicate by O.O. and one other of either H.H., L.H., H.T., L.E.W., or R.E.A. Conflicts were discussed and resolved or referred to co-authors (S.P., M.V., and N.M.A.)

who served as arbiters. Full-text review screening was also conducted independently by at least two reviewers (O.O. and one other of either H.H., L.H., L.E.W., or A.S.). Similar steps were taken to resolve conflicts, as with titles and abstracts.

## 2.4 | Data extraction and synthesis

Due to heterogeneity in the study settings, jurisdictions and type of economic evaluations applied, meta-analysis was not appropriate, and we conducted a narrative synthesis of the economic evaluation methods, results, and discussions of the included studies in accordance with the recommendations of the Synthesis Without Meta-analysis (SWiM) reporting guideline.<sup>28</sup> To this end, we developed pro forma data extraction tables for collating aggregate characteristics for the three intervention groups (prevention-only, prevention and treatment, and treatment-only) and critical assessment items for the individual studies. The development of the tables was also informed by the Consolidated Health Economic Evaluation Reporting Standards (CHEERS) statement (2013),<sup>29</sup> a 24-item checklist widely recommended by researchers, editors, and peer reviewers for reporting and assessing health economic evaluations. Piloting phases in the development of tables comprising critical assessment items involved independent data extractions and comparisons by four reviewers (O.O., A.S., H.H., and L.H.). O.O., M.V., N.M.A., and S.P. iteratively updated the structure of all tables until the final versions were agreed upon. The variables extracted for each study were as follows: year of publication, country/jurisdiction, interventions and comparators, intervention category, intervention type, components and targets (a brief description of the composition of the intervention[s]), study approach, setting, study design, primary data sources, type of economic evaluation, target population and age range, sample size (if relevant), model time horizon (how long into the future the predicted outputs of cost-effectiveness are applicable), study perspective, currency, price date, discount rate, measures of consequence(s), sensitivity analyses and key study assumptions, results, and conclusions. M.V., N.M.A., and S.P. resolved disputes around data extraction.

We also assessed the quality of reporting for individual studies using the CHEERS checklist.<sup>29</sup> To ensure that studies were scored fairly, we derived customized denominators for individual studies depending on the applicability of each item on the CHEERS statement. All studies were assessed independently by O.O., A.S., and H.H., and a final score was achieved through consensus. We synthesized evidence around methodological characteristics and summarized cost-effectiveness estimates by intervention grouping: prevention-only, prevention and treatment, and treatment-only.

## 3 | RESULTS

### 3.1 | Literature search and study selection

Our literature searches were conducted on August 5, 2021, and initially identified 22,007 papers, of which 7,450 duplicates were identified and removed. After title and abstract screening, 390 papers were

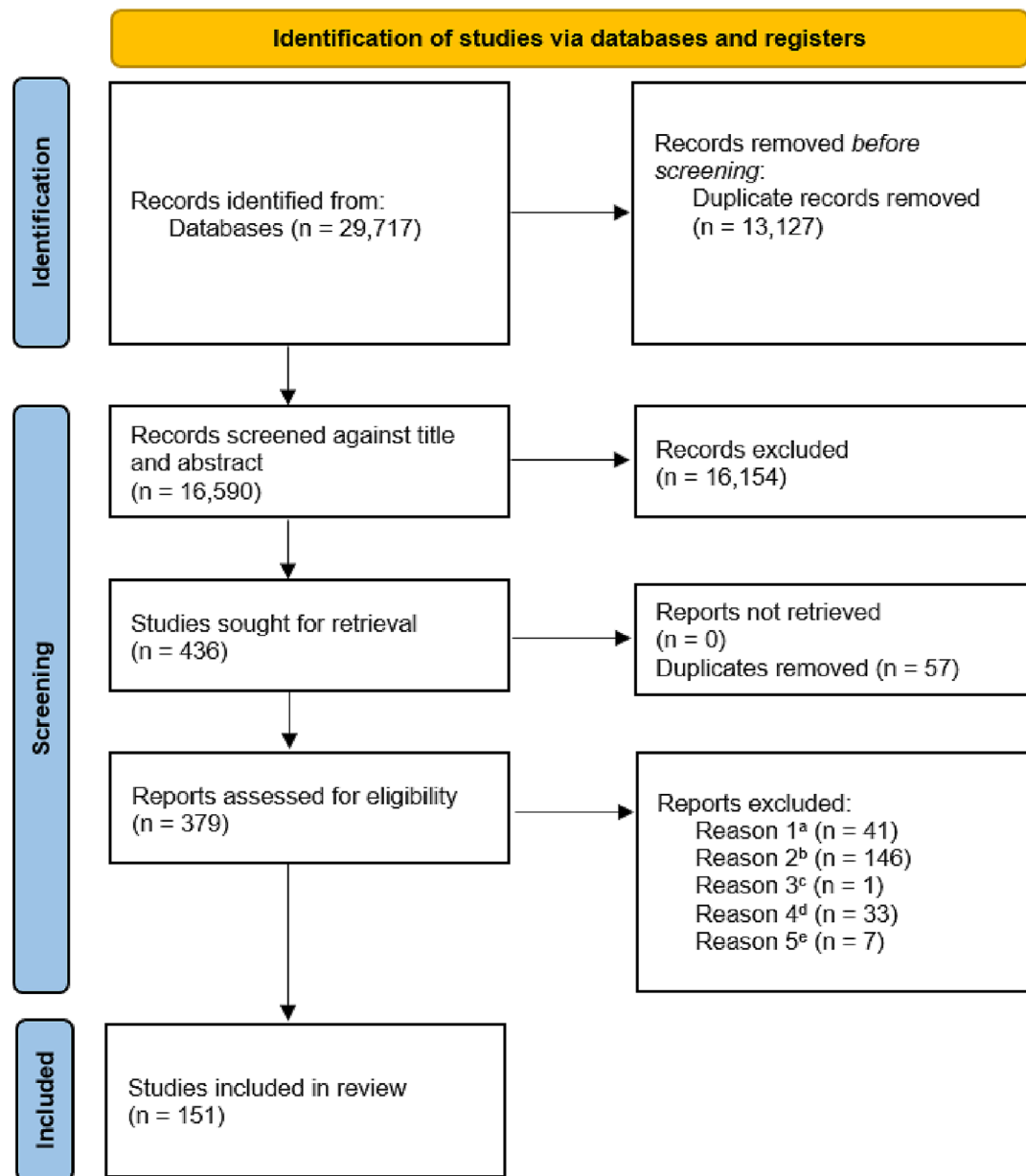
sought for full-text screening, from which 127 studies were deemed eligible for inclusion. In the updated searches conducted on April 19, 2023, a total of 7,710 papers were initially identified, and 5,677 duplicates were removed. After title and abstract screening, 46 papers were included for full-text screening, 24 of which were deemed eligible for inclusion.

After title and abstract screening, inter-rater reliability statistics for reviewer assessments ranged from 0.90 to 0.98 for proportionate agreement and 0.77 to 0.98 for random agreement probability. For full-text review, proportionate agreement ranged from 0.74 to 1.00, while random agreement probability ranged from 0.50 to 0.58. The main reason for exclusion was that the study did not report an

economic evaluation ( $n = 146$ ). Our gray literature search did not identify any studies of interest. The study selection process is displayed in Figure 1.

### 3.2 | Study characteristics across all intervention groupings

The volume of published studies tended to increase over 5-year periods from 2001, with the greatest number of studies published between 2016 and 2020. Only 9 studies of the 151 included studies were conducted in low and middle-income countries (LMICs)<sup>30–38</sup>



**FIGURE 1** PRISMA flow diagram of the study selection process. <sup>a</sup>Intervention not focused on tackling excess weight (overweight or obesity) in childhood; <sup>b</sup>not an economic evaluation; <sup>c</sup>title and abstract not published in the English language; <sup>d</sup>protocol study only; <sup>e</sup>review article not containing primary research evidence.

compared with 143 studies from high-income countries.<sup>31,39–180</sup> One study published in 2010 was set in a high-income country and six LMICs.<sup>31</sup>

Most studies in LMICs were conducted in China<sup>31–34,36,38</sup> and Mexico.<sup>30,31,35,38</sup> Other LMIC settings included Brazil,<sup>31,37</sup> Argentina,<sup>37</sup> El Salvador,<sup>37</sup> Trinidad and Tobago,<sup>37</sup> Peru,<sup>38</sup> India,<sup>31</sup> Russia,<sup>31</sup> and South Africa.<sup>31</sup> The United States was the most represented among the high-income countries, with 50 studies.<sup>51–80,132,141,143,144,147,151,152,155,158–161,164,166,167,171,175,176,178,180</sup> After the United States, the United Kingdom,<sup>31,41,46,47,81–98,137,142,153,154,156,157,165,169,170,174</sup> and Australia<sup>39,43,44,48–50,99–114,133,136,139,140,145,146,149,150,177</sup> accounted for the majority of the remaining studies from high-income countries, with 32 and 31 studies, respectively. Other high-income countries that formed the settings for studies included the Netherlands,<sup>115–117,131,163</sup> Germany,<sup>42,124,125,173</sup> Spain,<sup>118–121</sup> Canada,<sup>126–128,134</sup> New Zealand,<sup>122,123,130,168</sup> Finland,<sup>40,135,148</sup> Sweden,<sup>45,138</sup> Denmark,<sup>162</sup> Poland,<sup>172</sup> Portugal,<sup>129</sup> and France.<sup>179</sup>

Across the three intervention groups (prevention-only,<sup>30,39–50</sup> prevention and treatment,<sup>31–38,51–142</sup> and treatment-only<sup>143–180</sup>), intervention components were predominantly aimed at changing individual behavior.<sup>32–34,36,39–41,43–47,51,56–59,69,71,72,74,78,81,82,84–87,89–93,95,97,98,103–105,113–118,120–122,124,126–129,133,135,136,138,141–149,151,153–157,162–166,168,169,171,173–178,180</sup> Forty-six studies included a mix of intervention categories.<sup>31,34,38,45,48–50,52–54,60,61,63–68,70,73,75,76,79,80,83,94,99–102,105,107–111,115,116,123,125,130,131,134,137,139,140,160,162,167,171,172,179</sup> Solely environmental,<sup>30,42,132</sup> regulatory or policy-level<sup>35,37,62,77,88,96,106,112</sup> intervention categories were less common. Interventions in the surgical category<sup>150,158,159,161,170</sup> belonged strictly to the treatment-only group. Other methodological characteristics of the three intervention groups differed considerably, such as the study setting, type of economic evaluation, study design, and perspective. Characteristics of the included studies are summarized in Table 1 and in a more disaggregated form by intervention grouping in Tables 2–4.

### 3.2.1 | Estimation of resource use and costs

Trial-based studies were more likely to explicitly report their methods of collecting resource use and cost data compared to decision-analytic models. Study setting, jurisdiction, and perspective were crucial to the nature of resource and cost inputs factored into the economic evaluations. In school-based settings, the cost of delivering the intervention per school or student was usually derived from study records, which included data such as intervention materials, cost of the venue for physical activities, teacher and trainer or facilitator time, travel and administration costs, and miscellaneous expenses.<sup>97,98</sup> The control arms were generally assigned no costs or negligible up-front costs. A prevalent costing assumption was that interventions operated in a steady state, not requiring one-off start-up costs.<sup>60,65,100–103,109,111,116,122,145,150</sup> Depending on the perspective, trials conducted in home settings could include direct costs associated with delivering the intervention collected retrospectively (typically including personnel/provider/nurse/psychologist time, vehicle hire, purchase or running costs for home visits, personnel

training costs, and educational materials) and healthcare costs for doctor or specialist visits.<sup>39,174</sup> Assessments of clinical interventions such as bariatric surgery included direct medical costs associated with the procedure (cost of the procedure and post-operative care)<sup>161</sup>; long-term costs of treating obesity-related comorbidities,<sup>170</sup> as well as out-of-pocket payments; and payments by Medicare, Medicaid, or private insurance in the United States.<sup>159,180</sup> Most of the included studies were undertaken from a societal perspective, which took into account productivity costs such as absence from work and travel time of parents or caregivers, absenteeism from school, workplace absenteeism in adulthood, and early retirement attributable to the development of body weight-related diseases.<sup>30,34,40,42,45,51,52,54,56,69,73,78,100–102,115,116,125,158,163,164</sup> A few studies considered a limited or modified societal perspective where costs accrued by the public and non-governmental sectors were captured, but some downstream consequences of lost productivity were omitted.<sup>60,61,67,75,76,106,107,109,111,112,167</sup>

The economic evaluation of e-health interventions (“the use of information and communications technology in support of health and health-related fields”<sup>184</sup>) and interventions with m-health (a subset of e-health based on mobile wireless technologies<sup>185</sup>) components at their core emerged only within the past 5 years.<sup>47,48,79,113,114,133,142,171,177</sup> The costing of these interventions reveals contemporary complexities attended by the omission of associated resource use and costs. One study excluded costs relating to research and development of a multi-component m-health intervention,<sup>133</sup> while another study reported difficulties obtaining similar costs.<sup>142</sup> Additional costs likely to emanate from implementing mobile app-based interventions include app promotion and marketing costs to increase adoption.

### 3.2.2 | Estimation of consequences

The health consequences factored into CUAs were expressed in metrics that combined survival/mortality and preference-based measures of health outcomes into a single measure, such as QALYs, DALYs, or health-adjusted life years (HALYs).<sup>21</sup> CCAs and CEAs commonly reported health consequences as change in BMI z score or reduction in BMI units and, to a lesser extent, other anthropometric measures such as changes in waist-to-height ratio (WHtR), waist circumference (WC), child percent over BMI (%OBMI), or percent body fat. A few studies also reported changes in obesity prevalence as measures of consequences.

Our review also included studies that reported relevant non-anthropometric measures of consequences, given the established relationships between diet or physical activity and body weight. These proxy measures included changes in levels of physical activity and sedentary behavior such as metabolic equivalent (MET), minutes of moderate to vigorous physical activity (MVPA), and changes in dietary habits such as intake of dietary energy (kilojoules). Of all the included studies, 18 reported variations of non-anthropometric measures as the primary outcome.<sup>53,57–59,66,72,85,92,113,114,132,133,135,139–141,179,180</sup> In two studies, consequences were measured primarily as a change in the proportion of schools that adhered to a canteen policy,<sup>108</sup> the proportion of schools implementing a set of physical activity

TABLE 1 Aggregate descriptive summary of studies by grouping.

Number of included studies per characteristic (references in superscript)				
	Prevention-only (n = 13)	Prevention and treatment (n = 100)	Treatment-only (n = 38)	All studies (n = 151)
<b>Year of publication</b>				
2001–2005	0	1 <sup>51</sup>	2 <sup>143,144</sup>	3
2006–2010	0	1 <sup>231,52–55,81,82,99–101,122,130</sup>	8 <sup>145–152</sup>	20
2011–2015	2 <sup>39,46</sup>	2 <sup>32,56–65,83,102–104,118–120,123,124,126,127,131</sup>	8 <sup>153–160</sup>	33
2016–2020	7 <sup>30,40–45</sup>	44 <sup>33–35,66–79,84–96,105–112,115,116,121,125,128,129</sup>	14 <sup>161–174</sup>	65
2021 to April 2023	4 <sup>47–50</sup>	20 <sup>36–38,80,97,98,113,114,117,132–142</sup>	6 <sup>175–180</sup>	30
<b>Jurisdiction</b>				
High-income	12 <sup>39–50</sup>	93 <sup>31,51–142</sup>	38 <sup>143–180</sup>	143
LMICs	1 <sup>30</sup>	8 <sup>31–38</sup>	0	9
<b>Intervention category</b>				
Behavioral	7 <sup>39–41,43,44,46,47</sup>	51 <sup>32–34,36,51,56–59,69,71,72,74,78,81,82,84–87,89–93,95,97,98,103–105,113–118,120–122,124,126–129,133,135,136,138,141,142</sup>	28 <sup>143–149,151,153–157,162–166,168,169,171,173–178,180</sup>	86
Environmental	2 <sup>30,42</sup>	1 <sup>132</sup>	0	3
Policy	0	8 <sup>35,37,62,77,88,96,106,112</sup>	0	8
Surgical	0	0	5 <sup>150,158,159,161,170</sup>	5
Multiple categories	4 <sup>45,48–50</sup>	38 <sup>31,38,52–54,60,61,63–68,70,73,75,76,79,80,83,94,99–102,107–111,123,125,130,131,134,137,139,140</sup>	4 <sup>160,167,172,179</sup>	46
NA	0	2 <sup>55,119</sup>	1 <sup>152</sup>	3
Pharmacological	0	0	0	0
<b>Setting</b>				
Community	0	6 <sup>71,75,78,82,86,109</sup>	0	6
Family/Home	2 <sup>39,48</sup>	2 <sup>64,142</sup>	8 <sup>143–146,151,157,166,173</sup>	12
Healthcare/Clinical	2 <sup>40,45</sup>	0	9 <sup>148–150,158,159,161,163,167,170</sup>	11
Population-wide (state or country)	0	8 <sup>35,53,55,77,88,106,112,137</sup>	1 <sup>152</sup>	9
School/childcare centers	1 <sup>47</sup>	45 <sup>32,34,51,54,56,60,66–68,72,73,76,79,81,83–85,87,89–95,97,98,105,108,113–118,120,121,123,124,128,129,134,136,139,140</sup>	1 <sup>179</sup>	47
Multi-setting	8 <sup>30,41–44,46,49,50</sup>	38 <sup>31,33,36–38,52,57–59,61–63,65,69,70,74,80,96,99–104,107,110,111,122,125–127,130–133,135,138,141</sup>	19 <sup>147,153–156,160,162,164,165,168,169,171,172,174–178,180</sup>	65
NA	0	1 <sup>119</sup>	0	1
<b>Type of economic evaluation</b>				
CBA	0	5 <sup>61,73,75,83,116</sup>	0	5
CCA	0	1 <sup>75,78,79,74,80,85,88,90–92,104,110,117,118,127,129,142</sup>	6 <sup>143,144,146,149,152,157</sup>	23



TABLE 1 (Continued)

Number of included studies per characteristic (references in superscript)				
	Prevention-only (n = 13)	Prevention and treatment (n = 100)	Treatment-only (n = 38)	All studies (n = 151)
CMA	0	1 <sup>140</sup>	0	1
CEA	3 <sup>39,45,48</sup>	30 <sup>32,37,38,53,54,59,60,62,63,65-67,71,72,79,87,93,97,105,108,113,120,121,124,125,133,135,136,138,141</sup>	20 <sup>147,148,153-156,160,162,164,166-168,171-173,175,176,178-180</sup>	53
CUA	5 <sup>30,41-43,46</sup>	29 <sup>31,51,52,55,56,68,69,77,81,82,86,89,94,96,100-103,106,107,109,111,112,115,119,123,130,131,134</sup>	10 <sup>145,150,158,159,161,165,169,170,174,177</sup>	44
Two or more types	5 <sup>40,44,47,49,50</sup>	18 <sup>33-36,64,76,78,84,95,98,99,114,122,126,128,132,137,139</sup>	2 <sup>151,163</sup>	25
Study design				
Cross-sectional	0	1 <sup>53</sup>	0	1
Decision-analytic	8 <sup>30,41-44,47,49,50</sup>	51 <sup>31,34,35,37,38,51,52,55,56,60-65,67-70,73,75-78,80,82,88,96,97,99-103,106,107,109-112,115,119,123,126-128,130-132,134,137</sup>	13 <sup>145,150,152,153,158-161,167,170,177,178,180</sup>	72
Longitudinal	0	1 <sup>57</sup>	0	1
Feasibility/pilot study	1 <sup>46</sup>	4 <sup>91,93,95,142</sup>	3 <sup>154,166,171</sup>	8
Quasi-experimental/non-RCT	0	8 <sup>58,72,86,104,116,117,129,141</sup>	0	8
Trial-based economic evaluation	4 <sup>39,40,45,48</sup>	32 <sup>32,33,36,54,66,71,74,79,84,85,87,89,90,92,94,98,105,108,113,114,118,120-122,124,125,133,135,136,138-140</sup>	20 <sup>143,144,146-149,151,155-157,162-165,168,169,174-176,179</sup>	56
Not stated	0	3 <sup>59,81,83</sup>	2 <sup>172,173</sup>	5
Study Perspective				
Healthcare	7 <sup>39,41,43,44,46,48,50</sup>	18 <sup>37,63,81,82,85,87,88,95,108,110,123,126,127,130,134,137,139,140</sup>	13 <sup>149,152,153,156,157,161,165,168-170,174,177,178</sup>	38
Institutional/school system	0	8 <sup>32,66,72,113,120,121,128,132</sup>	0	8
Multiple perspectives	0	9 <sup>35,36,70,96,114,115,118,131,142</sup>	2 <sup>155,173</sup>	11
Provider/payer/funder	1 <sup>49</sup>	5 <sup>55,74,77,86,135</sup>	6 <sup>147,148,159,166,171,176</sup>	12
Public sector	0	10 <sup>33,84,89,90,92-94,97,98,136</sup>	2 <sup>162,179</sup>	12
Societal	5 <sup>30,40,42,45,47</sup>	39 <sup>34,38,51,52,54,56,60-62,64,65,67-69,73,75,76,78,80,99-103,105-107,109,111,112,116,117,122,124,125,129,133,138,141</sup>	9 <sup>145,146,150,151,158,163,164,167,175</sup>	53
Not stated	0	11 <sup>31,53,57-59,71,79,83,91,104,119</sup>	6 <sup>143,144,154,160,172,180</sup>	17

Abbreviations: CBA, cost-benefit analysis; CCA, cost-consequences analysis; CEA, cost-effectiveness analysis; CUA, cost-utility analysis; LMICs, low and middle-income countries; NA, not applicable; RCT, randomized controlled trial; Not stated, not stated or insufficient information provided in study.

TABLE 2 Descriptive analysis of the key assessment items for individual studies targeting only prevention.

