



**OBESITY PREVENTION IN CHILDREN AND YOUNG PEOPLE  
AGED 0-18 YEARS  
A Rapid Evidence Review  
FULL TECHNICAL REPORT  
Physical Activity, Nutrition and Obesity Research Group  
(PANORG)**

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### Key Messages

- Meeting the NSW Government target to reduce child overweight and obesity by 5% within 10 years (by 2025) will require a paradigm shift, with substantially enhanced investment for a comprehensive set of initiatives, delivered at scale and sustained for the decade. The purpose of this review is to outline what additional evidence has become available in the last five years on childhood obesity prevention strategies – with particular focus on those that have demonstrated effectiveness, and/ or show particular promise for intervening at a population level and/or children’s settings in NSW.
- Comparing 2015 with 2010 data, NSW is one of the few jurisdictions in the world to have achieved an improvement in childhood obesity rates with modest improvements in the proportion of overweight students in years K, 4 and 6 and apparent stabilization of the overall combined overweight and obesity rate for children age 5-16.
- These modest improvements have been achieved after substantial government investment in a portfolio of obesity prevention and management programs. Maintaining this current portfolio of programs and interventions in NSW at the existing intensity (‘business as usual’), might in the best case scenario, lead to improvements in the prevalence of child overweight and obesity in the range of 0.0% — 0.3% per annum.
- No single solution creates sufficient impact to reverse obesity: only a systemic, sustained, comprehensive portfolio of cumulative initiatives, delivered at scale, is likely to be effective in tackling overweight and obesity.
- Government leadership and policy action are key elements that enable and support the population behaviour change necessary to impact on child obesity. Whilst some policy initiatives may require co-operative action at a national level there are opportunities for NSW to take a leadership role; other policy actions can be initiated at a state level.
- Policy action (especially fiscal policy) reducing consumption of sugar sweetened beverages (SSBs) is identified as the single most cost-effective intervention and would save an estimated \$55 for every \$1 invested. There is strong public support for fiscal policy in Australia, with 69% of grocery buyers reporting they were in favour of a tax on soft drinks to reduce the cost of healthy food, with parents being more supportive than non-parents.
- Policy action reducing marketing of energy dense nutrient poor (EDNP) foods is rated as the second most cost-effective intervention and would save an estimated \$38 for every \$1 invested.
- All policy options identified in this report are highly cost-effective from a societal perspective, and some policy options would generate revenue as well as delivering health gains. All identified policy actions should be considered for inclusion to achieve the comprehensive approach required to achieve the Premier’s 2025 target.
- The review highlights gaps in knowledge of what works, under what circumstances, and for whom, in childhood obesity prevention and makes a series of recommendations for future research priorities. An important evaluation strategy to consider is the implementation of a companion cohort study to the 45 and Up study. That is, follow a large cohort of children through childhood and adolescence, tracking a number of different health outcomes over several years. This would act as an explanatory study of the incidence of obesity – why and how and at what rate do children move from acceptable weight to overweight and obesity. The practical aspects of such a cohort could be used to evaluate NSW interventions and explain weight gain in childhood.