Author, year of publication (country)	Intervention(s) and comparator(s)	Intervention category; components and targets (setting)	Target population (age/age range)	Type of economic evaluation; study design; study perspective
Hayes, A., et al., 2014 (Australia) <sup>39</sup>	Healthy Beginnings: home-based early intervention consisting of eight home visits by specially trained community nurses (including one visit at 30–36 weeks gestational age) versus usual care	Behavioral; diet and PA (home-based)	Infants in socio-economically disadvantaged areas of Sydney received the intervention for the first 2 years of life (0 to 4 years old)	CEA; within-trial economic evaluation; Healthcare funder
Barber, S. E., et al., 2015 (United Kingdom) <sup>46</sup>	Pre-schoolers in the Park intervention (PIP): an outdoor playground-based PA intervention for parents and their children versus usual practice	Behavioral; PA (community-based, school-based)	Pre-schoolers (18 months to 4 years old)	CUA; pilot trial alongside a preliminary economic evaluation; NHS and Personal Social Services
Kolu, P., et al., 2016 (Finland) <sup>40</sup>	Prenatal lifestyle counseling on PA, diet, and weight gain at five antenatal versus usual care	Behavioral; PA, diet (ante-natal clinics)	Pregnant women with at least one gestational diabetes mellitus (GDM) risk factor and their infants	CEA, CUA; cluster RCT alongside an economic evaluation; societal
Marsh, K., et al., 2016 (Mexico) <sup>30</sup>	IpIF (low protein content and caloric density) versus a currently used formula	Environmental; diet - protein infant formula modification (multiple settings possible)	Infants in Mexico born to mothers with excess weight	CUA; DAM (discrete-event simulation); societal
Döring, N., et al., 2018 (Sweden) <sup>45</sup>	PRIMROSE intervention: an early childhood obesity intervention delivered in the first 4 years of life versus usual care	Behavioral and policy; diet and PA - motivational interviewing (clinic-based - CHCs)	Pre-school children (9 months old)	CEA; trial-based economic evaluation; societal
Gc, V. S., et al., 2019 (United Kingdom) <sup>41</sup>	A comparatively simple after-school intervention and a more complex multicomponent intervention versus usual care	Behavioral; PA (school and community-based)	A hypothetical cohort of healthy children (16-year-olds)	CUA; DAM (Markov model); NHS
Sonntag, D., et al., 2019 (Germany) <sup>42</sup>	Infant formula nutrition: lower protein (LP) versus higher protein (HP) intake groups	Environmental; diet - protein infant formula modification (multiple settings possible)	Infants born from uncomplicated singleton pregnancies	CUA; DAM (Markov model) based on the European Childhood Obesity Project (CHOP) trial; societal
Tan, E. J., et al., 2020 (Australia) <sup>43</sup>	Prevention of Overweight in Infancy (POI) sleep intervention alone and in combination with food, activity, and breastfeeding advice (FAB) versus usual care	Behavioral; sleep modification, diet, PA, and breastfeeding advice (home and clinical settings)	Healthy infants received the intervention up to the first 2 years of life and then followed up to age 5 years	CUA; DAM (the EPOCH microsimulation model) based on a trial; health funder
Taylor, R., et al., 2020 (Australia) <sup>44</sup>	Sleep intervention during the first 2 years of life versus usual care	Behavioral; sleep modification, antenatal group-based education session (home and clinical settings)	Mother-infant dyads (the first 2 years of life)	CUA, CEA; DAM (insufficient information); health funder
Kalita, N., et al., 2022 (United Kingdom) <sup>47</sup>	The LifeLab Plus intervention: comprising (1) an education module and practical sessions for students; (2) teacher training; and (3) access to an interactive smartphone app versus control (usual schooling)	Behavioral; multi-component - diet, PA, and app-based m-health (school-based)	Hypothetical cohort of healthy weight adolescents (mean age of 13 years)	CEA, CUA; DAM (Markov model); societal



TABLE 2 (Continued)

Author, year of publication (country)	Intervention(s) and comparator(s)	Intervention category; components and targets (setting)	Target population (age/age range)	Type of economic evaluation; study design; study perspective
Killedar, A., et al., 2022 (Australia) <sup>48</sup>	Communicating Healthy Beginnings Advice by Telephone (CHAT) trial, consisting of three arms: (1) short message service (SMS) intervention; (2) telephone intervention; and (3) usual care (home-visiting approach)	Behavioral, policy; m-health - SMS and telephone contact to mothers of infants to prevent obesity (home-based)	Mothers and their infants (up to 2 years old) in New South Wales, Australia	CEA; trial-based economic evaluation; health payer's
Tran, H. N. Q., et al., 2022 (Australia) <sup>49</sup>	Romp & Chomp: a community-wide obesity prevention intervention versus no intervention	Behavioral, environmental, policy; diet - daily water, fruits and vegetables, fewer sweet drinks, PA - daily active play, reduced screen time (multiple settings possible)	Australian children (0 to 5 years old)	CEA, CUA; DAM (the Early Prevention of Obesity in Childhood [EPOCH] microsimulation model based on the Romp & Chomp quasi-experimental trial); funder
Killedar, A., et al., 2023 (Australia) <sup>50</sup>	Sleep intervention during the first 2 years of life versus usual care	Behavioral, policy; sleep modification, antenatal group-based education session (home and clinical settings)	Mother-infant dyads across three socioeconomic position (SEP) groups: low-, mid- and high-SEP (the first 2 years of life)	CEA, CUA; DAM (the EQuity-Informative Early Prevention of Obesity in Childhood [EQ-EPOCH] model; a discrete-time microsimulation model) based on a trial; health funder

Abbreviations: BMI, body mass index; CE, cost-effectiveness; CEA, cost-effectiveness analysis; CHCs, child healthcare centers; CUA, cost-utility analysis; DAM, decision analytic model; EQ-5D, EuroQoL 5Dimension; ICER, incremental cost-effectiveness ratio; NA, not applicable; PA, physical activity; QALY, quality-adjusted life year.

TABLE 2 (Continued)

Author, year of publication (country)	Study follow-up or decision analytic model time horizon; discounting	Currency unit (Price year)	Measure(s) of consequences	Key/base case results	CHEERS quality score
Hayes, A., et al., 2014 (Australia) <sup>39</sup>	2 years from baseline; 5% (costs and benefits)	Australian dollars (2012)	Reduction in BMI z-score/unit BMI avoided	Given CE threshold ranges of AUD 0–30,000 and AUD 0–3,000 per BMI unit avoided and reduction in BMI z-score, respectively, the ICERs were AUD 4,230 per unit BMI avoided and AUD 631 per 0.1 reduction in BMI z-score, if the intervention cost per child was AUD 1,309 per child over 2 years	100%
Barber, S. E., et al., 2015 (United Kingdom) <sup>46</sup>	1 year; NA	Pound sterling (2012/2013)	QALY gained for parents (EQ-5D)	Given a CE threshold of GBP 20,000 per QALY gained, an ICER of GBP 19,588 per QALY gained was estimated for pip	100%
Kolu, P., et al., 2016 (Finland) <sup>40</sup>	7 years follow up; not stated	Euros (2015)	Change in BMI (children and mothers), QALY gained (15D) and avoided sickness (mothers)	Given a societal CE threshold of EUR 100 per one avoided sickness absence day the intervention was deemed cost-effective but not cost-effective given a CE threshold of EUR 33,000 per QALY	95%

TABLE 2 (Continued)

Author, year of publication (country)	Study follow-up or decision analytic model time horizon; discounting	Currency unit (Price year)	Measure(s) of consequences	Key/base case results	CHEERS quality score
Marsh, K., et al., 2016 (Mexico) <sup>30</sup>	Lifetime; 3.5% (costs and benefits)	Mexican pesos (2014)	QALY gained	gained. Differences in BMI were significant in children but not among mothers Given CE thresholds of MXN 73,262 and MXN 219,696 per QALY gained, the probabilities of CE for IpIF were 60.6% and 58.2%	100%
Döring, N., et al., 2018 (Sweden) <sup>45</sup>	End of the trial: child at age 4 (48 months); not stated	Euros (2015)	BMI unit prevented	Given a CE threshold range of EUR 0–10,000 per BMI unit prevented, the probability of CE approached ~80% at ~EUR 10,000 per BMI unit prevented	93%
Gc, V. S., et al., 2019 (United Kingdom) <sup>41</sup>	65 years; 3.5% (costs and benefits)	Pound sterling (2013/2014)	QALY gained (EQ-5D)	Given a CE threshold of GBP 20,000 per QALY gained, an ICER of GBP 11,486 per QALY gained was estimated for the after-school intervention. The multi-component intervention was extendedly dominated with an ICER of GBP 68,056 per QALY gained	100%
Sonntag, D., et al., 2019 (Germany) <sup>42</sup>	Lifetime; 3% (costs and benefits)	Euros (2015)	QALY gained (EQ-5D)	Given societal CE thresholds of EUR 5,000 and EUR 20,000 per QALY gained, the probabilities of cost-effectiveness for LP relative to HP were 76% and 85%, respectively	100%
Tan, E. J., et al., 2020 (Australia) <sup>43</sup>	15 years; 5% (costs and benefits)	Australian dollars (2018)	QALY gained (meta-analysis) and unit BMI avoided	Given a CE threshold of AUD 50,000 per QALY gained, the ICERs per QALY gained for the Sleep intervention alone and FAB combination were AUD 18,125 (probability of CE: 74%) and AUD 94,667 (probability of CE: 23%), respectively	100%
Taylor, R., et al., 2020 (Australia) <sup>44</sup>	5 years and 15 years; not stated	Australian dollars (2018)	BMI unit avoided, QALY gained	Given a CE threshold of AUD 50,000 per QALY gained, ICERs of AUD 18,204 per QALY gained and AUD 536 per BMI unit avoided were estimated for the sleep intervention	57%
Kalita, N., et al., 2022 (United Kingdom) <sup>47</sup>	20 years; 3.5% (costs and benefits)	Pound sterling (2015)	QALY gained (EQ-5D-3L)	Given a CE threshold of GBP 20,000 per QALY gained, the probability of Lifelab Plus being cost-effective was 69% with an ICER of GBP 14,367 per QALY gained	100%

TABLE 2 (Continued)

Author, year of publication (country)	Study follow-up or decision analytic model time horizon; discounting	Currency unit (Price year)	Measure(s) of consequences	Key/base case results	CHEERS quality score
Killedar, A., et al., 2022 (Australia) <sup>48</sup>	2 years; 5% (costs and benefits)	Australian dollars (2018)	Reduction in BMI z-score/unit BMI avoided	Given a CE threshold of AUD 1,000 per 0.1 BMI-z units avoided, the probabilities of CE for the SMS and telephone interventions were 48% and 41%, respectively	100%
Tran, H. N. Q., et al., 2022 (Australia) <sup>49</sup>	10 years; 5% (costs and benefits)	Australian dollars (2018)	Unit BMI avoided, QALY gained	Given a CE threshold of AUD 50,000 per QALY gained, a 64% probability of CE was estimated. The ICERs were AUD 1,126 per BMI unit avoided, and AUD 26,399 per QALY gained	100%
Killedar, A., et al., 2023 (Australia) <sup>50</sup>	17 years; 5% (costs and benefits)	Australian dollars (2018)	BMI unit avoided, QALY gained (meta-analysis)	Given a CE threshold of AUD 50,000 per QALY gained, the probability of CE in each SEP group was 91.7%, 99.6%, and 78.5% for low-, mid- and high SEP, respectively. ICERs per QALY gained were, AUD 23,010, AUD 18,206, and AUD 31,981 for low-, mid- and high SEP, respectively	100%

Abbreviations: BMI, body mass index; CE, cost-effectiveness; CEA, cost-effectiveness analysis; CHCs, child healthcare centers; CUA, cost-utility analysis; DAM, decision analytic model; EQ-5D, EuroQol 5Dimension; ICER, incremental cost-effectiveness ratio; NA, not applicable; PA, physical activity; QALY, quality-adjusted life year.

**TABLE 3** Descriptive analysis of the key assessment items for individual studies targeting prevention and treatment.

Author, year of publication (country)	Intervention(s) and comparator(s)	Intervention category; components and targets (setting)	Target population (age/age range)	Type of economic evaluation; study design; study perspective
Wang, L. Y., et al., 2003 (United States) <sup>51</sup>	Intervention targeting obesity (Planet Health) versus "no intervention"	Behavioral; diet, PA, and TV viewing (school-based)	Girls with mixed-weight status (10 to 14 years old)	CUA; DAM (decision tree overweight progression model); societal
Brown, H. S., et al., 2007 (United States) <sup>52</sup>	The CATCH <sup>a</sup> intervention versus control	Behavioral, environmental; PA, PE, and modification to school food service (family-, home-, and school-based components)	Children of mixed-weight status across grades three, four, and five (8 to 11 years old)	CUA; DAM (decision tree excess weight progression model); societal
Nixon, J., et al., 2008 (United Kingdom) <sup>81</sup>	Three interventions with or without primary prevention, screening of BMI and treatment for children above threshold versus "do nothing"	Behavioral, policy; screening and primary prevention (school-based)	School children (not stated)	CUA; insufficient information; NHS
Peterson, M., et al., 2008 (United States) <sup>53</sup>	State-wide social marketing: exposure to varying levels of ADs versus "no ADs"	Behavioral, policy; PA, TV, and billboard AD (population-wide)	Children of mixed-weight status attending public schools (12 to 17 years old)	CEA; cross-sectional study (survey asked how exposure to media campaign impacted PA); not stated
Wang, L. Y., et al., 2008 (United States) <sup>54</sup>	An after-school intervention (MCG FitKid) versus usual after-school care control	Behavioral, environmental; diet, PA, and academic enrichment activities (school-based)	Third graders with mixed-weight status (mean age of 8.7 years old)	CEA; within-trial economic evaluation; societal
Magnus, A., et al., 2009 (Australia) <sup>99</sup>	A ban on TV ADs for energy-dense, nutrient-poor (EDNP) foods and beverages versus current practice	Behavioral, policy; diet and legislation (population-wide, home-setting)	Children (5 to 14 years old)	CEA, CUA; DAM (cohort multi-state transition model: the ACE-Obesity study); societal
Moodie, M., et al., 2009 (Australia) <sup>100</sup>	The Walking School Bus (WSB) program versus "current practice" defined as "do nothing"	Behavioral, policy; PA specifically to increase walking to school (population-wide, school-based)	Primary school children (5 to 7 years old)	CUA; DAM (cohort multi-state transition model: the ACE-Obesity study); societal
Cecchini, M., et al., 2010 (Brazil, China, India, Mexico, Russia, South Africa, England) <sup>31</sup>	Comparison of strategies targeting children grouped into: (1) school-based health promotion; (2) fiscal measures; (3) food AD regulation; and (4) food labeling	Behavioral, policy; diet, PA, AD, taxation, and subsidies (school-based, population-wide)	School-based health promotion (8 to 9 years old); fiscal measures (≥0 years old); food AD regulation (2 to 18 years old); and food labeling (≥0 years old)	CUA; DAM (microsimulation model adapted from the chronic disease prevention model [CDP]); not stated
McAuley, K. A., et al., 2010 (New Zealand) <sup>122</sup>	The APPLE <sup>a</sup> project: the provision of community activity coordinators at each intervention school versus usual care	Behavioral; diet, PA, and lifestyle-based (school- and community-based)	Children representative of the wider population (5 to 12 years old)	CEA, CUA; within-trial economic evaluation; societal
Mernagh, P., et al., 2010 (New Zealand) <sup>130,181</sup>	Four interventions: (1) Switch-Play versus no intervention (2) BAEW (3) School Nutrition Policy Initiative (SNPI) and (4) APPLE <sup>a</sup>	Behavioral, policy; reduction of TV viewing, diet, and PA (community-based, school setting)	Children in the general population, including for BAEW, Maori and Pacific subpopulations (for APPLE <sup>a</sup> , BAEW, SNPI and Switch-Play, 9, 8, 11 and 10 years old respectively)	CUA; DAM (simulation model with 14 obesity-related chronic disease states); healthcare

TABLE 3 (Continued)

Author, year of publication (country)	Intervention(s) and comparator(s)	Intervention category; components and targets (setting)	Target population (age/age range)	Type of economic evaluation; study design; study perspective
Moodie, M. L., et al., 2010 (Australia) <sup>101</sup>	The Active After-school Communities program: 2 to 3 sessions per week of PA programs during the after-school period versus no intervention	Behavioral, policy; PA (population-wide, school-based)	Children in grade 4 to 6 of mixed weight status (5 to 11 years old)	CUA; DAM (cohort multi-state transition model; modeled as part of the ACE-Obesity study); societal
Pringle, A., et al., 2010 (United Kingdom) <sup>182</sup>	Seven community-based interventions categories to increase MPA: inter- and intra-category comparisons	Behavioral; PA (community-based)	A sample of people in the United Kingdom (~one-third of sample 10 to 17 years old)	CUA; DAM (insufficient information); NHS
Trasande, L., 2010 (United States) <sup>55</sup>	Hypothetical scenarios in which childhood obesity is reduced	NA; NA (population-wide)	The 2005 cohort of children in the United States (6- and 12-years old cohorts)	CUA; DAM (cohort simulation model to estimate economic consequences of childhood obesity reduction scenarios); provider/payer perspective
Martínez, P. M., et al., 2011 (Spain) <sup>118</sup>	Weekly recreational, non-competitive PA program conducted after school hours versus usual afterschool care	Behavioral; PA (school-based)	Children of mixed weight status (9 to 10 years old)	CCA; within-trial economic evaluation; societal and institutional
Moodie, M., et al., 2011 (Australia) <sup>102</sup>	TravelSMART Schools Curriculum program versus current practice	Behavioral, policy; PA (population-wide, primary school-based)	Children of mixed weight status (10 to 11 years old)	CUA; DAM (cohort multi-state transition model; modeled as part of the ACE-Obesity study); societal
Ramos-Goni JM, Valcárcel-Nazco C, Castilla-Rodríguez I., 2011 (Spain) <sup>119</sup>	Hypothetical scenarios of public health intervention to prevent and correct childhood obesity (insufficient information)	NA; NA (NA)	A mixed group of children with healthy weight and obesity (not stated)	CUA; DAM (Markov model); not stated
Te Velde, S., et al., 2011 (Netherlands) <sup>131,182</sup>	Two fruit and vegetable school-based interventions: 2-year Pro Children (PC) intervention and the Schoolgruuten (SG) intervention versus "no intervention"	Behavioral, environmental; provision of free fruits and vegetables (family- and school-based)	10-year-olds in the Netherlands	CUA; DAM (multi-state life table); health services and societal
Wang, L. Y., et al., 2011 (United States) <sup>56</sup>	Planet Health, a school-based intervention targeting obesity and disordered weight control behaviors (DWCB) versus "no intervention"	Behavioral; diet, PA, and DWCB prevention (purging or diet pill use) and TV viewing (school-based)	Girls with mixed weight status (10 to 14 years old)	CUA; DAM and RCT; societal
Monsivais, P., & Rehm, C. D., 2012 (United States) <sup>57</sup>	Complete or partial replacement of fruit juice with fresh, inexpensive, popular fruits	Behavioral; diet - nutrient and energy intake (home-, school-, and childcare-based)	Children in the United States (3 to 18 years old)	CCA; longitudinal study (secondary analyses using the 2001-2004 NHANES and a national food price database); not stated
Gesell, S. B., et al., 2013 (United States) <sup>58</sup>	PA-enhanced ASP based in a community recreation center versus a standard school-based ASP	Behavioral; PA (school- and community-based)	Elementary school students who attend ASP (not stated)	CCA; observational prospective cohort study of a natural experiment involving costing; not stated

TABLE 3 (Continued)

Author, year of publication (country)	Intervention(s) and comparator(s)	Intervention category; components and targets (setting)	Target population (age/age range)	Type of economic evaluation; study design; study perspective
Kesztyüs, D., et al., 2013 (Germany) <sup>124</sup>	Ulm Research on Metabolism Exercise and Lifestyle Intervention in Children (URMEL-ICE) integrated into the usual school curriculum versus usual care (no intervention)	Behavioral; diet, PA, media, teaching, activity breaks and homework assignments (school-based)	Primary school children in their second grade from a mixed-weight group (mean ages 7.64 and 7.53 years old in the intervention and control groups, respectively)	CEA; within-trial economic evaluation; societal
Meng, L., et al., 2013 (China) <sup>32</sup>	Three interventions: (1) NE, (2) PA and (3) comprehensive (included the NE and PA interventions) versus control (usual care)	Behavioral; diet and PA (school-based)	Children of mixed-weight status (6 to 13 years old)	CEA; within-trial economic evaluation; institutional
Moodie, M. L., et al., 2013 (Australia) <sup>103</sup>	BAEW: an intervention to increase PA and healthy eating versus usual practice	Behavioral; reduction of TV viewing, diet, and PA (community-based, primary school setting)	Children of mixed-weight status (4 to 12 years old)	CUA; DAM (cohort multi-state transition model; the ACE-Obesity study); societal
Nelson, M., 2013 (England) <sup>83</sup>	The School Food Trust: an intervention targeting healthier school food provision versus no intervention	Environmental, policy; diet - school food standards (school-based)	Children in English primary and secondary schools (not stated)	CBA; back-of-the-envelope calculations (Insufficient information); not stated
Tran, B., et al., 2013 (Canada) <sup>126</sup>	APPLE <sup>b</sup> schools to prevent childhood obesity versus usual care	Behavioral; diet, PA, and lifestyle-based (school- and community-based)	Children of mixed weight status (11-year-olds)	CEA, CUA; DAM (state transition model); healthcare system
Babey, S. H., et al., 2014 (United States) <sup>59</sup>	Four categories of interventions compared: after-school programs; before-school programs; PE classes and extended-day PE; and short PA breaks during the school day	Behavioral; PA, PE (community-based and school-based)	Elementary, middle, and high school students (not stated)	CEA; Insufficient information - estimated the costs, reach and effect on PA for various interventions based on previously reported data; not stated
Rush, E., et al., 2014 (New Zealand) <sup>123</sup>	Project Energize, a multicomponent through-school PA and nutrition program versus usual care (unEnergized)	Behavioral, policy; diet and PA (school-based)	Younger (6 to 8 years of age) and older primary school children (9 to 11 years old)	CUA; DAM (Markov model) based on results of an RCT; Healthcare funder
Swinburn, B., et al., 2014 (Australia) <sup>104</sup>	BAEW: an intervention to increase PA and healthy eating versus usual practice	Behavioral; reduction of TV viewing, diet, and PA (community-based, primary school setting)	Children of mixed-weight status (4 to 12 years old)	CCA; economic evaluation based on a quasi-experimental, non-randomized study (follow-up data after completion of BAEW was cross-sectional as measurements were on new cohorts of children); not stated
Tran, B. X., et al., 2014 (Canada) <sup>127</sup>	APPLE <sup>b</sup> schools to prevent childhood obesity versus usual care	Behavioral; diet, PA and lifestyle-based (school and community-based)	Children of mixed weight status (11-year-olds)	CCA; DAM (BMI trajectories were projected from age 11 to 70 years using the National Population



TABLE 3 (Continued)

Author, year of publication (country)	Intervention(s) and comparator(s)	Intervention category; components and targets (setting)	Target population (age/age range)	Type of economic evaluation; study design; study perspective
Barrett, J. L., et al., 2015 (United States) <sup>60</sup>	The "Active PE" policy: a requirement that 50% of PE time of state's elementary school PE curriculum be devoted to MVPA versus current practice	Behavioral, policy; PA (school-based)	Children (6 to 11 years old)	Health Survey [NPHS] collected between 1996–2008; healthcare system CEA; DAM (Markov model was adapted from two models, the ACE, and CHOICES models) based on two trials (SPARK and CATCH <sup>b</sup> ); modified societal
Gortmaker, S. L., et al., 2015 (United States) <sup>61</sup>	Four childhood obesity interventions: (1) SSB excise tax; (2) eliminating tax subsidy of TV AD to children (TV AD); (3) ECE policy change (ECE); and (4) Active PE	Behavioral, environmental, policy; PA, diet, TV viewing, taxation, TV AD, and education (multiple settings possible)	SSB (2 to 19 years old), TV AD (2 to 19 years old), ECE (3 to 5 years old), and Active PE (6 to 11 years old)	CBA; DAM (Markov model was adapted from two models, the ACE, and CHOICES models); modified societal
Long, M. W., et al., 2015 (United States) <sup>62</sup>	Implementing a SSB excise tax versus the current practice	Policy; diet and tax (multiple settings possible)	The US population ( $\geq 2$ years old at baseline)	CEA; DAM (Multi-state model adapted from the ACE model); societal
McCollister, K. E., et al., 2015 (United States) <sup>63</sup>	Hypothetical assessment of Healthy Caregivers-Healthy Children (HC2) implemented in childcare centers versus control centers	Behavioral, environmental; diet, PA, PA-focused curricula for teachers, parents and children, and menu modifications (childcare center-based, family-based)	Children in Florida (2 to 5 years old)	CEA; DAM based on the HC2 trial; healthcare
Mora, T., et al., 2015 (Spain) <sup>120</sup>	Health education program: 3-h classes per week on healthy eating habits and PA versus control	Behavioral; diet, PA (school-based)	School children in Spain (6 years old)	CEA; within-trial economic evaluation (the AVall study); institutional/school system
Sonneville, K. R., et al., 2015 (United States) <sup>64</sup>	Eliminating tax subsidy of TV AD to children (TV AD) versus current practice	Behavioral, environmental, policy; diet, TV viewing, and tax (home-based)	Children (2 to 19 years old)	CBA, CUA; DAM (Multi-state model adapted from the ACE model); modified societal
Wright, D. R., et al., 2015 (United States) <sup>65</sup>	ECE policy change versus current practice	Behavioral, environmental, policy; PA, diet, and TV viewing (multiple settings possible, including childcare setting)	Children (3 to 5 years old)	CEA; DAM (Multi-state model adapted from the ACE model); societal
Jago, R., et al., 2016 (United Kingdom) <sup>84</sup>	Bristol Girls Dance Program versus control	Behavioral; PA - dance (school-based)	Girls (11 to 12 years old)	CEA, CUA; cluster RCT alongside an economic evaluation; public sector perspective (costs to local authorities and to the NHS)
Ladapo, J. A., et al., 2016 (United States) <sup>66</sup>	Students for Nutrition and Exercise (SNaX) intervention (a 5-week middle-school-based obesity-prevention program) versus control	Behavioral, environmental; diet - water consumption, signs and posters, school cafeteria (school-based)	Sixth to eighth grade students in middle-schools in Los Angeles (not stated)	CEA; RCT alongside an economic evaluation; institutional/school system

TABLE 3 (Continued)

Author, year of publication (country)	Intervention(s) and comparator(s)	Intervention category; components and targets (setting)	Target population (age/age range)	Type of economic evaluation; study design; study perspective
Lawlor, D. A., et al., 2016 (United Kingdom) <sup>65</sup>	Active for Life Year 5 (AFLY5): an intervention designed to increase PA and improve diet among primary-school students versus control	Behavioral; diet and PA (school-based)	Children at year 5 during the intervention (9 to 10 years old)	CCA; cluster RCT alongside an economic evaluation; NHS and Personal Social Services
Sutherland, R., et al., 2016 (Australia) <sup>105</sup>	The Physical Activity 4 Everyone (PA4E1) multi-component intervention versus usual care	Behavioral; PA (school-based, low-income communities)	Children of mixed weight status groups in their first year of high school (mean age 12 years old)	CEA; RCT alongside an economic evaluation (efficacy trial); societal
Cradock, A. L., et al., 2017 (United States) <sup>67</sup>	Six recommended prevention strategies as follows: (Active PE; Active Recess; Active School Day; Healthy Afterschool; New Afterschool Programs; and Hip Hop to Health, Jr.) versus the status quo	Behavioral, environmental, policy; PA in state-wide and national implementation (school, afterschool, and childcare settings)	Children regardless of BMI status (3 to 14 years old)	CEA; DAM (Individual level, discrete-time, microsimulation model); modified societal
Crino, M., et al., 2017 (Australia) <sup>106</sup>	Package size cap versus product reformulation to reduce kilojoule content of packaged SSBs	Policy; diet - SSBs (nation-wide)	Children (2 to 19 years old)	CUA; DAM (multi-state life table Markov model); limited societal
Ekwaru, J. P., et al., 2017 (Canada) <sup>128</sup>	APPLE <sup>b</sup> Schools (the intervention program) versus general schools (no intervention)	Behavioral; diet, PA and lifestyle-based (school-based)	Grade five students of mixed weight status (~ 10 years old)	CEA, CUA; DAM (state transition model with yearly cycles and capturing 13 chronic diseases); school system's cost perspective
Graziose, M. M., et al., 2017 (United States) <sup>68</sup>	Food, Health, & Choices (FHC), an obesity prevention NE curriculum delivered over 1 year versus current practice (no intervention)	Behavioral, policy; diet, PA, and screen time (school-based)	All New York City fifth-grade public school students (mean age 10 years old)	CUA; DAM (decision tree type, longitudinal, obesity progression model) based on an RCT; societal
Hajizadeh, N., et al., 2017 (United States) <sup>69</sup>	ParentCorps (family-centered enhancement to pre-kindergarten programming) versus standard pre-kindergarten programming	Behavioral; group series (mental health) for families and professional development for teachers (school- and family-based)	Black and Latino children from pre-kindergarten entry through the end of kindergarten attending high-poverty, urban schools in the United States (~ age 5 years old)	CUA; DAM (Markov Model projecting the long-term impact of cluster RCT) based on an RCT; societal
Kesztyüs, D., et al., 2017 (Germany) <sup>125</sup>	„Join the Healthy Boat”: a state-wide health promotion program in primary schools versus control	Behavioral, policy; PA, beverages, TV viewing (school-based, state-wide)	Children (mean aged ~ 7 years old)	CEA; RCT alongside an economic evaluation; societal
Lee, B. Y., et al., 2017 (United States) <sup>70</sup>	Two hypothetical levels of PA: 25 min of high-calorie-burning PA three times a week and 60 min of MPA each day	Behavioral, policy; PA (school- and community-based)	The US population of children (6 to 17 years old)	CCA; DAM (two-stage model: the first stage was an agent-based model; the second stage was a Markov model defined by 15 health states); health sector, societal

TABLE 3 (Continued)

Author, year of publication (country)	Intervention(s) and comparator(s)	Intervention category; components and targets (setting)	Target population (age/age range)	Type of economic evaluation; study design; study perspective
Moore, J. B., et al., 2017 (United States) <sup>71</sup>	Minigrant program (2010–2011) to increase PA among youth versus waitlist control group (2011–2012)	Behavioral; targeted grant funding for the implementation of multilevel PA interventions (community setting)	Children in grades 4 to 8 (not stated)	CEA; a repeated, cross-sectional, group-RCT alongside an economic evaluation; not stated
Wang, H., et al., 2017 (United States) <sup>72</sup>	Ready for Recess: a program for increasing PA in elementary schools versus no intervention	Behavioral; PA - accelerometers (school-based)	Elementary school students in the United States (not stated)	CEA; Non-randomized trial alongside an economic evaluation; institutional/school system
An, R., et al., 2018 (United States) <sup>73</sup>	Placing water dispensers at school cafeterias nationwide to promote lunchtime plain water consumption versus no action	Environmental, policy; drinking water (school-based)	All school children in primary, secondary, and high schools (not stated)	CBA; DAM (Markov model); societal
Anokye, N., et al., 2018 (United Kingdom) <sup>86</sup>	Stage 1 (introductory and less intensive sports sessions) versus stage 2 (portfolio of community sport sessions)	Behavioral; PA (community-based)	Inactive people over 14 years old	CUA; economic evaluation alongside a quasi-experiment (with an interrupted time series design); program provider
Beets, M. W., et al., 2018 (United States) <sup>74</sup>	Two ASPs: immediate or delayed	Behavioral; diet and PA (faith locations, schools, recreation, and community-based)	Children of mixed weight status (5 to 12 years old)	CCA; trial-based economic evaluation; program provider
Brown, V., et al., 2018 (Australia) <sup>107</sup>	Legislation to restrict TV AD of food and beverages HFSS until 9:30 pm versus baseline or usual viewing	Behavioral, policy; diet and legislation (population-wide, home-setting)	Australian children (5 to 15 years old)	CUA; DAM (state-transition cohort model using disease-specific life tables estimates of mortality and morbidity for nine obesity-related diseases); limited societal
Conesa, M., et al., 2018 (Spain) <sup>121</sup>	The intervention Educació en Alimentació Programme (EdAI): a set of educational intervention focused on improving lifestyle choices versus control (usual care)	Behavioral; diet and PA (school-based)	Children mixed weight status but about 70% being healthy weight in both arms (7 to 8 years old)	CEA; trial-based economic evaluation; institutional
Reilly, K. L., et al., 2018 (Australia) <sup>108</sup>	Three multicomponent interventions (high, medium, and low intensity) to enhance implementation of a healthy canteen policy versus "usual support"	Behavioral, environmental and policy; diet-based (school-based)	Students in primary schools of mixed weight status (5 to 12 years old)	CEA; trial-based economic evaluation (3 separate trials); Health service delivery
Wyatt, K., et al., 2018 (United Kingdom) <sup>87</sup>	Healthy Lifestyles Programme (HeLP): drama-based healthy lifestyles week, goal setting and reinforcement activities versus usual care	Behavioral; diet and PA (school-based)	Children in Southwest England (9 to 10 years old)	CEA; Cluster RCT alongside economic evaluation; NHS
Amies-Cull, B., et al., 2019 (England) <sup>88</sup>	20% reduction in the sugar content of certain high sugar products versus no reduction	Policy; diet (population-wide)	The general population (cohorts of 4 to 10 years old and 11 to 18 years old)	CCA; DAM (state transition model adapted from the PRIMEtime-CE model, a cohort chronic disease multistate lifetable model); NHS

TABLE 3 (Continued)

Author, year of publication (country)	Intervention(s) and comparator(s)	Intervention category; components and targets (setting)	Target population (age/age range)	Type of economic evaluation; study design; study perspective
Ananthapavan, J., et al., 2019 (Australia) <sup>109</sup>	Hypothetical community-based obesity prevention interventions (CBI) versus control	Behavioral, environmental and policy; diet, PA, change in school infrastructure and changes to the obesogenic environment within the community (community-based)	Australian children (5 to 18 years old)	CUA; DAM (multiple cohort state transition model comprising 9 diseases, each with four possible health states); limited societal
Basto-Abreu, A., et al., 2019 (Mexico) <sup>35</sup>	SSB excise tax scenarios compared (1 peso versus 2 pesos per liter)	Policy; diet: SSB consumption (population-wide)	The 2014 Mexican population including children (not stated)	CCA, CBA; DAM (cohort simulation model that adapted the CHOICES model); societal and public payer
Brown, V., et al., 2019 (Australia) <sup>110</sup>	Seven hypothetical scenarios of varying effect (reduction in BMI z-score); maintenance and subsequent decay to no effect	Behavioral, environmental and policy; multiple components including diet and PA (multi-setting)	Australian children (2 years old with modeling assumptions extending into adulthood)	CCA; DAM (multiple cohort life table model adapted from the CRE-Obesity Policy model); health service delivery
Canaway, A., et al., 2019 (United Kingdom) <sup>89</sup>	Intervention schools: a multifaceted, 12-month, school-based intervention versus control schools (usual care)	Behavioral; diet and PA (school-based)	Primary school children of mixed weight status (6 to 7 years old)	CUA; trial-based economic evaluation; public sector
Charles, J. M., et al., 2019 (United Kingdom) <sup>90</sup>	"Girls Active" program versus usual practice	Behavioral; PA – accelerometer, guidance and review of PA and PE practices (school-based)	Girls in UK secondary schools (11 to 14 years old)	CCA; economic evaluation alongside a cluster RCT; public sector, multi-agency perspective (community care, GP and local authority, school)
Coffield, E., et al., 2019 (United States) <sup>75</sup>	Shape Up Somerville: Eat Smart Play Hard (SUS) intervention designed to increase PA options and availability of healthful foods compared with control areas	Behavioral, environmental; diet and PA (community-based)	Elementary school students in the United States (mean age 8 years old)	CBA/return on investment; DAM (two-part regression model) based on a non-randomized controlled trial; limited societal
Gammon, C., et al., 2019 (United Kingdom) <sup>91</sup>	Physically active lesson (PAL) training program delivered to teachers in after-school sessions versus control schools	Behavioral; PA (school-based)	UK secondary school year 7 and 9 students (mean age 12.9 years old)	CCA; economic evaluation alongside a feasibility study and pilot cluster-RCT; not stated
Harrington, D., et al., 2019 (United Kingdom) <sup>92</sup>	"Girls Active" teacher-led school-based intervention versus usual practice	Behavioral; PA – teacher-led PE, teacher training and peer leadership (school-based)	Girls (11 to 14 years old)	CCA; economic evaluation alongside a cluster-RCT; public sector perspective (costs to local authorities and the NHS)
Kenney, E. L., et al., 2019 (United States) <sup>76</sup>	Installing water jet dispensers versus three other water consumption strategies: (1) Grab a Cup, Fill it Up; (2) portable tap water dispensers; and (3) install bottle-less water coolers	Environmental, policy; change in school drinking water environment (school-based)	Students in kindergarten through eighth grade (not stated)	CBA, CEA; DAM (the CHOICES model: a stochastic, discrete-time, individual-level microsimulation model); modified societal

TABLE 3 (Continued)

Author, year of publication (country)	Intervention(s) and comparator(s)	Intervention category; components and targets (setting)	Target population (age/age range)	Type of economic evaluation; study design; study perspective
Li, B., et al., 2019 (China) <sup>33</sup>	Chinese Primary School Children Physical Activity and Dietary Behaviour Changes Intervention (CHIRPY DRAGON) versus control	Behavioral; diet and PA (school- and family-based)	Primary school children in China (mean age ~6 years old)	CEA, CUA; economic evaluation alongside an RCT; public sector
Long, M. W., et al., 2019 (United States) <sup>77</sup>	SSB excise tax and Supplemental Nutrition Assistance Programme (SNAP) SSB restriction versus usual practice	Policy; SSB consumption (population-wide)	Entire population of Maine including children	CUA; DAM (the CHOICES model: A stochastic, discrete-time, individual-level microsimulation model); state-level stakeholder perspective
Sebire, S. J., et al., 2019 (United Kingdom) <sup>93</sup>	PLAN-A intervention: a peer led PA program versus control	Behavioral; PA (school-based)	Year 8 girls at English secondary schools (12 to 13 years old)	CEA; economic evaluation alongside cluster randomized control feasibility study; public sector perspective (to be funded by local government or academy schools)
Vieira, M. & Carvalho, G.S. 2019 (Portugal) <sup>129</sup>	The "Planning Health in School" program (PHS-pro), a learning module promoting healthy choices versus a non-randomized control group	Behavioral; water intake, TV viewing time, diet, and PA (school-based)	Children of varying weight status (10 to 14 years old)	CCA; economic evaluation alongside a non-randomized controlled trial; societal
Ananthapavan, J., et al., 2020 (Australia) <sup>111</sup>	12 childhood interventions: (1) alcohol price increase; (2) community-based interventions to promote (3) healthy eating and PA; (4) menu kilojoule labeling on fast food; (5) package size cap on SSBs; (6) reformulation in response to the Health Star Rating (HSR) system; (7) reformulation to reduce sugar in SSBs; (8) restricting TV AD of unhealthy foods; (9) restrictions on price promotions of SSBs; (10) school-based intervention to reduce sedentary behavior; (11) school-based intervention to increase PA; and (12) 20% sales tax on SSBs tax; supermarket self tags on healthier products versus "no intervention"	Behavioral, environmental, policy; PA, active play equipment, legislation on alcohol, SSB package size cap, TV AD of unhealthy food, SSB promotion, fast food labeling, voluntary healthy food tagging (school-based, community-based, population-wide)	Children with varying weight classifications, depending on the intervention (2 to 18 years old)	CUA; DAM (The ACE-Obesity Policy model - a proportional, multi-state life table Markov cohort model); limited societal
Breheny, K., et al., 2020 (United Kingdom) <sup>94</sup>	The Daily Mile: running or walking around school grounds for 15-min daily versus only the usual school health and wellbeing activities	Behavioral, policy; PA (school-based)	Children in all state-funded primary and junior schools (4 to 11 years old)	CUA; within trial cost-utility analysis; public sector



TABLE 3 (Continued)

Author, year of publication (country)	Intervention(s) and comparator(s)	Intervention category; components and targets (setting)	Target population (age/age range)	Type of economic evaluation; study design; study perspective
Clemes, S. A., et al., 2020 (United Kingdom) <sup>95</sup>	Replacing normal desks with sit-stand desks in classrooms for 4.5 months versus usual practice	Behavioral; PA (school-based)	Children in Bradford primary schools (9 to 10 years old)	CCA, CUA; economic evaluation alongside a pilot cluster RCT and DAM; extrapolation with Markov-type model (the MOVES model); health system and Personal Social Services
Ferguson, M. C., et al., 2020 (United States) <sup>78</sup>	The original Fierce & Fit program versus scenarios that varied the length of the program, frequency of meetings and amount of PA per meeting	Behavioral; PA (community-based)	Girl Scouts from kindergarten through eighth grade in Maryland (5 to 14 years old)	CBA, CCA; DAM (individual-level simulation model linked to a 15-health state Markov model); societal
Finster, M.P. & Feldman, J. 2020 (United States) <sup>79</sup>	Onsite versus online support to implement a school-based wellness program	Behavioral, environmental; diet and PA, web-based (e-health) (school-based)	Students in low SES neighborhoods (age and weight status not specified)	CEA; economic evaluation alongside an RCT (Healthy Schools Randomized Trial); not stated
Huse, O., et al., 2020 (Australia) <sup>112</sup>	National mandatory restriction on all price promotions for SSBs available for purchase for take-home consumption in Australia versus no policy	Policy; diet (population-wide)	The 2010 Australian population (2 to 100 years old)	CUA; DAM (multi-state life table Markov model); limited societal
Mytton, O. T., et al., 2020 (United Kingdom) <sup>96</sup>	Restriction of TV AD of food and beverages HFSS between 5.30 am and 9 pm (scenario A: withdrawn; scenario B: displaced to 9 pm to 5.30 am) versus no intervention	Policy; diet (population-wide, home-based)	Children in the United Kingdom (5 to 17 years old)	CUA; DAM (the PRIMEtime model: multi-state life table model); health sector, societal
Oosterhoff, M., et al., 2020 (Netherlands) <sup>115</sup>	Two health promotion interventions in school environment: HPSF and Physical Activity School versus normal practice	Behavioral; diet and PA (school-based)	Primary school children (4 to 12 years old)	CUA; DAM based on a quasi-experimental study; healthcare and societal
Oosterhoff, M., et al., 2020 (Netherlands) <sup>116</sup>	Two health promotion interventions in school environment: HPSF and Physical Activity School versus normal practice	Behavioral; diet and PA (school-based)	Primary school children (4 to 12 years old)	CBA/social return on investment; economic evaluation alongside a quasi-experimental study; societal
Xu, H., et al., 2020 (China) <sup>34</sup>	Three interventions: (1) NE, (2) PA, and (3) comprehensive (included the NE and PA interventions)	Behavioral; diet and PA (school-based)	Parents, teachers, and health workers also received some of the interventions (age and weight status not clearly stated but a baseline age of 10 years was implied)	CUA, CBA; DAM (an obesity progression model) based on a trial; societal
Corder, K. L., et al., 2021 (United Kingdom) <sup>97</sup>	GoActive: a school-based, peer-led 12-week program versus control	Behavioral; PA (school-based)	Children in non-fee-paying schools (13 to 14 years old)	CEA; DAM (exploratory economic modeling using the physical activity CE [PACE] model), based on a cluster RCT; health sector, public sector (cost to local authorities)



TABLE 3 (Continued)

Author, year of publication (country)	Intervention(s) and comparator(s)	Intervention category; components and targets (setting)	Target population (age/age range)	Type of economic evaluation; study design; study perspective
Jago, R., et al., 2021 (United Kingdom) <sup>98</sup>	PLAN-A intervention: a peer led PA program versus control	Behavioral; PA (school-based)	Girls in secondary schools (13 to 14 years old)	CEA, CUA; cluster randomized controlled trial alongside an economic evaluation; public sector
Kennedy, E. L., et al., 2021 (United States) <sup>80</sup>	Five hypothetical policies: (1) eliminating TV AD tax subsidy; (2) policy to reduce TV time in licensed childcare settings; (3) Fit5Kids childcare curriculum to reduce TV time at home; (4) motivational interviewing to reduce TV time during Women, Infants, and Children (WIC) clinic visits; and (5) home visits to reduce TV viewing	Behavioral, policy; TV viewing (multiple settings - home, childcare and clinic-based)	Children of different age groups (2 to 19 years old)	CCA; DAM (the CHOICES microsimulation model); societal
Lonsdale, C., et al., 2021 (Australia) <sup>113</sup>	9-to-10-month intervention: Internet-Based Professional Learning to Help Teachers Promote Activity in Youth (iPLAY) to increase school-based PA compared versus control	Behavioral; PA; 20-m shuttle laps, web-based (e-health) (school-based)	Children in grades 3 and 4 in New South Wales, Australia (mean age 8.85 years old)	CEA; cluster randomized controlled trial alongside an economic evaluation; school system
Reeves, P., et al., 2021 (Australia) <sup>114</sup>	Web-based menu planning intervention for childcare service food delivery versus usual care	Behavioral; diet, web-based menu planning (e-health) (childcare center-based)	Children in childcare services in New South Wales (3 to 6 years old)	CCA, CEA; economic evaluation conducted alongside a trial; health sector and societal
van Schayck, C., et al., 2021 (Netherlands) <sup>117</sup>	School lifestyle interventions (HPSF): combination of increased PA and healthy nutrition, increased PA alone and the control group	Behavioral; diet and PA (school-based)	Children in elementary schools (4 to 12 years old)	CCA; economic evaluation conducted alongside a quasi-experimental study (prospective controlled non-randomized study); societal
Auerbach, J. D., Fitzhugh, E. C., & Zavisca, E., 2021 (United States) <sup>132</sup>	Increased thoroughfare connectivity and walkability around schools versus the status quo (usual school bussing)	Environmental; PA - walking to school - (school- and community-based)	Elementary and secondary school pupils	CBA, CCA; DAM (data engineering of spatial data to find optimal thoroughfares); school system
Brown, A., et al., 2021 (Australia) <sup>133</sup>	Multi-component m-health to improve quality of school lunchboxes versus control (waitlist/data collection only)	Behavioral; App-based mobile health technology (m-health) support messages to parents, information pack, education, diet (family-, school-based)	Parents and their children (5 to 12 years old)	CEA; trial-based economic evaluation; societal
Ekwari, J. P., et al., 2021 (Canada) <sup>134</sup>	Comparison of three interventions: (1) Comprehensive School Health (CSH) approach; (2) multicomponent intervention prioritized by the key stakeholders; and (3) PE curriculum modifications	Behavioral, environmental; diet and PA (school-based)	Children in Canadian schools (4 to 18 years old)	CUA; DAM (Microsimulation model); healthcare system

TABLE 3 (Continued)

Author, year of publication (country)	Intervention(s) and comparator(s)	Intervention category: components and targets (setting)	Target population (age/age range)	Type of economic evaluation; study design; study perspective
Kuvaja-Köllner, V., et al., 2021 (Finland) <sup>135</sup>	PA counseling sessions and after-school exercise clubs versus control (verbal and written advice)	Behavioral; PA (group-based PA counseling with parents and after-school clubs) (family-, school-based)	Primary school children (6 to 9 years old) and their parents	CEA; trial-based economic evaluation; payer (extended service payer's perspective)
Sutherland, R., et al., 2021 (Australia) <sup>136</sup>	The Physical Activity 4 Everyone (PA4E1) multi-component intervention versus usual care	Behavioral; PA (school-based, low-income communities)	Children in disadvantaged secondary schools of mixed weight status groups in their first year of high school	CEA; RCT alongside an economic evaluation (implementation trial); public sector (public finance)
Zanganeh, M., et al., 2021 (China) <sup>36</sup>	Chinese Primary School Children Physical Activity and Dietary Behaviour Changes Intervention (CHIRPY DRAGON) versus control	Behavioral; diet (school lunch) and PA (school- and family-based)	Primary school children in China (6 to 7 years old) and their parents and grandparents	CEA, CUA; trial-based economic evaluation; public sector and societal
Cobiac, L. J., Law, C., & Scarborough, P. 2022 (United Kingdom) <sup>137</sup>	Three interventions compared: (1) a SSB tax (whole population); (2) a ban on TV advertising of unhealthy foods (children aged 5–17); and (3) a weight loss program (adults)	Behavioral and policy; diet - SSB tax, ban on TV advertising (population-wide)	The general population (infant cohort and children 5 to 17 years old)	CCA, CUA; DAM (state transition model adapted from the PRIMEtime-CE model, a cohort chronic disease multistate life-table model that applied the Population Attributable Fraction [PAF] for targeted diseases); health sector
Derwig, M., et al., 2022 (Sweden) <sup>138</sup>	Child-centered health dialog in Child Health Services (CHC) versus usual care including health visits	Behavioral; 10-min healthy lifestyle, diet, and PA (to all), targeted overweight children - weight stabilization intervention (home and clinical setting)	Mixed group of children with healthy weight and overweight (4 years old) and their caregivers	CEA; trial-based economic evaluation; societal
Lane, C., et al., 2022 (Australia) <sup>139</sup>	A multi-component Physically Active Children in Education (PACE) versus wait list control	Behavioral, environmental, policy; PA - support for leadership, school-policy development, in-school champions, in-person contact, online sessions, email, and telephone contact (school-based)	Primary school age children in New South Wales	CCA, CEA; trial-based economic evaluation; health service
Lane, C., et al., 2022 (Australia) <sup>140</sup>	Adapted Physically Active Children in Education (Adapted PACE) to reduce in-person contact versus the original PACE intervention	Behavioral, environmental, policy; PA - support for leadership, school-policy development, in-school champions, in-person contact, additional email, telephone, and online contact (e-health) with Adapted PACE (school-based)	Children across Australia (5 to 14 years old)	CMA; trial-based economic evaluation (non-inferiority cluster randomized controlled trial); health service
Mahashabde, R., et al., 2022 (United States) <sup>141</sup>	WISE (Together, We Inspire Smart Eating) versus usual nutrition education (UNE)	Behavioral; diet - nutrition promotion (family- and school-based)	Children (3 to 5 years old) and their parents	CEA; economic evaluation based on a quasi-experimental, non-randomized study, societal
Alcaraz, A., et al., 2023 (Argentina, Brazil, El Salvador, and Trinidad and Tobago) <sup>37,183</sup>	Current SSB consumption prevalence versus counterfactual scenario of no SSB consumption	Policy; diet - availability and consumption of SSB or clean drinking water, taxes, and AD	Investigated all age groups: costs and outcomes in children (0 to 18 years old) were reported	CEA (CUA in adults only); DAM (simulation model used to determine the Population