## The Evidence At-a-Glance

### OVERVIEW

- Prevention of childhood overweight and obesity is a priority for the NSW government and has recently been identified as a priority by the State Premier. The NSW Office of Preventive Health (OPH) commissioned The Physical Activity Nutrition Obesity Research Group (PANORG) at the University of Sydney to undertake a rapid evidence review with a focus on obesity prevention in children and adolescents (0-18 years). PANORG is co-located with and was supported by the World Health Organization (WHO) Collaborating Centre for Physical Activity, Nutrition and Obesity. The purpose of the review was to examine new evidence (published since 2011) and to provide advice on obesity prevention policy options for this target population.
- A team of nine researchers examined a wide range of public health scientific databases supplemented with online searches of grey literature, looking especially at higher quality evidence reviews (meta-analyses and systematic reviews of randomised trials or of longitudinal studies). Expert recommendations on childhood obesity prevention were also noted (for example, the report of the WHO Commission on Ending Childhood Obesity (ECHO). This methodology was used to approximate a formal systematic review and to identify evidence-based best practices and policy options. The overall quality of systematic reviews was acceptable with assessments of 34% (n=31) high quality, 59% (n= 55) moderate quality and 8% (n= 7) lower quality; systematic reviews scoring less than 4 on the AMSTAR checklist were excluded from the analysis.
- Section 3 of the report describes the core research questions addressed; section 4 describes the methods sources of evidence and screening process; section 5 maps the relevant evidence against the specified research questions; section 6 discusses policy implications; and section 7 describes the status and limitations of current evidence. Appendices cover model policy options (WHO ECHO), policy options to address harmful marketing, an international overview of relevant taxation policies; knowledge gaps and priorities for future research; a bibliography on systems approaches to obesity; and a tabulation characterising the key scientific studies identified by the research team.
- WHO has stated that obesity *can* be prevented through multisectoral action that simultaneously addresses different sectors that contribute to the production, distribution and marketing of food, while concurrently shaping an environment that facilitates and promotes adequate levels of physical activity (PA).
- NSW can claim to be one of the few jurisdictions in the world to have achieved an improvement in childhood obesity rates. Sub-group analyses from the NSW Schools Physical Activity and Nutrition Survey (SPANS) comparing 2015 data with 2010, provide evidence that modest improvements have been achieved in the proportion of overweight NSW students in years K, 4 and 6 with apparent stabilization of the overall combined overweight and obesity rate for children age 5-16 years.
- A sense of optimism in NSW, within an otherwise gloomy global scenario, has arguably been possible because NSW has taken the long-term strategic approach recommended by WHO. The observed modest improvements have been achieved only after substantial government investment in a range of obesity prevention and management programs in the early childhood and primary school ages (e.g., Munch and Move, Supported Play Groups, and Go4Fun) and in the school setting (e.g., Crunch and Sip, and Live Life Well @ School). The NSW Government target to reduce child overweight and obesity by 5% within 10 years (by 2025) is ambitious. Maintaining the current portfolio of programs and interventions in NSW at the existing intensity ('business as usual'), could lead to reductions in child overweight and obesity in the range of 0.0% — 0.3% per annum.
- Meeting the target will require a paradigm shift with substantially enhanced investment for a comprehensive set of initiatives, delivered at scale and sustained for a decade. No single solution creates sufficient impact to reverse childhood obesity: only a comprehensive, systemic program of multiple interventions is likely to be effective. All of the interventions recommended in this report are highly cost-effective from a societal perspective and some would generate revenue. For example, policy action on SSBs (the single most cost-effective intervention) would save an estimated \$55 for every \$1 invested. Similarly, policy action reducing marketing to children and adolescents of EDNP foods, (the second most cost-effective intervention) would save an estimated \$38 for every \$1 invested. Action on SSBs would also raise substantial revenue annually as well as delivering health gains.
- We identified 5 eligible systematic reviews for examining social marketing strategies. In general, results suggest that social marketing campaigns targeting children can be effective if well designed, implemented, resourced, and evaluated. However, it should be noted that the available evidence is limited, with much of it relating specifically to mass media campaigns.

## ***EVIDENCE FOR ACTION - BY POPULATION GROUP, SETTING AND STRATEGY***

### ***0-5-year-olds***

There is strong evidence, based on several high quality randomised controlled trials (RCTs) for the effectiveness of obesity prevention in children aged 0-2 (4 of these trials are from Australia and New Zealand). The investigators of these four regionally based trials came together to form the Early Prevention of Obesity in Childhood (EPOCH) prospective meta-analysis collaboration. EPOCH interventions have resulted in improvements in BMI at ages 18-24 months, as well as increased breastfeeding duration and a reduction in TV viewing. This approach, involving the largest trials in the 0-2 age group (total N>2000), remains a world first. The most promising obesity prevention interventions for children under 2 years of age appear to be those that focus on diet and responsive feeding. There is moderate evidence for preventive interventions in 3–5 year-old pre-schoolers, with more successful interventions requiring high levels of parental engagement, use of behaviour change techniques, a focus on skill building and links to community resources. Overall design specifications for obesity prevention programs in this age group are set out in Table 3.