TABLE 3 (Continued)

Author, year of publication (country)	Intervention(s) and comparator(s)	Intervention category; components and targets (setting)	Target population (age/age range)	Type of economic evaluation; study design; study perspective
Jackson-Morris, A., & Meyer, C. L. 2023 (Mexico, China, Peru) <sup>38</sup>	Country-specific priority interventions (insufficient information) versus the status quo scenario	regulation (multiple settings possible)  Multiple categories; fiscal policies, social marketing, breastfeeding promotion, school-based policies, and nutritional counseling (multiple settings possible)	National cohorts of children in Mexico, China, and Peru (0 to 19 years old)	Attributable Fraction [PAF] for targeted diseases and health economic impact of SSB consumption; healthcare system
Mahdi, S., et al., 2023 (United Kingdom) <sup>142</sup>	Exposure to app (Change4Life Food scanner) versus no intervention	Behavioral; diet - nutrition promotion (family-based)	Parents of children (4–11 years old)	CEA/return on investment; DAM (insufficient information); societal

Abbreviations: ACE, the assessing cost-effectiveness in obesity study; AD, advertisement/advertising; APPLE, A Pilot Programme for Lifestyle and Exercise; APPLE, Alberta Project Promoting active Living and healthy Eating; ASP, after-school program; BAEW, Be Active Eat Well; BMI, body mass index; CATCH, Coordinated Approach to Child Health; CATCH, The Child and Adolescent Trial for Cardiovascular Health; CBA, cost-benefit analysis; CCA, cost-consequences analysis; CE, cost-effectiveness; CEA, cost-effectiveness analysis; CHOICES, Childhood Obesity Intervention Cost Effectiveness Study; CHU-9D, Child Health Utility 9Dimension; CUA, cost-utility analysis; DALY, disability-adjusted life year; DAM, decision analytic model; ECE, early care and education; GP, General practitioner; HALY, Health-adjusted life years; HFSS, high in fat, sugar, and salt; HPSF, Healthy Primary School of the Future; HUI, Health Utilities Index; ICER, incremental cost-effectiveness ratio; LMIC, lower middle-income country; MET, metabolic equivalent; MPA, moderate physical activity; MVPA, moderate to vigorous physical activity; NA, not applicable; NE, nutrition education; NHANES, National Health and Nutrition Examination Survey; NHS, National Health Service; PA, physical activity; PA4E1, Physical Activity 4 Everyone; PE, physical education; PLAN-A, school-based peer-led PA intervention; QALY, quality adjusted life year; RCT, randomized controlled trial; SES, socioeconomic status; SPARK, The Sports, Play, and Active Recreation for Kids trial; SSB, sugar-sweetened beverage; TV, television; WC, waist circumference; WHtR, waist-to-height ratio; WTP, willingness to pay.

TABLE 3 (Continued)

Author, year of publication (country)	Study follow-up or decision analytic model time horizon; discounting	Currency unit (Price year)	Measure(s) of consequences	Key/base case results	CHEERS quality score
Wang, L. Y., et al., 2003 (United States) <sup>51</sup>	25 years (age 40 to 65 years); 3% (costs and benefits)	USUS dollars (1996)	QALY saved	Given a CE threshold of USD 30,000 per QALY saved, an ICER of USD 4,305 per QALY saved was estimated	93%
Brown, H. S., et al., 2007 (United States) <sup>52</sup>	26 years (age 40 to 65 years); 3% (costs and benefits)	US dollars (2004)	QALY saved and averted medical and labor productivity costs	Given a CE threshold of USD 30,000 per QALY saved, an of ICER of USD 900 per QALY saved was estimated	94%
Nixon, J., et al., 2008 (United Kingdom) <sup>81</sup>	Not stated; not stated	Euros (not stated)	QALY gained	Given a CE threshold of EUR 3,000 per QALY gained, primary prevention without screening (ICER EUR 290 per additional QALY) had a 100% probability of being cost-effective	37%

TABLE 3 (Continued)

Author, year of publication (country)	Study follow-up or decision analytic model time horizon; discounting	Currency unit (Price year)	Measure(s) of consequences	Key/base case results	CHEERS quality score
Peterson, M., et al., 2008 (United States) <sup>53</sup>	NA; NA	US dollars (not stated)	Intention to be active; and becoming more active (measure not specified)	Cost per person to become more active was lowest for billboard alone at USD 5.11 but cost USD 8.87 per person for the entire campaign	58%
Wang, L. Y., et al., 2008 (United States) <sup>54</sup>	1 year after randomization; NA	US dollars (2003)	Reduction in percent body fat (% BF)	Students who attended at least 40% of the intervention reduced %BF by 0.76% at an additional cost of USD 317/student, compared with students in the control group	97%
Magnus, A., et al., 2009 (Australia) <sup>99</sup>	Lifetime; 3% (costs and benefits)	Australian dollars (2001)	Changes in BMI and DALY saved	Given a CE threshold of AUD 50,000 per DALY saved, the intervention had a 100% probability of CE (gross ICER of AUD 3.70 per DALY saved and cost per BMI unit saved of AUD 0.33)	100%
Moodie, M., et al., 2009 (Australia) <sup>100</sup>	Lifetime; 3% (costs and benefits)	Australian dollars (2001)	BMI unit saved and DALY saved	Given a CE threshold of AUD 50,000 per DALY saved, WSB had a 0% of being CE	100%
Cecchini, M., et al., 2010 (Brazil, China, India, Mexico, Russia, South Africa, England) <sup>31</sup>	20 years and 50 years: 3% (costs and benefits)	US dollars (2005)	DALY averted and life years gained	Given country-specific CE thresholds, the study found that fiscal measures had the most consistently favorable ICERs across LMICs in both 20- and 50-year time horizons. Food labeling and regulation of food AD performed well in many countries but showed smaller health effects compared with fiscal measures. Poor ICERs were reported for school-based health promotion interventions within 50 years but tended to improve in longer time horizons	90%
McAuley, K. A., et al., 2010 (New Zealand) <sup>122</sup>	4 years from baseline (2 years of follow-up); 5% (costs)	New Zealand dollars (2006)	Reduction in weight z-score and QALY gained (HUI values)	While mean HUI values did not differ between the two groups, reduction in BMI z-score was equivalent to 2.0 kg of weight-	98%

TABLE 3 (Continued)

Author, year of publication (country)	Study follow-up or decision analytic model time horizon; discounting	Currency unit (Price year)	Measure(s) of consequences	Key/base case results	CHEERS quality score
Mernagh, P., et al., 2010 (New Zealand) <sup>130,181</sup>	Lifetime; 3.5% (costs and benefits)	New Zealand dollars (2010)	QALY gained	gain prevented at age 15. The implementation cost for the intervention was NZD 664 - NZD 1,708 per kg of weight-gain prevented from baseline to follow-up (4 years)	92%
				Given a maximum CE threshold of NZD 50,000 per QALY gained, the ICERs for Switch-Play; BAEW; SNPI; and APPLE <sup>a</sup> were 4,824 and 38,630; 123,536, 154,178 and 168,391; 134,252; and 205,101 NZD per QALY gained, respectively, compared to no intervention	
Moodie, M. L., et al., 2010 (Australia) <sup>101</sup>	Lifetime; 3% (costs and benefits)	Australian dollars (2001)	BMI unit saved and DALY saved	Given a CE threshold of AUD 50,000 per DALY saved, the probability of cost-effectiveness was only 8.9% (net cost per DALY saved of AUD 82,000 estimated)	100%
Pringle, A., et al., 2010 (United Kingdom) <sup>82</sup>	Not stated; not stated	Pound sterling (2003)	MPA improvement in completers, QALY gained	Given a CE threshold of GBP 20,000 per QALY gained, the cost per QALY gained ranged from GBP 47 to GBP 509 within each intervention category	65%
Trasande L. 2010 (United States) <sup>55</sup>	Lifetime; 3% (costs and benefits)	US dollars (2005)	QALY saved	Given CE thresholds of USD 20,000 and USD 50,000 per QALY saved, a 1%-point reduction in obesity among 6- and 12-years old would save 67,910 QALYs and 102,749 QALYs, and USD 166 million and USD 260 million in total medical expenditures, respectively	83%
Martínez, P. M., et al., 2011 (Spain) <sup>118</sup>	7 months from baseline; NA	Euros (2005)	Decrease in the percent of body fat	Usual afterschool care estimated at EUR 844.56/year/child, was 3 times more expensive than the intervention. The decrease in	87%

(Continues)

TABLE 3 (Continued)

Author, year of publication (country)	Study follow-up or decision analytic model time horizon; discounting	Currency unit (Price year)	Measure(s) of consequences	Key/base case results	CHEERS quality score
Moodie, M., et al., 2011 (Australia) <sup>102</sup>	Lifetime; 3% (costs and benefits)	Australian dollars (2001)	BMI unit saved and DALY saved	triceps skinfold thickness and percent of body fat for the intervention group relative to usual care ranged from −1.25 mm to −1.87 mm and −0.59% to −0.67%, respectively Given a CE threshold of AUD 50,000 per DALY saved (with cost-offsets), the intervention was estimated at a net cost per DALY saved of AUD 117,000	100%
Ramos-Goñi JM, Valcárcel-Nazco C, Castilla-Rodríguez I. 2011 (Spain) <sup>119</sup>	70 years; 3% (costs and benefits)	Euros (not stated)	QALY gained	Given a CE threshold of EUR 30,000 per QALY gained, the study proposed that any intervention exceeding 1% prevention/correction should be implemented if costs was less than EUR 2 per child and per year	31%
Te Velde, S., et al., 2011 (Netherlands) <sup>131,182</sup>	Lifetime; 3% (costs and benefits)	Euros (2006)	DALY averted	Given a CE threshold of EUR 19,600 per DALY averted (based on Dutch per capita income), the ICER for PC and for SG in versus no intervention was calculated to be 5,728/DALY and 10,674/DALY, respectively	100%
Wang, L. Y., et al., 2011 (United States) <sup>56</sup>	10 years; 3% (costs and benefits)	US dollars (2010)	QALY gained (15D instrument)	CE threshold not stated: the ICER for the intervention was estimated at net savings of USD 2,966 per QALY gained	100%
Monsivais, P., & Rehm, C. D. 2012 (United States) <sup>57</sup>	A one-day reduction in dietary energy per day; NA	US dollars (not stated)	Reduction in dietary energy (Kilojoules/day) and increase in fiber (grams/day)	Replacing all juice with fresh, whole fruit is estimated to reduce energy intake by 233 kJ/day and increase fiber intake by 4.3 g/day but would cost an extra USD 0.54/day	76%
Gesell, S. B., et al., 2013 (United States) <sup>58</sup>	12 weeks from baseline; NA	US dollars (2010)	Increase in MVPA	Increased PA in favor of the intervention was reported (a difference of 14.7% points in	82%



TABLE 3 (Continued)

Author, year of publication (country)	Study follow-up or decision analytic model time horizon; discounting	Currency unit (Price year)	Measure(s) of consequences	Key/base case results	CHEERS quality score
Keszytüs, D., et al., 2013 (Germany) <sup>124</sup>	1 year; NA	Euros (2008)	WC and WHtR gain prevented and BMI difference between groups	MVPA between groups). The standard school-based ASPs would also cost more (an additional USD 1.59 per child for 12 weeks) to achieve similar results	95%
Meng, L., et al., 2013 (China) <sup>32</sup>	1 academic year from baseline; NA	Chinese Yuan/US dollars (2010)	BMI reduction, BMI z-score avoided, overweight and obesity case avoided	No significant differences were found between control and NE or PA individually. The ICERs for the comprehensive group were US \$120 per 1 kg/m <sup>2</sup> BMI reduction, USD 249 per BMI z-score avoided, USD 1,309 per one overweight and obesity case avoided compared with control	92%
Moodie, M. L., et al., 2013 (Australia) <sup>103</sup>	Lifetime; 3% (costs and benefits)	Australian dollars (2006)	BMI units saved and DALY averted	Given a CE threshold of AUD 50,000 per DALY saved (with cost-offsets), the intervention yielded a net cost per DALY saved of AUD 29,798 in comparison with the comparator	100%
Nelson, M., 2013 (England) <sup>83</sup>	6 years; not stated	Pound sterling (2008)	Monetary benefits (observed changes in food services)	The ratio of benefits to costs of introducing a breakfast club was 4.38 (GBP 897000/GBP 205000)	64%
Tran, B., et al., 2013 (Canada) <sup>126</sup>	Lifetime; 3% (costs and benefits)	Canadian dollars (not stated)	Cases of excess weight prevented and QALY gained	CE threshold not stated: the ICER of the APPLE <sup>b</sup> Schools program was CAD 15,833 per QALY gained and CAD 24,359 or 11,047 per case of obesity or overweight prevented in adulthood, resulting in a benefit–cost ratio of 13:1	59%
Babey, S. H., et al., 2014 (United States) <sup>59</sup>	Not stated; not stated	US dollars (2013)	Reach, MET hours gained	Reach and cost per student were most favorable for extending the	61%

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TABLE 3 (Continued)

Author, year of publication (country)	Study follow-up or decision analytic model time horizon; discounting	Currency unit (Price year)	Measure(s) of consequences	Key/base case results	CHEERS quality score
Rush, E., et al., 2014 (New Zealand) <sup>123</sup>	Lifetime; 3.5% (costs and benefits)	New Zealand dollars (2011)	QALY gained	school day with mandatory PE participation and short PA breaks during the school day, with cost/MET-hours gained of USD 0.65–0.98 and USD 0.002–0.01 respectively  Given a CE threshold of NZD 50,000 per QALY gained, the ICER (among younger and older children, respectively) was NZD 30,438 and NZD 24,690, and lower for Māori (NZD 28,241, NZD 22,151) and for the middle SES schools (NZD 23,211, NZD 17,891) per QALY gained	92%
Swinburn, B., et al., 2014 (Australia) <sup>104</sup>	3-year follow-up; not stated	Australian dollars (not stated)	Decrease in prevalence of overweight/obesity	No significant difference in effects between both groups was reported, but by the end of follow-up, intervention schools invested ~AUD 30,000 per year, which was less than half the amount during BAEW and much lower than comparison schools (over AUD 66,000 per school year)	80%
Tran, B. X., et al., 2014 (Canada) <sup>127</sup>	59 years (11–70 years); not stated	Canadian dollars (not stated)	Difference in life course prevalence of obesity	On average, the life course prevalence of obesity was 0.8% less among APPLE <sup>®</sup> schools' children, with potential annual cost savings at CAD 33 to 82 million and CAD 150 to 330 million in the province of Alberta and Canada, respectively	70%
Barrett, J. L., et al., 2015 (United States) <sup>40</sup>	10 years; 3% (costs and benefits)	US dollars (2014)	BMI units reduced	The intervention was estimated to cost USD 1,720 per BMI unit reduced. This translated to an estimated USD 60.5 million in healthcare costs averted	98%
Gortmaker, S. L., et al., 2015 (United States) <sup>61</sup>	10 years; 3% (costs and benefits)	US dollars (2014)	BMI units reduced and net cost saved per USD spent	The net cost saved per dollar spent was USD 55, USD 38, and USD 6	98%

TABLE 3 (Continued)

Author, year of publication (country)	Study follow-up or decision analytic model time horizon; discounting	Currency unit (Price year)	Measure(s) of consequences	Key/base case results	CHEERS quality score
Long, M. W., et al., 2015 (United States) <sup>62</sup>	2 years (10 years for general population); 3% (costs and benefits)	US dollars (2014)	BMI units reduced	for SSB, TV AD and ECE respectively Over 2 years, the cost per BMI unit reduced due to the tax was estimated at USD 8.54 in children and youth aged 2 to 19 years of age	100%
McCollister, K. E., et al., 2015 (United States) <sup>63</sup>	3 years follow up from the start of intervention and projected lifetime horizons; not stated	US dollars (2013)	Percent obesity avoided	If HC2 reduces obesity by 1%, 5% and 10%, the study projects lifetime savings of USD 228,000, USD 1,140,000, and USD 2,280,000, respectively	70%
Mora, T., et al., 2015 (Spain) <sup>120</sup>	Two years of intervention and 4-year follow-up; not stated	Euros (2008)	Change in BMI	A ratio of net intervention costs and net intervention effects of EUR 41 per 1.13 kg/m <sup>2</sup> BMI reduction was estimated	82%
Sonneville, K. R., et al., 2015 (United States) <sup>64</sup>	10 years; 3% (costs and benefits)	US dollars (2014)	QALY gained and net cost saved per \$ spent	CE threshold not stated: the net reduction in cost (implementation and healthcare costs) and the total QALY gained over 10 years were USD 343 million and 4,540, respectively. The net cost savings per dollar spent was estimated at USD 38	100%
Wright, D. R., et al., 2015 (United States) <sup>65</sup>	10 years; 3% (costs and benefits)	US dollars (2014)	BMI units reduced and net cost saved per USD spent	The ICER for the SSB was estimated at USD 57.80 per BMI unit avoided over a two-year period, and a net healthcare cost savings of USD 51.6 was estimated for a 10-year time horizon	100%
Jago, R., et al., 2016 (United Kingdom) <sup>84</sup>	1 year after baseline; NA	Pound sterling (2013/2014)	Change in MVPA and QALY gained (EQ-5D-Y)	CE threshold not stated: the study found no difference in MVPA and no QALY gained at 1 year between the intervention (costing GBP 73 per participant) and control	90%
Ladapo, J. A., et al., 2016 (United States) <sup>66</sup>	5 weeks (trial period); NA	US dollars (2014)	Number served: portions of fruits and vegetables, free/reduced-price lunches, full-priced lunches, all lunches served; snacks	The CE of the program was valued at USD 1.20 per additional fruit portion served, USD 8.43 per additional full-priced lunch, USD	92%

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TABLE 3 (Continued)

Author, year of publication (country)	Study follow-up or decision analytic model time horizon; discounting	Currency unit (Price year)	Measure(s) of consequences	Key/base case results	CHEERS quality score
Lawlor, D. A., et al., 2016 (United Kingdom) <sup>85</sup>	1 year follow-up; NA	Pound sterling (2012/2013)	Changes in levels of PA, sedentary behavior, and fruit and vegetable consumption	2.11 per additional reduced-price/free lunch and USD 1.69 per unit reduction in snacks sold  Although the intervention only cost GBP 18/child, there was no improvement in levels of PA, sedentary behavior and fruit and vegetable consumption	89%
Sutherland, R., et al., 2016 (Australia) <sup>105</sup>	2 years; not stated	Australian dollars (2014)	Mean minute of MVPA gained and MET minute gained, unit (10%) reduction in BMI z-score, BMI unit avoided	ICERs were AUD 56 per additional minute of MVPA/day, AUD 749 per MET hours gained per person/day, AUD 563 per 10% reduction in BMI z-score and AUD 1,408 per BMI unit avoided	93%
Cradock, A. L., et al., 2017 (United States) <sup>67</sup>	10 years (2015 to 2025); 3% (cost)	US dollars (2014)	BMI unit reduction, cases of childhood obesity prevented, and healthcare cost savings	The ICER for New Afterschool Program was dominant, while the ICERs for the remaining interventions ranged from USD 361 to USD 2,825 per BMI unit change per person	91%
Crino, M., et al., 2017 (Australia) <sup>106</sup>	Lifetime; 3% (costs and benefits)	Australian dollars (2010)	Change in BMI and HALY gained	Given a CE threshold of AUD 50,000 per HALY gained, both interventions were dominant. Package size cap and energy reduction would save 73,883 HALYs and 144,621 HALYs, yielding cost-offsets of 750.9 m and 1.4bn AUD, respectively	96%
Ekwaru, J. P., et al., 2017 (Canada) <sup>128</sup>	Lifetime; 3% (costs and benefits)	Canadian dollars (2008)	QALY gained, person year of excess weight prevented, and person year of obesity prevented	Given a CE threshold of CAD 50,000 per QALY gained, the probability of CE was 64% in the base case scenario (the ICERs were CAD 33,421 per QALY gained, CAD 1,555 per person year of excess weight prevented, and CAD 1,709 per person year of obesity prevented)	96%
Graziose, M. M., et al., 2017 (United States) <sup>68</sup>	Lifetime; 3% (costs and benefits)	US dollars (2012)	QALY saved	Given a CE threshold of USD 50,000 per QALY saved, the ICER was USD 275 per QALY saved	98%

TABLE 3 (Continued)

Author, year of publication (country)	Study follow-up or decision analytic model time horizon; discounting	Currency unit (Price year)	Measure(s) of consequences	Key/base case results	CHEERS quality score
Hajizadeh, N., et al., 2017 (United States) <sup>69</sup>	Lifetime; 5% (costs and benefits)	US dollars (2015)	Achievement test scores, change in rates of obesity and QALY gained	CE threshold not stated: ParentCorps was predicted to save USD 4387 per child with a QALY increase of 0.27	98%
Kesztyüs, D., et al., 2017 (Germany) <sup>125</sup>	1 year post intervention; NA	Euros (2010/2011)	Changes in WC and WHtR	Given a parental WTP for the intervention of EUR 123 per year, the intervention was cost saving. The costs per incidental case of averted abdominal obesity varied between EUR 1,515 and EUR 1,993, with a cost per child and year of EUR 25	97%
Lee, B. Y., et al., 2017 (United States) <sup>70</sup>	Lifetime; 3% (costs)	US dollars (2016)	Reduction in cases of obesity, QALY saved	Increasing the current level of children who get 25 min of high-calorie-burning PA from 31.9% to 75% was estimated to save a total of 18,913,447 QALYs and avert USD 16.6bn in direct medical costs and USD 23.6 bn in lost productivity	96%
Moore, J. B., et al., 2017 (United States) <sup>71</sup>	1 year after baseline; NA	US dollars (2011)	Increase in MVPA (minutes per day)	The CE ratio (USD/MVPA minutes per day) ranged from USD 0.02 to USD 0.58 across both years of intervention	82%
Wang, H., et al., 2017 (United States) <sup>72</sup>	One year post intervention; NA	US dollars (2008)	Total MET-hours gained	Given a CE threshold of 35 cents per MET-hour gained, Ready for Recess cost 32 cents per MET-hour gained per student per school day	92%
An, R., et al., 2018 (United States) <sup>73</sup>	Lifetime; 3% (costs and benefits)	US dollars (2016)	Number of cases of excess weight prevented expressed in terms of per capita annual medical cost of adult excess weight	The net benefit of the intervention was USD 174 per student. A net benefit of USD 199 and USD 149 per student was estimated for boys and girls, respectively	100%
Anokye, N., et al., 2018 (United Kingdom) <sup>86</sup>	Immediately after 6 weeks of intervention; NA	Pound sterling (2015/2016)	QALY gained	Given a CE threshold of GBP 30,000 per QALY gained, stage 2 had a 29% probability of being cost-effective relative to stage 1	100%
Beets, M. W., et al., 2018 (United States) <sup>74</sup>	End of the 2-year trial; NA	US dollars (2015)		The ICERs for a 1% increase in the number of children accumulating	88%

(Continues)

TABLE 3 (Continued)

Author, year of publication (country)	Study follow-up or decision analytic model time horizon; discounting	Currency unit (Price year)	Measure(s) of consequences	Key/base case results	CHEERS quality score
Brown, V., et al., 2018 (Australia) <sup>107</sup>	Lifetime; 3% (costs and benefits)	Australian dollars (2010)	Changes in MVPA and changes in number of days fruits/vegetables, water, desserts, and SSBs served	30 min or more of MVPA/day ranged from USD 0.05–0.23 (immediate) and USD 0.26–0.08 (delayed) for boys and girls, respectively	100%
Conesa, M., et al., 2018 (Spain) <sup>121</sup>	End of the trial: 28 months (2.3 years); NA	Euros (2007)	Reductions in energy intake (mean KJ/day), reductions in BMI and HALY saved	Given a CE threshold of AUD 50,000 per HALY saved, the intervention was dominant	95%
Reilly, K. L., et al., 2018 (Australia) <sup>108</sup>	End of trials (12 months); NA	Australian dollars (2015)	Number of obesity cases avoided, decrease in obesity prevalence, decrease in BMI units, and decrease in BMI z-score units	For boys, the ICERs of EUR 968.66/case of obesity avoided, EUR 44.68/BMI one-unit decrease, EUR 3.56/1% obesity prevalence reduction and EUR 65.16/BMI z-score one-unit decrease were reported	97%
Wyatt, K., et al., 2018 (United Kingdom) <sup>87</sup>	24 months post baseline; 3.5% (costs and benefits)	Pound sterling (2015)	Percent point increase in the proportion of schools that adhered to the policy	The ICERs for the three interventions were AUD 2,982 (high intensity), AUD 2,627 (medium intensity) and AUD 4,730 (low intensity) per percent increase in the proportion of schools reporting “adherence” compared to “usual support”	95%
Amies-Cull, B., et al., 2019 (England) <sup>88</sup>	10 years in the base case; not stated	Pound sterling (not stated)	Change in BMI, WC, percent body fat or PA levels	Intervention cost of GBP 214 per child, but study found no significant difference between the intervention and control groups in change in BMI, WC, percent body fat or PA levels	91%
Ananthapavan, J., et al., 2019 (Australia) <sup>109</sup>	Lifetime; 3% (costs and benefits)	Australian dollars (2010)	Calorie change and reduction in obesity	The study estimated a potential reduction in obesity among 4–10-year-olds by 5.5%, 11–18-year-olds by 2.2% for the intervention. A total net healthcare cost saving of GBP 285.8 million was estimated over 10 years	100%



TABLE 3 (Continued)

Author, year of publication (country)	Study follow-up or decision analytic model time horizon; discounting	Currency unit (Price year)	Measure(s) of consequences	Key/base case results	CHEERS quality score
Basto-Abreu, A., et al., 2019 (Mexico) <sup>35</sup>	10 years; 3% (costs and benefits)	Peso and US dollars (2014)	SSB consumption, obesity cases prevented, DALY averted and QALY gained	The excise tax of 1 peso per liter of SSB is estimated to prevent 94,300 cases of childhood obesity, versus 283,300 cases for MXN 2 per liter. The costs saved per dollar invested was USD 3.98 and USD 6.88 for MXN 1 and MXN 2 per liter tax, respectively	100%
Brown, V., et al., 2019 (Australia) <sup>110</sup>	Lifetime; 3% (costs and benefits)	Australian dollars (2010)	HALYs saved, life years saved and healthcare cost-savings	Given a CE threshold of AUD 50,000 per HALY saved, and assuming a reduction in BMI z-score of 0.13 in children aged 2 to 5 years, the scenario of lifetime effect maintenance resulted in 36,496 HALYs saved and healthcare cost-savings of AUD 301 million	100%
Canaway, A., et al., 2019 (United Kingdom) <sup>89</sup>	30 months: intervention was delivered over a 12-month period and follow-up was 18 months post-intervention; 3.5% (costs and benefits)	Pound sterling (2014)	Difference in BMI z-scores and QALY gained (CHU-9D)	Given a CE threshold of GBP 20,000 – GBP 30,000 per QALY, the ICER associated with the intervention was GBP 26,815 per QALY gained	100%
Charles, J. M., et al., 2019 (United Kingdom) <sup>90</sup>	14 months post-baseline; 3.5% (costs)	Pound sterling (2015/2016)	Mean minutes of MVPA per day, QALY gained (CHU-9D), and service use	“Girls Active” cost between GBP 2–7 per student, per school year. The study did not demonstrate any statistically significant differences between groups for any of the measures of consequences	98%
Coffield, E., et al., 2019 (United States) <sup>75</sup>	2-year intervention, 10-year time horizon for model; 3% (costs and benefits)	US dollars (2014)	Healthcare costs, productivity losses averted	The study estimates that SUS saved USD 1.51 for every USD 1.00 invested in the program, giving a net benefit of USD 197,120 over 10 years	95%
Gammon, C., et al., 2019 (United Kingdom) <sup>91</sup>	8 weeks post training; NA	Pound sterling (not stated)	Change in sedentary time and PA, self-reported well-being, and mental health, QALY gained (CHU-9D)	Training delivery cost GBP 910. Evidence of preliminary effectiveness was not demonstrated in feasibility and pilot studies	75%

TABLE 3 (Continued)

Author, year of publication (country)	Study follow-up or decision analytic model time horizon; discounting	Currency unit (Price year)	Measure(s) of consequences	Key/base case results	CHEERS quality score
Harrington, D., et al., 2019 (United Kingdom) <sup>92</sup>	14 months after the start of the intervention; 3.5% (costs)	Pound sterling (2015/2016)	Change in MVPA	"Girls Active" demonstrated no significant effect. The slight increase in MVPA at 7 months did not persist to 14 months. Intervention costs ranged from GBP 23 to GBP 95/student	90%
Kenney, E. L., et al., 2019 (United States) <sup>76</sup>	10 years; 3% (costs)	US dollars (2015)	Case of childhood obesity prevented, BMI unit reduced and healthcare cost savings per dollar invested	For the water jets school-based intervention, the healthcare cost savings per dollar invested was USD 0.31 and the cost per BMI avoided was USD 105.29	95%
Li, B., et al., 2019 (China) <sup>33</sup>	1 year; NA	Pound sterling (2016/2017)	Change in BMI, QALY gained (CHU-9D)	Given a CE threshold of GBP 20,000 to 30,000 per QALY gained, the probability of the intervention being cost-effective was at least 95% with an ICER of GBP 1,700 per QALY gained	95%
Long, M. W., et al., 2019 (United States) <sup>77</sup>	10 years; 3% (costs and benefits)	US dollars (2015)	BMI reduction, cases of obesity prevented (reported for children and entire population) and QALY gained	CE threshold not stated: ten-year (2017–2027) CE estimates for SSB excise tax and SNAP SSB Restriction, respectively: net costs (USD million) -74.0 and -10.9; and QALYs gained 3,560 and 749	93%
Sebire, S. J., et al., 2019 (United Kingdom) <sup>93</sup>	1 year after participant selection; NA	Pound sterling (2016)	Increase in MVPA and QALY gained (EQ-5D-Y)	The study estimated a 6.1 min between-arms difference in weekday MVPA at follow-up in favor of the intervention arm, with an intervention cost of cost GBP 37 per girl. No significant changes in QALYs were observed in both groups	95%
Vieira, M. & Carvalho, G.S. 2019 (Portugal) <sup>129</sup>	10 months from baseline; NA	Euros (2012)	The per capita net cost of implementing the PHS-pro intervention in children versus cost of treating a case of adult obesity	The per capita net cost of implementing the intervention was EUR 36.14/child/year compared to direct costs estimated for treating one adult with obesity in Portugal (EUR 3849.15/year)	83%

TABLE 3 (Continued)

Author, year of publication (country)	Study follow-up or decision analytic model time horizon; discounting	Currency unit (Price year)	Measure(s) of consequences	Key/base case results	CHEERS quality score
Ananthapavan, J., et al., 2020 (Australia) <sup>111</sup>	Lifetime; 3% (costs and benefits)	Australian dollars (2010)	HALYs gained	Given a CE threshold of AUD 50,000 per HALY gained, the study found that all childhood interventions were either dominant or had a ICER ranging from AUD 1,728 to AUD 8,155	100%
Breheny, K., et al., 2020 (United Kingdom) <sup>94</sup>	1 year; NA	Pound sterling (2017)	QALY gained (CHU-9D)	Given a CE threshold of GBP 20,000 per QALY gained, the ICER for the intervention had a 76% probability of CE in the whole sample (GBP 7,445 per QALY gained) and an ICER of GBP 2,492 per QALY gained in girls, but was not cost-effective in boys	100%
Clemes, S. A., et al., 2020 (United Kingdom) <sup>95</sup>	4 month and 30-year time horizons; 3.5% (costs and benefits)	Pound sterling (2016)	Mean METs/day, change in weekday sitting time and QALY gained (EQ-5D-Y)	Given a CE threshold of GBP 30,000 per QALY gained, the study estimated an incremental CE ratio of GBP 78,986 per QALY gained for the intervention over a 30-year time horizon	95%
Ferguson, M. C., et al., 2020 (United States) <sup>78</sup>	Lifetime; 3% (costs and benefits)	US dollars (2016)	Average change in BMI percentile, reduction in cases of overweight and obesity and QALY gained	Changing the Fierce & Fit program to a 12-week program, with two meetings per week and 30 min of PA per session saved a further USD 84,828 in lifetime medical costs, USD 81,365 in lifetime productivity losses and 7.85 QALYs, giving a cost-benefit of USD 95,943	89%
Finster, M.P. & Feldman, J. 2020 (United States) <sup>79</sup>	4 years; not stated	US dollars (not stated)	Average percent point increase in overall wellness (School Health Index) score	The cost per average percent point increase in overall wellness score was USD 336 and USD 256 for the onsite and online interventions, respectively	76%
Huse, O., et al., 2020 (Australia) <sup>112</sup>	Lifetime; 3% (costs and benefits)	Australian dollars (2010)	HALY gained	With a total HALYs gained estimated at 34,260 and the intervention cost an estimated AUD 17.0 M, the policy was said	100%

(Continues)

TABLE 3 (Continued)

Author, year of publication (country)	Study follow-up or decision analytic model time horizon; discounting	Currency unit (Price year)	Measure(s) of consequences	Key/base case results	CHEERS quality score
Mytton, O. T., et al., 2020 (United Kingdom) <sup>96</sup>	Lifetime; 1.5% for first 30 years, 1.3% for the next 45 years, and 1.1% thereafter (benefits)	Pound sterling (2015)	Change in % of children with obesity; DALY averted	to be dominant (cost-saving and health promoting)  CE threshold not stated: if HFSS was either withdrawn or displaced, the number of DALYs avoided would be 120,000 and 35,000, respectively, while the health-related net monetary benefits (millions) would be GBP 7,400 and GBP 2,200, respectively	91%
Oosterhoff, M., et al., 2020 (Netherlands) <sup>115</sup>	Lifetime; 4% and 1.5% (costs and benefits, respectively)	Euros (2018)	QALY gained (meta-analysis)	Given a CE threshold of EUR 20,000 per QALY gained, PAS was dominated and HPSF was the most cost-effective with an ICER of EUR 19,734 per QALY gained	100%
Oosterhoff, M., et al., 2020 (Netherlands) <sup>116</sup>	2 years; 2.5% (costs and benefits)	Euros (2016)	Outcomes expressed in monetary terms (combined across several sectors including healthcare and education)	Per child, investments of EUR 859 and EUR 1,017 generated benefits of EUR 8 and EUR 49 for HPSF and PAS, respectively	100%
Xu, H., et al., 2020 (China) <sup>34</sup>	55 years (ages 10 to 65 years); 3% (costs and benefits)	Renminbi and US dollars (2019)	QALY gained, cases of obesity prevented, and costs averted	Given a CE threshold of USD 5,000 per QALY gained, the ICERs were CNY 10,335.2 (USD 1,478.6) and CNY 4626.3 (USD 661.8) per QALY gain for CNP and NE respectively, compared with PA intervention. Estimates of monetary benefits were CNY 1.2, CNY 0.7, and CNY 0.4 per CNY 1 cost for CNP, NE, and PA interventions, respectively	89%
Corder, K. L., et al., 2021 (United Kingdom) <sup>97</sup>	10 months post-intervention and 10 years; 3.5% (benefits)	Pound sterling (2019)	Change in minutes of MVPA and QALY gained (CHU-9D)	At 10 months, there was a mean decrease of 8.3 min of MVPA in the control group, compared with 10.4 min in the intervention. The intervention cost GBP 13 per student. However, lower QALY gains were estimated for the intervention compared to control.	96%

TABLE 3 (Continued)

Author, year of publication (country)	Study follow-up or decision analytic model time horizon; discounting	Currency unit (Price year)	Measure(s) of consequences	Key/base case results	CHEERS quality score
Jago, R., et al., 2021 (United Kingdom) <sup>198</sup>	12 months of intervention; NA	Pound sterling (2019)	Change in MVPA (minutes per day) and QALY gained (CHU-9D and EQ-5D-Y visual analog scale [VAS])	Conclusions were similar in explanatory modeling (CE threshold GBP 20,000) Given a CE threshold range of GBP 0–100 per minutes of MVPA per day, the probability of CE remained below 20%. There was no strong evidence of between-arm difference for MVPA and QALY. The intervention cost GBP 31/person	100%
Kenney, E. L., et al., 2021 (United States) <sup>80</sup>	10 years (model projection 2020 to 2030); 3% (costs)	US dollars (2019)	Cases of childhood obesity prevented	Making food AD no longer tax-deductible would reach the most children (106 million) and prevent the most cases of obesity (78,700 cases), with net healthcare cost savings	100%
Lonsdale, C., et al., 2021 (Australia) <sup>113</sup>	24 months after intervention allocation; not stated	Australian dollars (2018)	Multistage 20-m shuttle run to assess cardiorespiratory fitness; incremental laps	At 12 months and 24 months respectively, the ICER was AUD 27 and AUD 15 for each additional lap achieved	83%
Reeves, P., et al., 2021 (Australia) <sup>114</sup>	12 months after randomization; NA	Australian dollars (2017/2018)	Compliance of menus with dietary guidelines, mean servings of each food group	The intervention cost AUD 482 more than usual care. Although menu and food group compliance did not improve, there were significant improvements in servings of fruit and discretionary food. CEA suggested a favorable incremental cost per unit increase in compliance score with the web-based intervention	97%
van Schayck, C., et al., 2021 (Netherlands) <sup>117</sup>	4 years post baseline; not stated	Euros (not stated)	Change in BMI z-score	Increased PA and healthy nutrition resulted in a decreased BMI z-score (–0.04); increased PA alone resulted in a decreased BMI z-score (–0.01); BMI z-score increased in control group (0.05). The net societal cost for increased PA and healthy nutrition was EUR 1/child/day	63%

TABLE 3 (Continued)

Author, year of publication (country)	Study follow-up or decision analytic model time horizon; discounting	Currency unit (Price year)	Measure(s) of consequences	Key/base case results	CHEERS quality score
Auerbach, J. D., Fitzhugh, E. C., & Zavisca, E. 2021 (United States) <sup>132</sup>	10 years; not stated	US dollars (2017)	Additional walking time gained (MVPA)	CE threshold not stated: on average, additional thoroughfare connections would provide elementary and middle school students with an additional 37 min of MVPA and 54 min of MVPA, respectively. Compared with bussing, sidewalks saved USD 427 and USD 109,129 for elementary and middle schools, respectively, over 10 years	66%
Brown, A., et al., 2021 (Australia) <sup>133</sup>	10 weeks; NA	Australian dollars (2019)	Reduction in dietary energy (Kilojoules)	Given a CE threshold of AUD 40 per person per unit reduction in lunchbox energy, the probability of CE was 99%. The ICERs per reduction in total kilojoules and discretionary kilojoules from the lunchbox were AUD 0.54 and AUD 0.24	100%
Ekwaru, J. P., et al., 2021 (Canada) <sup>134</sup>	Lifetime; 1.5% (costs)	Canadian dollars (2016)	QALY gained	ICER calculations were insufficiently reported, but a CE threshold of CAD 50,000 per QALY gained was stated. The incremental intervention effects and total costs were given as follows: CSH (0.014 QALY gained and CAD 682); Multicomponent (0.009 QALY gained and CAD 444); and PE curriculum modifications (0.008 QALY gained and CAD 416)	100%
Kuvaja-Köllner, V., et al., 2021 (Finland) <sup>135</sup>	2 years; 3% (costs and benefits)	Euros (2014)	Increase in PA (hours)	Given a CE threshold range of EUR 14–19 per 1-h increase in PA, the intervention had a 95% probability of CE: costs per increased PA hour were EUR 6.21 without and EUR 8.62 with parents' time use, respectively	100%
Sutherland, R., et al., 2021 (Australia) <sup>136</sup>	24 months; not stated	Australian dollars (not stated)	Percent change in the proportion of schools implementing at least	CE threshold not stated: the ICER was estimated to be AUD 25,944 per percent increase in the	88%



TABLE 3 (Continued)

Author, year of publication (country)	Study follow-up or decision analytic model time horizon; discounting	Currency unit (Price year)	Measure(s) of consequences	Key/base case results	CHEERS quality score
Zanganeh, M., et al., 2021 (China) <sup>36</sup>	1 year; NA	Chinese Yuan (Pound sterling/ U.S. dollars) (2016/2017)	four of the seven school PA practices Change in BMI z-score, QALY gained (CHU-9D)	proportion of schools implementing at least four of the seven PA practices Given a CE threshold of GBP 20,000 per QALY gained, the probability of the intervention being cost-effective was at least 96% with an ICER of 8,888 Yuan (GBP 1,760/USD 2,502) per QALY gained (public sector perspective). Per BMI z-score change, the ICER was Yuan 273 (GBP 54/USD 77)	100%
Cobiac, L. J., Law, C., & Scarborough, P. 2022 (United Kingdom) <sup>137</sup>	Lifetime; 3.5% costs and 1.5% benefits (0–30 years) 3% costs and 1.29% benefits (31–75 years) and 2.5% costs and 1.07% benefits (76–125 years)	Pound sterling (2015)	Obesity prevalence and QALY gained	Given a CE threshold of GBP 60,000 per QALY gained, the interventions had positive net monetary benefits, both in combination (GBP 31,400) and individually (SSB tax: GBP 12,100 and TV AD bans: GBP 18,300)	91%
Derwig, M., et al., 2022 (Sweden) <sup>138</sup>	12-month follow-up; NA	Euros (2017)	Change in BMI z-score	CE threshold not stated: ICER was EUR 183 per 0.1 z-BMI unit prevented. In subgroup analysis, change in BMI z-score varied by gender and socioeconomic index	95%
Lane, C., et al., 2022 (Australia) <sup>139</sup>	12 months; NA	Australian dollars (2018)	Additional minute of PA implemented by classroom teachers	CE threshold not stated: the ICER was AUD 29 for an additional minute of weekly PA implemented per school	100%
Lane, C., et al., 2022 (Australia) <sup>140</sup>	12-month follow-up; NA	Australian dollars (2019)	Likelihood of non-inferiority (additional minute of weekly PA), cost savings per school	The study estimated a 96% probability of Adapted PACE being non-inferior to PACE. Relative to PACE, Adapted PACE was associated with cost-savings of USD 373 per school	95%
Mahashabde, R., et al., 2022 (United States) <sup>141</sup>	Not stated; not stated	US dollars (not stated)	Intake of WISE-specific vegetables/fruits captured using an adapted Food Frequency Questionnaire (FFQ), decrease in BMI percentile	CE threshold not stated: the incremental costs for 1 unit reduction in BMI percentile and	55%

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TABLE 3 (Continued)

Author, year of publication (country)	Study follow-up or decision analytic model time horizon; discounting	Currency unit (Price year)	Measure(s) of consequences	Key/base case results	CHEERS quality score
Alcaraz, A., et al., 2023 (Argentina, Brazil, El Salvador, and Trinidad and Tobago) <sup>37,183</sup>	1 year; NA	US dollars (2020)	Cases of obesity and overweight	1-unit FFQ increase were USD 0.23 and USD 0.41, respectively In 2020, 1.5 million cases of overweight and obesity in children (under 18 years of age) were attributable to SSB consumption, and USD 18 million was expended in 1 year on direct medical costs to treat overweight and obesity attributable to SSB consumption in children	86%
Jackson-Morris, A., & Meyer, C. L. 2023 (Mexico, China, Peru) <sup>38</sup>	2025–2090 in Mexico 2025–2092 in China and Peru; not stated	US dollars (not stated)	Years of life lost, reduction in lifetime costs	Years of life lost not reported. Implementing country-specific interventions was estimated to reduce lifetime costs by USD 124 billion (Mexico), USD 14 billion (Peru), and USD 2 trillion (China)	52%
Mahdi, S., et al., 2023 (United Kingdom) <sup>142</sup>	3 months; NA	Pound sterling (2019/2020)	QALY gained (CHU-9D)	Mean reduction reductions between groups were reported for in QALYs (–0.004); healthcare costs (GBP -30.77) and workplace productivity losses (GBP -64.24)	100%

Abbreviations: ACE, the assessing cost-effectiveness in obesity study; AD, advertisement/advertising; APPLE, A Pilot Programme for Lifestyle and Exercise; APPLE, Alberta Project Promoting active Living and healthy Eating; ASP, after-school program; BAEW, Be Active Eat Well; BMI, body mass index; CATCH, Coordinated Approach to Child Health; CATCH, The Child and Adolescent Trial for Cardiovascular Health; CBA, cost-benefit analysis; CCA, cost-consequences analysis; CE, cost-effectiveness; CEA, cost-effectiveness analysis; CHOICES, Childhood Obesity Intervention Cost Effectiveness Study; CHU-9D, Child Health Utility 9Dimension; CUA, cost-utility analysis; DALY, disability-adjusted life year; DAM, decision analytic model; ECE, early care and education; GP, General practitioner; HALY, Health-adjusted life years; HFSS, high in fat, sugar, and salt; HPSF, Healthy Primary School of the Future; HUI, Health Utilities Index; ICER, incremental cost-effectiveness ratio; LMIC, lower middle-income country; MET, metabolic equivalent; MPA, moderate physical activity; MVPA, moderate to vigorous physical activity; NA, not applicable; NE, nutrition education; NHANES, National Health and Nutrition Examination Survey; NHS, National Health Service; PA, physical activity; PA4E1, Physical Activity 4 Everyone; PE, physical education; PLAN-A, school-based peer-led PA intervention; QALY, quality adjusted life year; RCT, randomized controlled trial; SES, socioeconomic status; SPARK, The Sports, Play, and Active Recreation for Kids trial; SSB, sugar-sweetened beverage; TV, television; WC, waist circumference; WHtR, waist-to-height ratio; WTP, willingness to pay.