### ***Childcare setting***

To date there is weak-to-moderate evidence for the effectiveness of childhood obesity interventions in the childcare setting. Available research suggests that interventions can be effective in impacting weight outcomes and that the likely success factors are (i) high parental involvement; (ii) parents encouraging their children to drink water in preference to SSBs; (iii) including specific diet/PA components in programs; and (iv) ensuring consistency of educational material across settings.

### ***School Setting***

There is strong evidence for the effectiveness of child obesity prevention programs improving BMI, particularly for programs targeted to children aged 6 to 12 years. Most evidence comes from programs located in the school setting itself (with involvement of other settings in some cases). There is strong evidence for the effectiveness of (i) PA-only interventions delivered in schools with home involvement and for (ii) combined diet– PA interventions delivered in schools when *both* home and community components are also included. There is moderate evidence for the effectiveness of school-based interventions: (i) targeting either diet or PA singly; (ii) combining interventions delivered in schools with home *or* community components; and (iii) combining interventions delivered in the community with a school component.

### ***Children aged 5-12 years/ Primary schools***

There is strong evidence for multi-component interventions as noted above however PA (only) focussed programs can be effective. There is moderate evidence for effective environmental components including (i) organised physical activities during breaks, before and after school, (ii) improved availability of PA opportunities in and around the school environment; (iii) increased physical education lesson time; (iv) improved availability or accessibility of healthy food options; and (v) restricted availability and accessibility of unhealthy food options. Moderate evidence supports the effectiveness of sedentary behaviour interventions which can have small but significant effects on reducing BMI, with consistent findings for the benefits of restrictions on TV viewing time. The level of parental involvement is an important success factor for these sedentary behaviour interventions.

### ***Young people aged 13-18 years***

Young people or adolescents (13-18 years old) pose a challenge for obesity prevention program designers and currently we lack strong conclusive evidence on effective interventions. Parental involvement has less influence here compared to younger age groups. Targeting adolescents specifically with obesity prevention /education programs appears not to be as effective as a taking a broader community-wide approach, incorporating interventions which target environments and upstream prevention strategies noted elsewhere in this report (for example, tackling marketing of EDNP foods including SSBs). The implication is that unless public policy addresses marketing of EDNP foods and affordability/accessibility of SSBs, gains achieved with younger age groups may be lost during adolescence.

### ***School food services and environments including school canteens***

There is strong and consistent evidence that multi-component interventions, particularly interventions of longer duration, that include changes to the nutrition environment, can be effective in influencing weight status, and specific food consumption patterns such as an increase in fruit and vegetable consumption. Program success factors appear to centre on (i) changing the availability of foods at school; (ii) incorporating a mix of educational and environmental interventions; and (iii) ensuring sustained duration of interventions. This strong evidence is confined to primary-school-age children. For the secondary school phase there is moderate evidence for the effectiveness of educational interventions on food intake and weak evidence for multi-component interventions. Promising new evidence supports: (i) interventions to target portion size (specifications are detailed in Table 7 of the report); (ii) audit and feedback processes to support implementation of healthy school canteens; and (iii) investing in more intense/ higher 'dose' of program interventions to support healthy food provision in schools. Broad implementation of healthy food procurement policies (in schools and other public settings relevant to children, adolescents and their parents) has the potential to increase the overall demand for more healthy products, and to drive the reformulation of foods by food manufacturers.