**TABLE 4** Descriptive analysis of the key assessment items for individual studies targeting only treatment.

Author, year of publication (country)	Intervention(s) and comparator(s)	Intervention category: components and targets (setting)	Target population (age/age range)	Type of economic evaluation; study design; study perspective
Goldfield, G., et al., 2001 (United States) <sup>143</sup>	Mixed group treatment (group and individualized) versus group treatment only	Behavioral; diet, PA, and self-monitoring (family-based)	Children with obesity and their families (8 to 12 years old)	CCA; within-trial economic evaluation; not stated
Raynor, H. A., et al., 2002 (United States) <sup>144</sup>	20-week intervention: group and individual versus group sessions	Behavioral; diet (family-based)	Children with obesity and their families (8 to 12 years old)	CCA; within-trial economic evaluation; not stated
Moodie, M., et al., 2008 (Australia) <sup>145</sup>	The LEAP trial: involved GP consultations at home versus "no intervention"	Behavioral; diet, PA, and GP consultations (family-based and GP-mediated)	Children with overweight and moderate obesity (5 to 9 years old)	CUA; DAM (Markov model adapted from the ACE model) modeled on an RCT; societal
Wake, M., et al., 2008 (Australia) <sup>146</sup>	The LEAP trial: involved GP consultations at home versus "no intervention"	Behavioral; diet, PA, and GP consultations (family-based and GP-mediated)	Children with overweight and moderate obesity (5 to 9 years old)	CCA; within-trial economic evaluation; societal
Janicke, D. M., et al., 2009 (United States) <sup>147</sup>	Parent-only intervention versus family-based intervention	Behavioral; diet and PA (rural community setting, family-based)	Children with overweight or obesity and their parents (8 to 14 years old)	CEA; within-trial economic evaluation; service provider
Kalavainen, M., et al., 2009 (Finland) <sup>148</sup>	Family-based group treatment (15 separate sessions for parents and children) versus routine counseling (two appointments for children)	Behavioral; diet and PA (primary healthcare)	Children with obesity (7 to 9 years old)	CEA; within-trial economic evaluation; service provider
Wake, M., et al., 2009 (Australia) <sup>149</sup>	LEAP2: primary care screening followed by consultations (brief counseling), alongside family materials versus control	Behavioral; diet, PA, and primary care screening followed by brief counseling (clinic-based)	Children with overweight or mild obesity (5 to 10 years old)	CCA; within-trial economic evaluation; health sector
Ananthapavan, J., et al., 2010 (Australia) <sup>150</sup>	Laparoscopic adjustable gastric banding versus no surgery	Surgical; bariatric surgery (clinic-based)	Adolescents with severe obesity (15 to 19 years old)	CUA; DAM (cohort multi-state transition model; the ACE-Obesity study) based on a case series of 28 adolescents; societal
Nowicka, P., et al., 2010 (United States) <sup>151</sup>	BB: an intensive program versus a control group that received traditional clinical weight management counseling	Behavioral; diet and PA (home- and family-based)	Children with overweight (8 to 16 years old)	CBA, CEA, CUA; within-trial economic evaluation; societal
Wang, L. Y., et al., 2010 (cost-consequences analysis) <sup>152</sup>	Hypothetical intervention: 1%-point decrease in the number of adolescents with excess weight	NA; NA (population-wide)	Adolescents with overweight and obesity (16 to 17 years old)	CCA; DAM (BMI progression model estimating consequences of body weight reduction scenarios); healthcare perspective
Hollingsworth, W., et al., 2012 (United Kingdom) <sup>153</sup>	Lifestyle interventions (identified in literature review of 10 RCTs) to treat childhood excess weight versus no intervention	Behavioral; diet and PA (hospital- and community-based)	Children with overweight or obesity in state schools (4 to 5 and 10 to 11 years old)	CEA; DAM (the National Heart Forum "Obesity Model") and literature review of RCTs; NHS
Robertson, W., et al., 2012 (United Kingdom) <sup>154</sup>	"Families for Health": a 12-week manualized program involving a	Behavioral; healthy eating, PA, information on parenting skills,	Children with overweight or obesity (7 to 13 years old)	CEA; pilot study (report of the 2-year follow up results, with economic evaluation); not stated

(Continues)

TABLE 4 (Continued)

Author, year of publication (country)	Intervention(s) and comparator(s)	Intervention category: components and targets (setting)	Target population (age/age range)	Type of economic evaluation; study design; study perspective
Epstein, L. H., et al., 2014 (United States) <sup>155</sup>	2.5-h session each week: a "before-and-after" evaluation Two assumptions of parent/child treated separately (PC); PC-1 (parent and child treated on separate days) and PC-2 (parent and child treated on same days) versus family-based (FBT) obesity treatment	social and emotional development (community-, family-based) Behavioral; diet and PA (clinic- and family-based)	Children at or above the 85th BMI percentile and had a parent with excess weight (8 to 12 years old)	CEA; within-trial economic evaluation; payer and societal
Hollinghurst, S., et al., 2014 (United Kingdom) <sup>156</sup>	Mandometer® training versus Primary Care-Care of Childhood Obesity (PC-COCO) clinic	Behavioral; diet, PA and Mandometer® training (primary care, home, and clinic-based)	The PC-COCO study - children with BMI $\geq$ 98th centile (5 and 16 years old); the Mandometer® study - children with BMI $>$ 95th centile (9 to 17 years old)	CEA; within-trial economic evaluation (based on two trials - the PC-COCO study and the Mandometer® study); healthcare funder
Law, C., et al., 2014 (United Kingdom) <sup>157</sup>	Mind, Exercise, Nutrition, Do it! (MEND) program versus control	Behavioral; diet, PA, and mental wellbeing (family-based)	Adolescents with overweight/obesity (7 to 13 years old)	CCA; within-trial economic evaluation; NHS and Personal Social Services
Li, L. 2014 (United States) <sup>158</sup>	LAGB and RYGB versus no obesity treatment	Surgical; bariatric surgery (clinic-based)	Children with severe obesity in the United States (13 to 19 years old)	CUA; DAM (Markov model); societal
Bairdain, S., & Samnaliev, M. 2015 (United States) <sup>159</sup>	RYGB no surgery	Surgical; bariatric surgery (clinic-based)	Adolescents with obesity (mean age 17.3 years old)	CUA; DAM (Markov model) based on results of an RCT; payer
Kass, A. E. 2015 (United States) <sup>160</sup>	A family-based social facilitation weight loss maintenance intervention delivered at high intensity ("SFM-High") versus standard of care	Behavioral, policy; diet, PA, and screening - parent-child dyads (multi-setting: primary care-, community-, school-based)	Children with overweight, obesity and severe obesity (mean age $\sim$ 9.5 years old)	CEA; DAM (insufficient information - long term economic modeling of an RCT); not stated
Klebanoff M. J., et al., 2017 (United States) <sup>161</sup>	Bariatric surgery (RYGB and SG modeled as a single cohort) versus no surgery	Surgical; bariatric surgery (clinic-based)	Adolescents with severe obesity (mean age 17 years old)	CUA; DAM (state-transition model); healthcare provider
Larsen, K. T., et al., 2017 (Denmark) <sup>162</sup>	Camp group (CG), a six-week high-intensity day-camp intervention versus Standard group (SG), a six-week low-intensity intervention	Behavioral; PA - motivation-enhancing PA and health education (family-based, municipal setting)	Fifth-grade children with overweight and obesity (mean age of 12 years old)	CEA; RCT alongside an economic evaluation; local government (municipality)
Makkes, S., et al., 2017 (Netherlands) <sup>163</sup>	Two intensive 1-year lifestyle treatment interventions consisting of either an inpatient period of 2 months (short-stay group) or 6 months (long-stay group)	Behavioral; diet, PA, and active participation of the parents/caregivers (clinical setting; specialized childhood obesity center)	Children with severe obesity (8 to 19 years old)	CEA, CUA; RCT alongside an economic evaluation; societal
Quattrin, T., et al., 2017 (United States) <sup>164</sup>	Family-based behavioral treatment (FBT) and an attention-controlled information control (IC) group	Behavioral; diet and PA - parent and child-focused (family-based and clinical setting)	Children with overweight and obesity (BMI over the 85th percentile for their age and sex) with their parents (BMI $\geq$ 25) (2 to 5 years old)	CEA; RCT alongside an economic evaluation; societal

TABLE 4 (Continued)

Author, year of publication (country)	Intervention(s) and comparator(s)	Intervention category: components and targets (setting)	Target population (age/age range)	Type of economic evaluation; study design; study perspective
Robertson, W., et al. 2017 (United Kingdom) <sup>165</sup>	"Families for Health," a 10-week family-based childhood obesity treatment intervention versus usual care	Behavioral; diet, PA, parenting skills, and relationship skills (family and community-based)	Children with overweight or obesity and their parents or carers (6 to 11 years old)	CUA; RCT alongside an economic evaluation; NHS and Personal Social Services
Saelens, B. E., et al., 2017 (United States) <sup>166</sup>	Professional-delivered versus Peer-delivered (previously treated parents) Pediatric Weight Management Treatment	Behavioral; diet, and PA (family-based)	Children with overweight or obesity and their parents (7 to 11 years old)	CEA; economic evaluation based on the costing of two pilot trials (the Engaging Parents in Child Health [EPICH] and Parent Partnership trials); Payer
Sharifi, M., et al., 2017 (United States) <sup>167</sup>	Study of Technology to Accelerate Research (STAR) intervention versus usual care	Behavioral, policy; diet, PA - electronic health record (EHR)-based decision support for primary care providers, and self-guided behavior-change support for parents (clinic-based)	Children with obesity (6 to 12 years old)	CEA; DAM (the CHOICES microsimulation model was used to project the effect of implementing the STAR trial nationally) based on a trial: modified societal
Anderson, Y. C., et al. 2018 (New Zealand) <sup>168</sup>	Two home-based multi-disciplinary child obesity intervention programs (high-intensity and low-intensity) versus conventional hospital-based care	Behavioral; multi-disciplinary assessment and advice to promote healthy diet and PA choices (home-, community-, and hospital-based care)	Children with BMI $\geq$ 98th centile or BMI $>$ 91st centile with weight-related comorbidities (treatment arms 5 to 16 years old; comparator arm 4 to 15 years old)	CEA; trial-based economic evaluation; health funder
Panca, M., et al., 2018 (England) <sup>169</sup>	HELP: a weight management program for adolescents versus enhanced standard care	Behavioral; motivational, multicomponent lifestyle (diet and PA) modification intervention (family- and community-based)	Young people with obesity (12 to 18 years old)	CUA; trial-based economic evaluation; NHS
Panca, M., et al., 2018 (United Kingdom) <sup>170</sup>	Bariatric surgery: RYGB and SG versus no surgery	Surgical; bariatric surgery (clinic-based)	Adolescents with BMI $>$ 40 kg/m <sup>2</sup> (mean age for RYGB and SG 17.8 and 18.7 years respectively)	CUA; DAM (Markov cohort model used to estimate the long-term health economic consequences based on data collected from 18 adolescents who underwent bariatric surgery); NHS
Vidmar, A. P., et al., 2019 (United States) <sup>171</sup>	iPhone® app intervention with clinic visits that targeted addictive eating behavior versus the Children's Hospital Los Angeles multi-disciplinary weight management clinic (EMPOWER) intervention consisting of a team of healthcare professionals who evaluated patients	Behavioral, environmental; App-based mobile health technology (m-Health) and clinical evaluation-based (clinic- and home-based)	Adolescents with obesity without significant obesity comorbidities but exhibiting signs of addictive eating (12 to 18 years old)	CEA; economic evaluation alongside a pilot study; provider
Bandurska, E., et al., 2020 (Poland) <sup>172</sup>	A 12-month multidisciplinary obesity management comprising screening for overweight, specialist care,	Behavioral, environmental; diet, PA, and psychological support (clinic- and community based)	Children with overweight or obesity (6 to 15 years old)	CEA; economic evaluation based on a longitudinal intervention study

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TABLE 4 (Continued)

Author, year of publication (country)	Intervention(s) and comparator(s)	Intervention category: components and targets (setting)	Target population (age/age range)	Type of economic evaluation; study design; study perspective
Lier, L., et al., 2020 (Germany) <sup>173</sup>	parental education, and specialist consultation versus no intervention The Children's Health Interventional Trial (CHILT) intervention: weekly medical consultations, nutritional or psychological therapy sessions and exercise sessions	Behavioral; diet and PA (family-based)	Children with obesity (8 to 16 years old)	where a cohort was followed (insufficient information); not stated CEA/return on investment; DAM (insufficient information); healthcare and societal
Viner, R. M., et al., 2020 (United Kingdom) <sup>174</sup>	HELP: a weight management program for adolescents versus enhanced standard care	Behavioral; motivational, multicomponent lifestyle (diet and PA) modification intervention (family- and community-based)	Children with obesity (12 to 18 years old)	CUA; economic evaluation alongside an RCT; NHS
Woolford, S. J., et al., 2022 (United States) <sup>175</sup>	Motivational interviewing for parents of children with excess weight versus usual care	Behavioral; motivational interviewing (by telephone or in-person visits) - primary care practitioner and registered dietitian (clinical setting, family-based)	Parent-child dyads: children with baseline BMI between the 85th-97th percentiles (2 to 8 years old)	CEA; trial-based economic evaluation; societal
Zoellner, J. M., et al., 2022 (United States) <sup>176</sup>	iChoose (high intensity, parent-child dyads) versus Family Connections (low intensity, parents only)	Behavioral; nutrition education, physical activity, behavior modification techniques (community- and family-based)	Parent-child dyads: children with overweight: BMI 85th - < 95th percentile and obesity: BMI ≥ 95th percentile (mean age ~10 years old)	CEA; trial-based economic evaluation; Provider/payer (community program implementation perspective)
Carrello, J., et al., 2023 (Australia) <sup>177</sup>	Hypothetical e-health intervention versus "do nothing" approach	Behavioral; diet and PA (multiple settings possible)	Children with overweight and obesity (14/15 years old)	CUA; DAM (the Early Prevention of Obesity in Childhood [EPOCH] microsimulation model); healthcare system
Omorou, A. Y., et al., 2023 (France) <sup>179</sup>	Screening for overweight and obesity in schools and subsequent care versus usual care	Policy and behavioral; screening by school nurse, group care management - 7 × 1.5 h sessions (if overweight or obesity identified) - diet and PA (school-based)	Children with overweight and obesity (14 to 18 years old: mean age 15.6 years)	CEA; trial-based economic evaluation; public (public payer)
Pryor, S., et al., 2023 (United States) <sup>178,233</sup>	Bright Bodies intervention (high-intensity weight management program) versus traditional clinical weight management	Behavioral; diet and PA (home- and family-based)	Children and adolescents with obesity: BMI > = 95th percentile (8 to 16 years old)	CEA; DAM (microsimulation model based on data from randomized controlled trial); healthcare system
Siegel, R., et al., 2023 (United States) <sup>180</sup>	Two interventions: (1) Loss-framed incentives; and (2) gain-framed incentives versus control	Behavioral; financial incentives/disincentives (home- and community-based)	Children with obesity (12 to 18 years old)	CEA; DAM (decision tree); not stated

Abbreviations: ACE, the assessing cost-effectiveness in obesity study; BB, Bright Bodies; BMI, body mass index; CCA, cost-consequences analysis; CE, cost-effectiveness; CEA, cost-effectiveness analysis; CHOICES, Childhood Obesity Intervention Cost Effectiveness Study; CUA, cost-utility analysis; DALY, disability-adjusted life year; DAM, decision analytic model; EQ-5D-Y, EuroQol 5Dimension Youth version; GP, General practitioner; HELP, Healthy Eating and Lifestyle Programme; ICER, incremental cost-effectiveness ratio; LAGB, Laparoscopic adjustable gastric banding; LEAP, the live, eat, and play trial; NA, not applicable; NHS, National Health Service; PA, physical activity; QALY, quality-adjusted life year; RCT, randomized controlled trial; RYGB, laparoscopic Roux-en-Y gastric bypass; SG, laparoscopic sleeve gastrectomy.



TABLE 4 (Continued)

Author, year of publication (country)	Study follow-up or decision analytic model time horizon; discounting	Currency unit (Price year)	Measure(s) of consequences	Key/base case results	CHEERS quality score
Goldfield, G., et al., 2001 (United States) <sup>143</sup>	1 year; NA	US dollars (not stated)	Change in BMI z-score or change in percent overweight	Both groups showed similarity in weight control results, but group treatment was less expensive (USD 1,390 versus USD 491)	79%
Raynor, H. A., et al., 2002 (United States) <sup>144</sup>	12 months after baseline; NA	US dollars (not stated)	Change in BMI, change in energy intake and serving intake	The study found significant decreases in percent of overweight for children and parents in both groups but no significant difference in effects or cost per 1,000 kcal was observed between the two groups	71%
Moodie, M., et al., 2008 (Australia) <sup>145</sup>	Lifetime (9-month follow-up of LEAP trial); 3% (costs and benefits)	Australian dollars (2001)	DALY saved	Given a CE threshold of AUD 50,000 per DALY saved, the probability of CE was 79.8% (net cost per DALY saved of AUD 4,670)	96%
Wake, M., et al., 2008 (Australia) <sup>146</sup>	15 months after randomization; NA	Australian dollars (2003)	Children's change in BMI, PA, and dietary habits	The intervention incurred higher costs but improvements in BMI and PA did not differ between groups at 15 months follow-up. Dietary habits improved in the intervention arm	92%
Janicke, D. M., et al., 2009 (United States) <sup>147</sup>	10-month follow-up after randomization; NA	US dollars (not stated)	BMI unit reduction	Change in weight status between groups not significantly different but parent-only intervention was USD 521 compared to USD 872 for family intervention	79%
Kalavainen, M., et al., 2009 (Finland) <sup>148</sup>	12 months post baseline; NA	Euros (2004)	reduction in BMI z-score	The study estimated an additional cost of EUR 266 for a 0.1 reduction in BMI z-score for the family-based group compared with routine counseling	97%
Wake, M., et al., 2009 (Australia) <sup>149</sup>	12 months after randomization; NA	Australian dollars (2007)	Change in BMI, PA in counts/minute, nutrition score	The intervention failed to significantly improve BMI, PA, or nutrition, despite being more expensive (AUD 1,317 per child versus AUD 81 per child for control)	97%
Ananthapavan, J., et al., 2010 (Australia) <sup>150</sup>	Lifetime; 3% (costs and benefits)	Australian dollars (2001)	Change in BMI, DALY saved	Given a CE threshold of AUD 50,000 per DALY saved, a net cost per DALY saved of AUD 4,400 was estimated for the intervention	100%

TABLE 4 (Continued)

Author, year of publication (country)	Study follow-up or decision analytic model time horizon; discounting	Currency unit (Price year)	Measure(s) of consequences	Key/base case results	CHEERS quality score
Nowicka, P., et al., 2010 (United States) <sup>151</sup>	Not stated; not stated	US dollars (not stated)	QALY saved, adult obesity averted	Given a CE threshold of USD 30,000 per QALY saved, the ICERs for the BB intervention compared with control were USD 2,511 per QALY saved and USD 1,506 per adult obesity averted. The net benefit was USD -2,785, but control had a significantly larger negative net benefit	43%
Wang, L. Y., et al., 2010 (cost-consequences analysis) <sup>152</sup>	Lifetime; 3% (costs and benefits)	US dollars (2007)	QALY gained	In the least favourable scenario, a 1%-point reduction in adolescents with overweight/obesity would reduce medical costs by USD 463 million and increase QALYs by 34,394	93%
Hollingsworth, W., et al., 2012 (United Kingdom) <sup>153</sup>	Lifetime; 3.5% (costs and benefits)	Pound sterling (not stated)	Life year gained	For children aged 10 to 11 years, the discounted cost per life year gained was estimated at GBP 13,589. Similar results are reported for children aged 4 to 5 years	91%
Robertson, W., et al., 2012 (United Kingdom) <sup>154</sup>	2 years after the start of the intervention; not stated	Pound sterling (2006)	Change in BMI z-score	The analysis demonstrated a cost of GBP 2,543 per unit reduction in BMI z-score	75%
Epstein, L. H., et al., 2014 (United States) <sup>155</sup>	1 year from baseline; NA	US dollars (2013)	Unit of weight loss (defined in children as percent over BMI (%OBMI))	In children, the cost-effectiveness for FBT was USD 209.17/% over BMI, compared to USD 1,036.50/% over BMI for PC-1 and USD 973.98/% over BMI for PC-2. Similarly, FBT was cheaper per unit of weight loss for parent compared to separate treatment	87%
Hollinghurst, S., et al., 2014 (United Kingdom) <sup>156</sup>	1 year from baseline; NA	Pound sterling (not stated)	Reduction in BMI z-score	Given a CE threshold range of GBP 0–2,000 per 0.1-point improvement in BMI z-score, the PC-COCO clinic was the preferred choice until GBP 600. Beyond GBP 600, Mandometer® was most likely to be cost effective	92%
Law, C., et al., 2014 (United Kingdom) <sup>157</sup>	10-week follow-up; NA	Pound sterling (2010/2011)	Change in BMI	Participant BMI decreased by, on average, 0.76 kg/m <sup>2</sup> over the 10-week follow-up, at a cost of GBP 773 per completer	92%

TABLE 4 (Continued)

Author, year of publication (country)	Study follow-up or decision analytic model time horizon; discounting	Currency unit (Price year)	Measure(s) of consequences	Key/base case results	CHEERS quality score
Li, L. 2014 (United States) <sup>158</sup>	Lifetime; 3% (costs and benefits)	US dollars (2012)	QALY gained	Given a CE threshold of USD 30,000 per QALY, the costs per QALY gained were USD 3,379 and USD 5,192 for LAGB and RYGB, respectively, compared with no treatment	87%
Bairdain, S., & Samnaliev, M. 2015 (United States) <sup>159</sup>	3 and 7 years from the age of 18 years; 3% (costs and benefits)	US dollars (2013)	Unit change in BMI and QALY gained (EQ-5D)	Given a CE threshold of USD 100,000 per QALY gained, bariatric surgery was not cost-effective in the first 3 years. By year 7 post-operation, bariatric surgery was deemed to be cost-effective at USD 36,570 per QALY gained	96%
Kass, A. E. 2015 (United States) <sup>160</sup>	Lifetime; not stated	US dollars (not stated)	Life year gained	Compared to standard of care, the ICER for treating children with SFM-High was USD 17,877 per life year gained	48%
Klebanoff M. J., et al., 2017 (United States) <sup>161</sup>	3 (base case), 4 and 5 years; 3% (costs and benefits)	US dollars (2015)	QALY gained	Given a CE threshold of USD 100,000 per QALY saved, at 3 years USD 154,684 per QALY (surgery dominated); at 5 years USD 91,032 per QALY	87%
Larsen, K. T., et al., 2017 (Denmark) <sup>162</sup>	Two years follow-up; NA	Danish crowns (2012)	Changes in BMI and BMI z-score	The ICER was DDK 149,669 per unit decrease in BMI z-score for CG compared with SG (CG was costlier but also more effective)	87%
Makkes, S., et al., 2017 (Netherlands) <sup>163</sup>	1 year of treatment and 1 year of follow-up; 4% and 1.5% (costs and benefits, respectively)	Euros (2010)	BMI z-scores and QALY gained (EQ-5D)	The difference in BMI z-score and QALYs between both groups after 24 months was statistically insignificant. Short stay was significantly less expensive	100%
Quattrin, T., et al., 2017 (United States) <sup>164</sup>	1 year of treatment and 1 year of follow-up; NA	US dollars (2013)	Percent over BMI (%OBMI) change (overweight or underweight relative to the 50th percentile BMI reference standard) and changes in BMI	The FBT ICER compared to IC was USD 116.1 per unit reduction in % OBMI for children and parents, the ICER was USD 353.8 per kilogram reduction in weight	100%
Robertson, W., et al. 2017 (United Kingdom) <sup>165</sup>	1 year post randomization; NA	Pound sterling (2013/2014)	Change in BMI z-score and QALY gained (EQ-5D-Y)	Given a CE threshold of GBP 30,000 per QALY, the ICER for the "Families for Health" program was estimated at GBP 552,175 per QALY gained	100%

TABLE 4 (Continued)

Author, year of publication (country)	Study follow-up or decision analytic model time horizon; discounting	Currency unit (Price year)	Measure(s) of consequences	Key/base case results	CHEERS quality score
Saelens, B. E., et al., 2017 (United States) <sup>166</sup>	1 year after treatment ended; NA	US dollars (2015)	BMI change	Similar decreases in in child z-BMI were observed in both groups but costs were significantly lower for peer compared to professional delivery	89%
Sharifi, M., et al., 2017 (United States) <sup>167</sup>	10 years (model projection 2015–2025); 3% (costs)	US dollars (2014)	BMI reduction, cases of obesity averted, and life-year saved	The intervention cost USD 237 per BMI unit reduced. If maintenance of effect was assumed, at 10 years, USD 774 per life-year saved was estimated	100%
Anderson, Y. C., et al. 2018 (New Zealand) <sup>168</sup>	12 months from baseline; NA	New Zealand dollars (2016)	BMI z-score	The low-intensity group was NZD 939 lower than the conventional group. In the high-intensity intervention group, it was NZD 155. Both low- and high-intensity groups had mean BMI z-score reductions of 0.03 more than the conventional group	97%
Panca, M., et al., 2018 (England) <sup>169</sup>	Treatment ended at 6 months and follow-up for another 6 months; NA	Pound sterling (2013/2014)	QALY gained (EQ-5D-3L)	Given a CE threshold of GBP 30,000 per QALY, the ICER was GBP 120,630 per QALY gained and there were no differences in adjusted QALYs between both groups	100%
Panca, M., et al., 2018 (United Kingdom) <sup>170</sup>	Lifetime; 3.5% (costs and benefits)	Pound sterling (2013/2014)	QALY gained	Given a CE threshold of GBP 30,000 per QALY, the ICER for males and females, respectively, were GBP 2,018 and GBP 2,005 (RYGB); and GBP 1,978 and GBP 1,941 (SG)	100%
Vidmar, A. P., et al., 2019 (United States) <sup>171</sup>	6 months post-baseline; NA	US dollars (not stated)	Mean change in BMI z-score and excess percent over the 95th percentile (%BMIp95)	The app intervention had a lower cost than the EMPOWER clinic intervention (USD 855.15 vs. USD 1,428.00). EMPOWER completers demonstrated comparable decreases in BMI z-scores and %BMIp95 6 months after baseline	100%
Bandurska, E., et al., 2020 (Poland) <sup>172</sup>	7 years; not stated	Polish zloty and Euros (not stated)	Child removed from overweight or obesity	The costs of removing a child from the overweight group and obese group were PLN 27,758 (EUR 6,463) and PLN 23,601 (EUR 5,495), respectively	74%

TABLE 4 (Continued)

Author, year of publication (country)	Study follow-up or decision analytic model time horizon; discounting	Currency unit (Price year)	Measure(s) of consequences	Key/base case results	CHEERS quality score
Lier, L., et al., 2020 (Germany) <sup>173</sup>	11-month intervention, 10-year cost saving projection; 3% (costs)	Euros (not stated)	Change in BMI z-score	Participant BMI z-score decreased by, on average, 0.19-units. Future cost savings were estimated to be between EUR 1,859 - EUR 1,926 per participant, equating to a return on investment of 3.3–7.0%	91%
Viner, R. M., et al., 2020 (United Kingdom) <sup>174</sup>	1 year follow-up; NA	Pound sterling (2013/2014)	QALY gained (EQ-5D-3L)	There were no differences in QALY outcomes or resource use between the HELP intervention and control during follow-up, but HELP incurred an excess intervention cost of GBP 850	95%
Woolford, S. J., et al., 2022 (United States) <sup>175</sup>	2-year follow-up; not stated (acknowledged but not applied)	US dollars (2019)	BMI percentile point change	Given a CE threshold of roughly USD 400 per BMI percentile point decrease, the probability of CE was roughly 50%. The ICER was USD 363 per BMI percentile point decrease per participant over 2 years	98%
Zoellner, J. M., et al., 2022 (United States) <sup>176</sup>	6 months; NA	US dollars (not stated)	Change in BMI z-score	BMI z-score changes were statistically insignificant within both groups. Implementation costs per child with improved BMI z-score were USD 2841 and USD 955 for iChoose and Family Connections, respectively	92%
Carrello, J., et al., 2023 (Australia) <sup>177</sup>	Lifetime; 5% (costs and benefits)	Australian dollars (2019)	QALY gained (meta-analysis)	Given a CE threshold of AUD 50,000 per QALY gained, a 96% probability of CE was estimated	100%
Omorou, A. Y., et al., 2023 (France) <sup>179</sup>	2 academic years; not stated (acknowledged but not applied)	Euros (2021)	Averted case of overweight/obesity, BMI unit decrease, and increase in MPA	The screening and care strategy resulted in ICERs of EUR 1634.48 per averted case of overweight and obesity, EUR 255.43 per kg/m <sup>2</sup> decrease per screened adolescent, and EUR 165.28 per 1,000 MET. Minute/week increase per screened adolescent	93%
Pryor, S., et al., 2023 (United States) <sup>178,233</sup>	10 years (24 months trial follow-up); 3% (costs)	US dollars (2020)	BMI unit reduction	In the base case analysis (assuming depreciating effects post-intervention), Bright Bodies reduced	100%

(Continues)

TABLE 4 (Continued)

Author, year of publication (country)	Study follow-up or decision analytic model time horizon; discounting	Currency unit (Price year)	Measure(s) of consequences	Key/base case results	CHEERS quality score
Siegel, R., et al., 2023 (United States) <sup>180</sup>	6 months; NA	US dollars (not stated)	Incremental adherence index point (adherence to the weight management program)	a participant's BMI by 1.67 kg/m <sup>2</sup> per year over ten years compared with control. Bright Bodies was associated with an additional cost of USD 360/person, and cost-savings USD 1,126 per person over 10 years  The ICERs for the gain group and the loss group were USD 5.73 and USD 3.38 per incremental adherence point, respectively	93%

Abbreviations: ACE, the assessing cost-effectiveness in obesity study; BB, Bright Bodies; BMI, body mass index; CCA, cost-consequences analysis; CE, cost-effectiveness; CEA, cost-effectiveness analysis; CHOICES, Childhood Obesity Intervention Cost Effectiveness Study; CUA, cost-utility analysis; DALY, disability-adjusted life year; DAM, decision analytic model; EQ-5D-Y, EuroQol 5Dimension Youth version; GP, General practitioner; HELP, Healthy Eating and Lifestyle Programme; ICER, incremental cost-effectiveness ratio; LAGB, Laparoscopic adjustable gastric banding; LEAP, the live, eat, and play trial; NA, not applicable; NHS, National Health Service; PA, physical activity; QALY, quality-adjusted life year; RCT, randomized controlled trial; RYGB, laparoscopic Roux-en-Y gastric bypass; SG, laparoscopic sleeve gastrectomy.

practices,<sup>136</sup> or a change in overall wellness (School Health Index) score,<sup>79</sup> respectively.

For trial-based studies, health consequences were typically measured at specified time intervals from baseline to follow-up. Some studies measured parental outcomes utilizing the EuroQol 5Dimension (EQ-5D)<sup>46</sup> and the 15D.<sup>40</sup> One study collected separate child and parent-proxy measures using the EuroQol 5Dimension Youth version (EQ-5D-Y) and the parent's health-related quality of life using the EQ-5D.<sup>165</sup> A study that reported both EQ-5D-Y scores and weekday MVPA found no evidence of an association between the two measures of consequences.<sup>93</sup> Another study assessed children's health-related quality of life with the Health Utilities Index (HUI) Mark 2 using parents as proxies.<sup>122</sup> The choice of valuation protocol for calculating utility values at each trial measurement time point depended on the applied instrument. For instance, given the unavailability of a pediatric-specific Dutch utility tariff, Makkes et al.<sup>163</sup> applied a Dutch population value set to the EQ-5D measures and expressed concerns about the potential insensitivity of the instrument. Panca et al.<sup>169</sup> also assessed health-related quality of life in children using the EQ-5D and applied a valuation protocol for the UK population. In trials that used the Child Health Utility 9Dimension (CHU-9D), the measure was administered as a self-reported instrument,<sup>33,36,89–91,94,97,142</sup> and the valuation protocol for a childhood population was applied, as the CHU-9D is validated in children aged 7 to 11 years.<sup>186</sup>

Decision analytic models tended to derive health consequences from multiple sources. Some studies applied utility values obtained from meta-analyses to categorical childhood weight status (healthy weight, overweight, and obesity).<sup>43,50,115,177</sup> Other model-based studies with time horizons extending into adulthood applied utility decrements derived for excess weight in adult populations to childhood cohorts.<sup>128</sup> Alternatively, a health state utility value of 1 was assigned to childhood cohorts; that is, children were assumed to be in perfect health, regardless of their weight status.<sup>30,51,52</sup> Treatment effects often derived from longitudinal studies and applied to childhood BMI trajectories or transition probabilities determined the distribution of children in each weight classification over time. Upon progressing into adulthood, cohorts or individuals transitioned into a disease-free healthy weight state or excess weight-related disease states (e.g., cardiovascular diseases and cancers) with associated utility decrements. Where proxy measures such as MVPA were considered instead of weight status, a similar modeling approach was adopted: Children progressed through the model with varying levels of physical activity determined by intervention effectiveness and subsequently transitioned into the appropriate disease-free or chronic disease states.<sup>41</sup> At the end of the model time horizon, total preference-based health-related quality-of-life outcomes were estimated for intervention and comparator cohorts.

### 3.2.3 | Analytical methods, assumptions, and sensitivity analyses

Trial-based studies (economic evaluations conducted alongside randomized controlled trials) were the predominant study design solely



in the treatment-only group of interventions.<sup>143,144,146–149,151,155–157,162–165,168,169,174–176,179</sup> Most trial-based studies performed regression analysis with total costs and QALY outcomes as dependent variables and the intervention group as the independent variable. Some studies reported similar demographic and baseline characteristics between intervention and control groups.<sup>39,45</sup> Others included covariates (e.g., baseline measures of consequences, clustering effect, age, gender, and socioeconomic status) to adjust for between-group differences.<sup>46,54,122,138</sup> Sensitivity analyses included complete case analysis and intention-to-treat analysis.<sup>40,90,142,164,169</sup>

Decision analytic modeling<sup>187</sup> was the most frequently applied study design for conducting economic evaluations of interventions targeting childhood excess weight.<sup>30,31,34,35,37,38,41–44,47,49–52,55,56,60–65,67–70,73,75–78,80,82,88,96,97,99–103,106,107,109–112,115,119,123,126–128,130–132,134,137,145,150,152,153,158–161,167,170,177,178,180</sup> Decision analytic models typically consisted of decision trees,<sup>51,52,68</sup> state-transition or Markov models<sup>41,42,47,60,61,69,73,99,106,110–112,123,128,137,145,150,158,159,170</sup> (the prevailing method in this design category), and simulation approaches (individual-level, discrete-time, and discrete-event simulations).<sup>30,31,43,49,50,55,67,76,77,80,130,134,167,177,178</sup> Key sensitivity analysis methods in decision-analytic modeling included deterministic sensitivity analysis and scenario analysis testing various parameter and structural assumptions. Probabilistic sensitivity analysis<sup>188</sup> was frequently used to characterize the uncertainty of cost-effectiveness estimates in both decision-analytic modeling and trial-based studies. Cost-effectiveness acceptability curves (CEACs),<sup>189</sup> essential for depicting the probability of cost-effectiveness over a range of cost-effectiveness thresholds, were less frequently reported.<sup>30,36,39–43,45,175</sup> When explored, assumptions of treatment effect decay or persistence tended to have substantial implications on cost-effectiveness results.<sup>49,99,110,111,128,130,145,150,167,178</sup>

### 3.2.4 | Discounting

Discounting reflects society's preference by converting future costs, consequences, or benefits of interventions into present values.<sup>190</sup> The authors generally applied discount rates to future costs and benefits as recommended by the relevant jurisdictions in which the individual studies were conducted. In the United Kingdom and New Zealand, rates of 3.5% were applied,<sup>191</sup> except for one UK-based study that applied declining long-term discount rates starting at 3.5% for costs and 1.5% for benefits,<sup>137</sup> citing guidance issued by HM Treasury.<sup>192</sup> Rates of 3% were typical in the United States and Australia, but the most recent studies in Australia applied a 5% discount rate to costs and benefits.<sup>48–50,177</sup> Across all studies, discount rates did not exceed 5%. Many studies with follow-up periods or time horizons exceeding 1 year did not report discount rates, and no justification was provided for their omission.<sup>38,40,44,45,59,63,81–83,88,104,105,113,117,120,127,132,136,151,154,160,162,172,173</sup> Where applicable, individual study discount rates are reported in Tables 2–4.

### 3.2.5 | Applied cost-effectiveness thresholds

In the context of CUAs, judgments on cost-effectiveness were mostly based on a stated cost per QALY gained threshold. These benchmarks for assessing ICERs varied by country and sometimes within the same country: EUR 5,000 and EUR 20,000 for Germany,<sup>42</sup> EUR 30,000 for Spain,<sup>119</sup> and EUR 33,000 for Finland.<sup>40</sup> In New Zealand and Canada, thresholds of NZD 50,000<sup>123,130</sup> and CAD 50,000<sup>128,134</sup> per QALY gained were applied, respectively. One study in a Chinese childhood population applied a GBP 20,000 per QALY threshold.<sup>36</sup> The highest within-country variation was in the United States, where studies quoted USD 20,000,<sup>55</sup> USD 30,000,<sup>51,52,151,158</sup> 50,000,<sup>55,68</sup> and USD 100,000<sup>159,161</sup> as cost-effectiveness thresholds for an additional QALY. In line with the National Institute for Health and Care Excellence (NICE) guidelines, UK thresholds were either set at a lower bound of GBP 20,000<sup>41,46,47,82,94,97</sup> or an upper bound of GBP 30,000,<sup>86,95,165,169,170</sup> or both GBP 20,000 and 30,000 thresholds<sup>89</sup> per QALY gained. One UK-based study applied a threshold of EUR 3,000 per QALY gained, but no justification was provided for the decision.<sup>81</sup> Only one UK-based study<sup>137</sup> assumed a higher threshold value of GBP 60,000 per QALY, citing guidance issued by HM Treasury.<sup>192</sup> Studies in Australia quoted cost-effectiveness thresholds of AUD 50,000 per QALY gained,<sup>43,44,49,50,177</sup> per DALY averted,<sup>99–103,145,150</sup> and per HALY gained.<sup>106,107,109–112</sup> Studies in the Netherlands stated EUR 19,600 per DALY averted based on the Dutch per capita income<sup>131</sup> and EUR 20,000 per QALY gained.<sup>115</sup> A study involving multiple countries applied country-specific thresholds that amounted to three times the gross domestic product per head per DALY averted.<sup>31</sup>

Compared with CUAs, fewer CEA studies specified a cost-effectiveness threshold, typically by performing probabilistic sensitivity analysis and graphing a cost-effectiveness acceptability curve (CEAC). Quoting annual maximum parental willingness to pay (WTP) thresholds of EUR 35<sup>124</sup> and EUR 123<sup>125</sup> for the costs of interventions per child, respectively, the authors of two German CEAs deemed both interventions cost-effective. However, the threshold applied in one of the studies was hypothetical,<sup>124</sup> while the other was empirically derived.<sup>125</sup> In the United States, a CEA determined that an intervention established cost-effectiveness using a threshold of 35 cents per MET-hour gained.<sup>72</sup> Another US-based study applied a threshold of USD 400 per BMI percentile point decrease.<sup>175</sup> Two UK-based CEAs applied cost-effectiveness threshold ranges of GBP 0–100 per minute of MVPA per day<sup>98</sup> and GBP 0–2,000 per 0.1-point improvement in BMI z score,<sup>156</sup> respectively. An Australian study explored separate cost-effectiveness threshold ranges of AUD 0–30,000 per unit BMI avoided and AUD 0–3,000 per 0.1 reduction in BMI z score,<sup>39</sup> while another applied a threshold of AUD 1,000 per 0.1 BMI z score.<sup>48</sup> A threshold range of AUD 0–45 per unit reduction in lunchbox energy from discretionary foods was considered in one Australian study.<sup>133</sup> A Swedish study explored a cost-effectiveness threshold range spanning EUR 0–10,000 per BMI unit prevented.<sup>45</sup> One Finnish study applied a societal cost-effectiveness threshold of EUR 100 per avoided sickness absence day,<sup>40</sup> while another used a threshold of EUR 14–19 per 1-h increase in physical activity.<sup>135</sup>

Without an explicit cost-effectiveness threshold, decision-making may prove complicated if an intervention is more effective and costlier than a comparator. One of the included studies<sup>140</sup> met the criteria for classification as a CMA.<sup>18,19</sup> In CBAs, a ratio of benefits to costs exceeding one indicated value for money.<sup>83</sup> Some CBA-type studies determined cost-effectiveness by estimating the difference in net cost saved per unit currency spent<sup>61,75,116</sup> or net monetary benefit<sup>73</sup> between competing interventions.

### 3.2.6 | Study quality assessment

Individual descriptive characteristics and CHEERS quality scores are reported for all 151 studies grouped as prevention-only (Table 2), prevention and treatment (Table 3), and treatment-only interventions (Table 4). Tables S2 and S3 present the 24 CHEERS checklist items and a breakdown of scores for each item by study, respectively. Additional descriptive information on costs and intervention effectiveness data sources, sensitivity analysis, and study or model assumptions is available in Table S4.

The lowest CHEERS scores were recorded for nine studies where only abstracts were available from our searches.<sup>38,44,81,117,119,126,141,151,160</sup> Scores for these nine studies ranged from 31% to 63%, mainly due to the minimalist structure and restricted word count stipulated for abstracts. However, there was considerable variation across the content of the abstracts. For instance, some abstracts described the target population insufficiently<sup>81,119</sup> or omitted the description of study perspective,<sup>119,151,160</sup> follow-up or model time horizon,<sup>81,141,151</sup> and discount rate.<sup>38,44,81,117,141,151,160</sup>

In our review of the remaining studies (142 full-text studies), the minimum and maximum CHEERS scores were 58% and 100%, respectively, with a mean score of 93% across all the included studies. Only five studies scored less than 70%.<sup>53,59,82,83,132</sup> Among these studies, there was a tendency to omit details about study perspective and discounting. The descriptions of methods, study parameters, assumptions for decision-analytical models, and uncertainty characterization were also largely scant in these studies. Finally, the choice of comparator was scarcely justified in most of the included studies. In the following sections, study characteristics are further explored, and cost-effectiveness results are presented for the disaggregated groupings (prevention-only, prevention and treatment, and treatment-only).

## 3.3 | Study characteristics: Prevention-only interventions

### 3.3.1 | Intervention components and target populations

Interventions in seven of the 13 prevention-only studies aimed to influence behaviors associated with diet and/or physical activity.<sup>39–41,45–47,49</sup> Three studies assessed interventions that combined components of diet and/or physical activity with sleep modification.<sup>43,44,50</sup>

Two studies evaluated interventions seeking to change the nutrition environment by way of protein infant formula modification.<sup>30,42</sup> Two studies were m-health-based: one involved deploying a multi-component smartphone app intervention among 13-year-olds in a school setting,<sup>47</sup> and the other compared the use of telephone or short message service (SMS) to contact mothers of infants.<sup>48</sup> All comparators were usual care or no intervention, except for one study that compared lower protein with higher protein content formula.<sup>42</sup>

All prevention-only interventions were conducted among baseline populations of pregnant women and newborn babies or children within the first 5 years of life, except for two studies, which targeted populations of 13- and 16-year-olds.<sup>41,48</sup> One study focused on children in socioeconomically disadvantaged areas.<sup>39</sup> One study undertook subgroup analysis for white and South Asian subpopulations.<sup>46</sup>

### 3.3.2 | Key cost-effectiveness results

Authors described 11 (85%) of the 13 interventions in the prevention-only studies as cost-effective or potentially cost-effective. Specifically, an early sleep intervention<sup>43,44</sup> and an afterschool behavioral intervention targeting healthy weight 16-year olds<sup>41</sup> were deemed cost-effective. Potentially cost-effective interventions included a lower protein infant formula intervention<sup>30,42</sup>; four early childhood behavioral interventions<sup>39,46,49,50</sup>; a behavioral intervention targeting pregnant women at risk of gestational diabetes<sup>40</sup>; and a multi-component mobile app intervention.<sup>47</sup>

In Australia, SMS and telephone delivery of health messages to mothers of infants each had less than a 50% probability of being cost-effective compared with an in-person, home-visiting approach given a threshold of AUD 1,000 per 0.1 BMI z units avoided.<sup>48</sup> The authors of a Swedish study determined that there was inadequate evidence to support the cost-effectiveness of a population-based primary prevention intervention targeting preschool children due to uncertainty in the effect measure.<sup>45</sup> A Finnish study found that cost-effectiveness evidence varied depending on the measure of consequences.<sup>40</sup> In this case, prenatal lifestyle counseling intervention was deemed cost-effective given a societal cost-effectiveness threshold of EUR 100 per avoided sickness absence day but not cost-effective given a societal CE threshold of EUR 33,000 per QALY gained. In one pilot trial and preliminary economic evaluation of an outdoor playground-based physical activity intervention for parents and their children where the ICER, GBP 19,588 per QALY gained, fell just below the recommended GBP 20,000 cost-effectiveness threshold, and the authors proposed a full randomized controlled trial (RCT) to confirm results.<sup>46</sup> Subgroup analysis in this pilot trial estimated vastly different ICERs by ethnicity: GBP 275,203 per QALY gained for a white population and GBP 9,346 per QALY gained for a South Asian subpopulation.<sup>46</sup> An Australian study of a sleep intervention found that cost-effectiveness also varied by socio-economic position with probabilities of cost-effectiveness of 92%, 100%, and 79% for low-, mid-, and high socio-economic positions, respectively, given a cost-effectiveness threshold of AUD 50,000 per QALY gained. Cost-effectiveness results are detailed for all nine studies in Table 2.

### 3.4 | Study characteristics: Prevention and treatment interventions

#### 3.4.1 | Intervention components and target populations

Fifty four (54%) of the interventions targeting prevention and treatment focused on changing individual behavior by influencing dietary habits and physical activity, one of which involved the use of app-based mobile technology (m-health).<sup>133</sup> A few solely behavioral interventions also sought to reduce television viewing.<sup>51,103,104</sup> Nine studies modeled interventions at policy levels featuring the implementation of sugar-sweetened beverage (SSB) excise taxation,<sup>35,37,62,77,137</sup> policies on reduction in sugar content<sup>88</sup> or repackaging of high sugar products and energy-dense beverages,<sup>106</sup> restriction on price promotion of SSBs,<sup>112</sup> and restriction of television advertising of SSBs and foods high in fat, sugar and salt (HFSS).<sup>96,137</sup> Four interventions included components delivered using online or web-based technology (e-health)<sup>193</sup> at schools<sup>79,113,140</sup> and childcare centers.<sup>114</sup> Thirty-eight studies evaluated interventions with the main components cutting across multiple intervention categories.<sup>31,38,52–54,60,61,63–68,70,73,75,76,79,80,83,94,99–102,107–111,123,125,130,131,134,137,139,140</sup> All but three of these multi-category interventions involved behavioral components: Of the three that did not, one intervention targeted food standards across English schools,<sup>83</sup> while two others sought to change the school drinking water environment in the United States.<sup>73,76</sup> One study considered hypothetical scenarios of reduction in the prevalence of obesity, and no intervention was specified.<sup>55</sup> The information describing the intervention categorization in another study was insufficiently described.<sup>119</sup> The comparators for the prevention and treatment group of interventions were predominantly usual care or a “do nothing” option.

Targeted age ranges varied substantially across studies. However, the age ranges in a considerable number of studies tended to include primary school children aged 5 and 6 years and children in preadolescence/early adolescence (approximately 8 to 13 years). Eight studies were conducted solely on girls,<sup>51,56,78,84,90,92,93,98</sup> while the remaining studies included boys and girls. Some studies focused entirely on children in socioeconomically deprived settings or conducted subgroup analyses for children from disadvantaged backgrounds.<sup>69,79,105,107,123,130</sup>

#### 3.4.2 | Key cost-effectiveness results

Of the 100 studies that targeted prevention and treatment of childhood excess weight, 75% estimated that interventions were either cost-effective<sup>31–34,36,51,52,68,72,79,81,82,86,94,99,103,104,106,107,109,111,112,115,118,121,123–125,128,130,131,137</sup> or potentially cost-effective.<sup>35,53,54,56–62,64–67,69,71,73–78,80,83,88,89,93,96,105,108,113,114,116,117,120,122,126,127,129,133–135,140</sup>

Eleven deemed interventions unlikely to be cost-effective compared to current practice or control, all of which were carried out in school-settings, namely, a program to increase walking to school<sup>100</sup>; two to three after-school sessions per week of physical activity programs<sup>101</sup>; a

program to increase active transport<sup>102</sup>; a girls' dance program<sup>84</sup>; an intervention aimed at increasing physical activity and improving diet in primary school children<sup>85</sup>; a drama-based healthy lifestyles week program<sup>87</sup>; training of teachers to deliver a physical activity program<sup>91</sup>; a teacher-led physical activity intervention for girls<sup>92</sup>; replacing normal desks with sit-stand desks<sup>95</sup>; a school-based, peer-led 12-week physical activity program<sup>97</sup>; a peer led physical activity program for girls<sup>98</sup>; and a school-based physical activity program for girls.<sup>90</sup> The remaining five studies were hypothetical analyses that compared varying scenarios of theoretical reductions in excess weight or estimated targets for the reduction of excess weight or increase in physical activity that would be cost-effective.<sup>55,63,70,110,119</sup> Cost-effectiveness results for all prevention and treatment interventions are further described in Table 3.

Most studies were conducted in samples representative of the broader childhood population, but cost-effectiveness tended to vary by gender when considered. In one study, specifying a package size cap of 375 ml on packaged single-serve SSBs appeared more cost-effective in boys.<sup>106</sup> In another, an educational intervention focused on improving lifestyle choices was cost-effective for boys but not for girls.<sup>121</sup> However, another study found that running or walking around school grounds for 15 min daily was cost-effective for the whole sample and girls but not for boys.<sup>94</sup> Similarly, one study found that a policy to reduce the sugar content in certain high-sugar products by 20% had potentially larger health benefits for girls than boys,<sup>88</sup> and another study found that a primary school intervention targeting diet and physical activity was more effective in girls and children with excess weight.<sup>33</sup> One study reported that cost-effectiveness varied between boys and girls, depending on the intervention (immediate or delayed afterschool programs).<sup>74</sup> Of the eight studies conducted solely in female subpopulations, four studies (50%) reported that the interventions were either cost-effective<sup>51,56,93</sup> or potentially cost-effective,<sup>78</sup> respectively. The remaining four studies stated that they did not find evidence of cost-effectiveness.<sup>84,90,92,98</sup>

Cost-effectiveness also varied by ethnicity, age, and socioeconomic status (SES). One study estimated lower ICERs for a multicomponent through-school physical activity and nutrition program in the Māori subpopulation and children in middle SES schools compared to the entire population and lower ICERs for older children across all subgroups compared with younger children.<sup>123</sup> Similarly, another study that focused on four interventions targeting television viewing, diet, and physical activity reported lower ICERs for Māori and Pacific populations compared to the general population of children in New Zealand.<sup>130</sup> A study of a program that targeted physical activity and physical education, and aimed to modify school food service conducted in a predominantly Hispanic sample, was deemed cost-effective,<sup>52</sup> and another study found a family-centered, mental health intervention focused on Black and Latino children who attended high-poverty, urban schools in the United States to be potentially cost-effective.<sup>69</sup> An economic evaluation of legislation restricting television advertising of food and beverages HFSS demonstrated greater health benefits and cost-savings for children in the more deprived areas.<sup>107</sup> Finally, one study targeting students in low SES neighborhoods found an online intervention more cost-effective than the onsite version.<sup>79</sup>

## 3.5 | Study characteristics: Treatment-only interventions

### 3.5.1 | Intervention components and target populations

Of the 38 treatment-only interventions, 27 (71%) were behavioral interventions with components focused on diet and physical activity.<sup>143-149,151,153-157,163-166,168,169,173-180</sup> One intervention included the use of a mobile health technology (m-health) component to target addictive eating behavior.<sup>171</sup> Five were bariatric surgery interventions.<sup>150,158,159,161,170</sup> Five interventions involved components across multiple categories,<sup>160,162,167,171,172</sup> and one was a hypothetical intervention with no stated components.<sup>152</sup> Another study was based on a hypothetical e-health intervention.<sup>177</sup> Interventions were mostly compared to usual care or “do nothing.”

Most non-surgical interventions targeted pre-teen and early teen years (approximately 6 to 13 years). Except for one bariatric surgery intervention delivered to children as young as 13 years,<sup>158</sup> the minimum age for children who received surgical interventions was 15.

### 3.5.2 | Key cost-effectiveness results

Only five (13%) of the treatment-only interventions evaluated were described as unlikely to be cost-effective by the authors, all of which were based primarily on behavioral components, namely, home-based general practitioner (GP) consultations<sup>146</sup>; primary care surveillance followed by structured secondary prevention<sup>149</sup>; a 10-week family-based behavioral intervention<sup>165</sup>; a community-delivered multicomponent intervention<sup>169</sup>; and a family-based weight management program in the United Kingdom that involved motivational interviewing.<sup>174</sup> A US-based study found that a motivational interviewing intervention with telephone and in-person visits from pediatricians, nurse practitioners, and registered dietitians had a 50% probability of being cost-effective given a cost-effectiveness threshold of approximately USD 400 per BMI percentile point decrease. This probability rose to about 90% at USD 1,500 per BMI percentile point decrease.<sup>175</sup>

Duration of follow-up and model time horizon drove cost-effectiveness results. For instance, an intervention that involved GP consultations at home was not cost-effective after the trial follow-up of 15 months<sup>146</sup> but proved to be cost-effective when modeled over a lifetime.<sup>145</sup> Similarly, two studies found that bariatric surgery was not cost-effective using a three-year horizon but became cost-effective beyond a 10-year time horizon.<sup>159,161</sup> Other studies based on a lifetime horizon found bariatric surgery cost-effective.<sup>150,158,170</sup> Two studies investigated cost-effectiveness for types of surgical procedures compared to no surgery: One study assessed laparoscopic adjustable gastric banding (LAGB) and laparoscopic Roux-en-Y gastric bypass (RYGB),<sup>158</sup> while another assessed RYGB and laparoscopic Sleeve Gastrectomy (SG).<sup>170</sup> Both studies estimated higher ICERs for RYGB. Cost-effectiveness results for treatment-only interventions are detailed in Table 4.

## 4 | DISCUSSION

### 4.1 | Summary of findings

This systematic review underscores evolving developments in the economic evaluation of interventions for children with excess weight and synthesizes evidence of cost-effectiveness. The increase in the number of studies over recent years highlights the growing interest in the topic in the context of the increasing prevalence of childhood excess weight and constrained public resources for its management. Although this review included few studies from LMICs, we expect that in the coming years, there will be a notable increase in studies reporting economic evaluations of interventions targeting excess weight in children following trends in increased prevalence driven by changing diet and lifestyle, among other factors.<sup>194</sup>

The grouping of studies into prevention-only, prevention and treatment, and treatment-only interventions further elucidates intervention and population characteristics and the methodological diversity across studies. Prevention-only interventions were the least represented (9%) in the included studies and were typically delivered to pregnant women,<sup>40</sup> mother-infant dyads,<sup>44,50</sup> and children in the first few years of life.<sup>30,39,42,43,45</sup> The settings of choice were primarily clinical<sup>40,45</sup> or home based, along with family members.<sup>39,48</sup> Unique intervention components in this group included reduced protein content in infant formula<sup>30</sup> and sleep modification,<sup>44,50</sup> both deemed cost-effective. In general, individual prevention-only interventions were likely to be cost-effective compared to usual care.

Prevention and treatment interventions were the most common of the three groups of interventions evaluated. Schools were the predominant setting for this group of interventions.<sup>32,34,51,54,56,60,66-68,72,73,76,79,81,83-85,87,89-95,97,98,105,108,113-118,120,121,123,124,128,129,134,136,139,140</sup> The intervention components in this group overwhelmingly targeted individual behavior but often cut across environmental and policy categories.<sup>32-34,36,51,56-59,69,71,72,74,78,81,82,84-87,89-93,95,97,98,103-105,113-118,120-122,124,126-129,133,135,136,138,141,142</sup> Most interventions in this grouping tended to be cost-effective compared to usual care or a “do nothing” option.

In addition to other intervention categories, treatment-only interventions featured bariatric surgery,<sup>150,158,159,161,170</sup> generally deemed cost-effective over a lifetime horizon compared to usual care or no treatment. Like prevention-only interventions, the settings were more likely to be healthcare based<sup>148-150,158,159,161,163,167,170</sup> or in the home alongside family members.<sup>143-146,151,157,166,173</sup> Generally, treatment-only interventions were likely to be cost-effective in the long run.

The literature reveals pertinent discourses surrounding the clinical significance of treatment effect sizes and the policy implications of statistically insignificant differences in BMI effects between compared interventions.<sup>195</sup> Some studies have defined a clinically meaningful benefit as at least a 5% reduction in body weight from baseline.<sup>196</sup> However, this definition remains open to debate.<sup>197</sup> Importantly, a lack of statistically or clinically significant differences in effects does not foreclose a favorable decision on cost-effectiveness.<sup>198-200</sup> A case

in point is studies that apply cost-minimization analysis (CMA),<sup>201</sup> a method of health economic evaluation that becomes relevant when conducted alongside non-inferiority, cluster-randomized controlled trials and where an intervention may offer economic benefits despite the absence of clinically or statistically significant difference in treatment effect. In health economic evaluations, the gold standard for characterizing uncertainty is rooted in probabilistic sensitivity analysis, where the uncertainties surrounding input parameters of treatment effects and costs are accounted for jointly.<sup>188</sup> Related to probabilistic sensitivity analysis are several approaches for reporting the variability in economic outcomes. These include the construction of a confidence interval for the cost-effectiveness ratio or performing a value of information analysis to quantify the expected value of reducing or eliminating decision uncertainty.<sup>199</sup>

The cost-effectiveness thresholds for CUAs were generally based on methods guidance for individual countries<sup>202,203</sup> but occasionally differed within countries. No national or international cost-effectiveness thresholds were specified for CEAs reporting ICERs in natural units, for example, the incremental cost per unit change in BMI z score. However, in a few instances, the authors applied a threshold range to help readers and decision-makers decide whether an intervention offered good value for money. For CEAs, we recommend reporting graphical summaries of probabilities of cost-effectiveness across a plausible range of thresholds using CEACs and cost-effectiveness acceptability frontiers (CEAFs).<sup>204</sup> In a few of the included studies, authors determined that the intervention was unlikely to be cost-effective if a similarity in effects was estimated but the intervention was costlier. Generally, interventions in the included studies were deemed cost-effective, although many studies did not sufficiently justify the comparator choice.

## 4.2 | Methodological challenges

Studies of the three intervention groupings shared some methodological characteristics and concerns. The plethora of measures of consequences in CEAs and CUAs (the most frequently applied economic evaluation methods for assessing pediatric excess weight interventions) complicate inter-study comparability. Including various outcomes for CCA can broaden the application of an economic evaluation for multiple decision-makers with diverse preferences and priorities. However, this is not always feasible, and rigor is required in selecting outcomes with the broadest applicability. Stakeholder-led prioritization and development of core outcome sets for interventions targeting childhood excess weight are in the early stages and currently focus on outcomes for specific age ranges,<sup>205</sup> settings,<sup>206</sup> or interventions.<sup>207</sup> Further consideration is warranted, but there are indications that decision-makers are principally interested in ascertaining the effects of interventions on excess weight, health-related quality of life and capability, or well-being.<sup>208–210</sup> The use of CEA, the type of economic evaluation specified for disease/condition-specific outcomes or proxy measures of intervention effectiveness, limits the scope of cost-effectiveness-based decision-making.<sup>211</sup> Thus, proxy measures

such as change in MET or MVPA and change in dietary habits should preferably only be reported as ancillary outcomes. Further, for CEAs, widely adopted natural units such as BMI z scores are preferable to unstandardized measures such as child percent over BMI (%OBMI) because they account for the variation in children's body composition by age and gender.<sup>212</sup>

Anthropometric outcomes, particularly those structured around measures of BMI, have been heavily criticized for lack of equivalent representation of body fat across sex and ethnic groups.<sup>213–215</sup> To attenuate this bias, summary measures that integrate the deleterious effects of excess weight on health-related quality of life with its impact on longevity have been proposed.<sup>211,216</sup> Preference-based measures such as the QALY and DALY meet this criterion. In addition, they are the measures of choice for NICE<sup>191</sup> in England and Wales, the Pharmaceutical Benefits Advisory Committee (PBAC)<sup>217</sup> in Australia, and health technologies agencies in several other high-income countries.<sup>218</sup> The challenges with eliciting utilities for measures like the QALY in children are not unique to the study of excess weight and have been given sufficient coverage in the literature.<sup>219–221</sup> Specifically, the following methodological concerns were relevant to the studies included in our review: (1) the heterogeneous nature of the childhood subgroups, (2) the challenge of capturing effects across developmental stages in childhood, and (3) constraints surrounding the cognitive abilities of children to complete complex preference-based measures. Current efforts at resolving these issues, for example, through the use of parental proxy assessment of health states and adaptations of existing utility instruments like the EQ-5D-Y or the development of entirely new pediatric-specific utility instruments like the CHU-9D and weight-specific instruments such as the Weight-specific Adolescent Instrument for Economic evaluation (WAlTE), still bear the risk of bias and age restrictions.<sup>220,222–224</sup>

Only a minority of studies in our review assessed parental health-related quality of life, and none of the included studies evaluated well-being outcomes using a preference-based measure.<sup>225</sup> In recognition of the potential health-related externalities that may accrue to parents and caregivers of children experiencing excess weight, Frew<sup>208</sup> advocated for including family member benefits if relevant to the economic evaluation perspective. Furthermore, the multi-sectoral nature of interventions targeting excess weight implies that non-health benefits may be excluded when the QALY paradigm is strictly applied. Additional value may be found in quantifying and including well-being outcomes<sup>208</sup> or conducting economic evaluations from a societal perspective using a CBA framework.<sup>226</sup>

Decision analytic models offer the opportunity to capture potential downstream benefits experienced in adulthood after the administration of an intervention might have been discontinued. Since the evidence supporting treatment effectiveness is usually immature, assumptions surrounding the persistence or waning of effects are likely to be needed beyond what available data may show. Many included decision-analytic model-based studies used optimistic scenarios of prolonged treatment benefits to estimate base case results over an extended period.<sup>110,111,128,150,167</sup> On the other hand, a common limitation of trial-based studies tended to be the shortness of



study timeframes.<sup>86,142</sup> We recommend reporting results from extensive scenarios with varying assumptions of effect decay and for different time horizons informed by clinical and expert opinion and observational evidence where this becomes available. In line with previous guidelines, trial time horizons should be considered carefully to ensure that they correspond with expected changes in measures of outcome, and modeling should be attempted to bridge the knowledge gap due to inadequate study follow-up.<sup>199</sup>

We noted substantial heterogeneity in the measurement and valuation of resource use and cost outcomes across studies, driven chiefly by national context, study perspective, and setting. Many studies conducted for a US population converted charges to costs and included a range of medical expenditures.<sup>55,159</sup> The preponderance of societal perspectives is encouraging, as it indicates a lower risk of bias towards underestimating costs. On the other hand, excluding intervention set-up costs could potentially overestimate the cost-effectiveness of interventions requiring a substantial upfront investment in technology or a considerable learning curve for personnel, for instance, achieving proficiency in a new surgical procedure. While robust sensitivity analysis that includes one-off intervention costs may mitigate this bias, justification of the assumption in the base case analysis should be provided.

Preventing or treating childhood excess weight using e-health and m-health interventions is nascent yet promising. As suggested by some of the studies we reviewed, there might be an opportunity to cost-effectively translate existing lifestyle interventions to online and mobile app-based versions.<sup>79,140</sup> However, the complexities associated with costing these interventions present a knowledge gap for the assessment of cost-effectiveness.<sup>227</sup> We advocate for transparency in reporting any difficulties associated with estimating the cost components of these interventions.

Our review established that threshold-based assessment of cost-effectiveness was predisposed to considerable variation by gender, age, ethnicity, and SES across the three groups of interventions targeting childhood excess weight. This finding calls for attention to disparities in the prevalence and burden of childhood excess weight reported in many population subgroups.<sup>228-230</sup> Nevertheless, the number of studies that explored trade-offs between cost-effectiveness and health inequalities in subgroups of interest remains underwhelming. In line with Weatherly et al.,<sup>231</sup> we recommend that researchers planning to conduct economic evaluations of interventions targeting childhood excess weight should review the literature to identify equity-relevant subgroups within the broader study populations.

Finally, our finding that most interventions evaluated were reported to be cost-effective calls into question the appropriateness of comparators. The overwhelming majority of interventions were compared to variations of usual care or “do nothing” approaches. Even in studies that evaluated multiple interventions, fully incremental analyses were rarely estimated. We acknowledge that most children with excess weight may not have access to any weight control support and doing nothing may be a tenable comparator. However, we believe that the choice of comparators might be aided and justified by

literature searches to identify relevant interventions based on the target population, setting, and study perspective.

### 4.3 | Comparison with the existing literature

The study by Zanganeh et al.<sup>9</sup> was an extensive review of the methods, study quality, and the results of economic evaluations of 39 studies published between 2001 and 2017. Still, it excluded surgical procedures and innovative interventions such as sleep modification and interventions delivered through information and communication technologies. Some key findings from Zanganeh and colleagues were echoed in our review. For instance, interventions with individual-level behavioral components remained the dominant intervention category, studies are still predominantly conducted in high-income countries, and evidence synthesis is likely to remain challenging for the foreseeable future due to unresolved methodological heterogeneity.

Similarly, the searches for another systematic review by Oosterhoff et al.<sup>16</sup> were conducted in 2017 and comprised only economic evaluations of school-based interventions targeting children aged 4–12. The more recent systematic review by Mahdi et al.,<sup>17</sup> which critically appraised the methods applied in economic evaluations of obesity interventions in children, was limited to dietary interventions intended to prevent obesity and excluded studies of hypothetical interventions and studies conducted in infants. Fundamentally, our systematic review was not restricted by the aforementioned limitations of previous studies. This review included three times as many studies as the review by Zanganeh et al. and captured several novel interventions, underscoring the rapidly evolving pace of research in the economic evaluation of childhood excess weight interventions.

### 4.4 | Strengths and limitations

This systematic review summarizes cost-effectiveness evidence and offers recommendations for practice and policy across 151 economic evaluations of interventions targeting childhood excess weight. Our delineation of interventions into three groups (prevention-only, prevention and treatment, and treatment-only) untangles both shared methodological characteristics and inter-study diversity. Extending the work of previous reviews, our inclusion of a broader range of intervention categories and components situates economic research in this area in its historical and contemporary contexts. Our comprehensive eligibility criteria and searches across relevant databases allowed for a robust assessment of interventions targeting childhood outcomes. We also included studies of hypothetical interventions suitable for forecasting and target setting.

Despite its strengths, this review is not without limitations. We did not use the new version of the CHEERS statement issued in 2022.<sup>232</sup> The new statement lends itself more readily to all types of health economic evaluations. However, since most of the included studies were published before 2022, we deemed scoring them against



a newly published standard unfair. Second, due to time constraints, we did not contact the authors of the nine abstracts included in our review, which could have improved our reporting assessment of their studies using the CHEERS statement.

Between-study variations in methodological approaches precluded the use of meta-analysis for combining cost-effectiveness evidence across studies. The setting, jurisdiction, cost-effectiveness threshold, and type of economic evaluation varied vastly across studies. Therefore, we adopted a narrative review approach comparable to previous reviews in the field.<sup>9,17,193</sup>

## 4.5 | Recommendations for policy and future research

No single type of economic evaluation is appropriate for assessing interventions targeting every childhood population across all settings and perspectives. Conducting economic evaluations from multiple perspectives may illuminate the interplay between health and other sectors in preventing and/or addressing childhood excess weight problems. We propose the following good practices and methodological considerations when undertaking economic evaluations in this area: (1) When selecting measures of consequences for conducting CCAs and CEAs, priority should be given to standardized natural units that measure changes in body fat composition, as this would facilitate interpretation and promote generalisability. (2) To aid decision-making, CEACs and CEAFs should be graphed for a plausible cost-effectiveness threshold range, even if a national cost-effectiveness threshold is unavailable. (3) For CUAs, utility values should be elicited with particular consideration for the age appropriateness and sensitivity of the instrument, the valuation protocol, and the potential health-related quality-of-life impacts of the intervention on family members or carers. (4) Measures of capability or well-being should preferably also complement measures of health-related quality of life. (5) CBAs are encouraged to remedy any missed externalities accrued in non-health sectors. (6) The choice of comparators should be justified, and a fully incremental analysis should be performed for all included interventions. (7) Robust sensitivity analysis to test assumptions of treatment effect maintenance or decay and costing assumptions surrounding intervention start-up costs and productivity costs should be performed. (8) Finally, pre-study searches of the literature and deliberating with experts to identify subgroups relevant to the decision problem and study jurisdiction are highly recommended.

## 5 | CONCLUSIONS

This study reports a systematic review of economic evaluations of interventions targeting childhood excess weight and found that most interventions in the prevention-only, prevention and treatment, and treatment-only groups were reported to be cost-effective. However, intervention cost-effectiveness was sensitive to age, sex,

socioeconomic status, and model assumptions surrounding treatment effect. Our study identified important methodological issues, which, if addressed, will enhance the quality and comparability of economic evaluations of interventions targeting childhood excess weight.

## AUTHOR CONTRIBUTIONS

Olu Onyimadu, Mara Violato, Susan A. Jebb, and Stavros Petrou conceptualized this review; Olu Onyimadu, Mara Violato, Nerys M. Astbury, and Stavros Petrou contributed to the design of the study; Olu Onyimadu, Hannah Hüls, Laura Heath, Alexandra Shipley, Harriet Taylor, Laura E. Wilkins, and Roxanna E. Abhari carried out study selection; Olu Onyimadu, Laura Heath, Alexandra Shipley, and Hannah Hüls performed data extraction and quality appraisal; Olu Onyimadu carried out the analysis, interpreted the data, and drafted the paper; Olu Onyimadu, Mara Violato, Nerys M. Astbury, Susan A. Jebb, and Stavros Petrou critically revised the paper. All authors have read and approved the content of the review.

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## CONFLICT OF INTEREST STATEMENT

The authors declare no conflict of interest.

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## SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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