### ***Active travel strategies***

There is consistent moderate evidence that active travel strategies can result in modest increases in PA and fitness, with active traveller school students accumulating more daily moderate-to-vigorous physical activity (MVPA) than those using motorised transport in the majority of studies. A growing evidence base suggests that interventions to promote the uptake and maintenance of active travel through adolescence may offer protection against the development of excess BMI. New evidence from a UK longitudinal study of over 2000 pupils shows that a consistently or predominantly active travel pattern is associated with a lower BMI for boys; an effect on girls BMI was not apparent however. The high tracking of active travel from childhood through adolescence (ages 12 to 17 in the UK study) suggests that early intervention during the transition from primary to secondary school, followed by interventions to promote maintenance of active travel through adolescence, may be of greatest benefit. The NSW Active Travel Charter for Children is an important and highly recommended initiative in this context.

### ***Home and family-centred strategies***

There is strong evidence for the home and family setting as a context to address reductions in TV viewing / screen time in younger children. There is weak to moderate evidence for other home-/ family-centred strategies. Intervention success is generally found to be higher in younger compared to older children. Four success factors have been identified for designing more effective interventions: (i) consistency of educational material across settings; (ii) capacity building of parents; (iii) parents encouraging their children to drink water in preference to SSBs; and (iv) level of parental satisfaction and participation. As noted above, the most promising obesity prevention interventions for children under 2 years of age appear to be those that focus on diet and responsive feeding. Interventions to promote healthy family meals can be effective; suggested program design specifications include goal setting, interactive group activities, interventions focussed on cooking and food preparation, cost, shopping, and adolescent influence.

### ***Community-based strategies***

There is moderate evidence for the effectiveness of community-based initiatives that include a school component. Improvements have generally been limited to weight change in primary school-aged children, with limited evidence of changes in healthy eating or PA (but not weight change) in the other age groups. There is more convincing local evidence of effectiveness from one community-based program implemented in NSW (Good for Kids); a case study is provided as Table 5 of the report.

### ***Primary health care/ health service setting***

For prevention there is as yet only weak evidence for the effectiveness of primary care-based interventions and the current generation of programs is generally very resource intensive. For treatment / management of paediatric overweight and obesity there is strong evidence for the effectiveness of interventions in the primary care setting; results are modest but important. Success factors for interventions are: (i) training for health professionals before intervention delivery; (ii) including behaviour change components (healthy diet, PA and sedentary behaviour); (iii) effecting behaviour change via a combination of counselling, education, written resources, support and motivation; and (iv) tailoring intervention intensity according to whether behavioural, anthropometric or metabolic changes are the clinical priority.

### ***Equity and ethical perspectives on prevention strategies***

There is weak evidence that community-based initiatives at the very least do not worsen health inequalities and may actually reduce them; similarly, there is weak evidence that school-based interventions do not exacerbate inequalities. There is weak-to-moderate evidence that programs targeting socioeconomically disadvantaged children under 2 years of age can be effective. Few obesity prevention studies report assessing the possible harm or unintended consequences of interventions; current evidence suggest that these strategies do not increase body image concerns, unhealthy dieting practices, level of underweight, or unhealthy attitudes to weight, and that all children can benefit. Obesity prevention interventions should incorporate safeguards and ensure evaluation of unintended consequences as well as intended outcomes.

### ***Strategies to reduce consumption of sugar-sweetened beverages (SSBs)***

Policy action (especially fiscal policy) reducing consumption of SSBs is identified as the single most cost-effective intervention and would save an estimated \$55 for every \$1 invested. There is strong public support for fiscal policy in Australia, with 69% of grocery buyers reporting they were in favour of a tax on soft drinks to reduce the cost of healthy food, with parents being more supportive than non-parents. The WHO Commission on Ending Childhood Obesity (ECHO) report has recommended that governments consider fiscal policies, such as taxes to reduce the consumption of unhealthy foods such as SSBs and EDNP foods.

### ***Strategies to reduce children's exposure to marketing of EDNP foods***

Research evidence shows that unhealthy food marketing contributes to the high prevalence of childhood overweight and obesity. Policy action reducing marketing of EDNP foods is rated as the second most cost-effective intervention and would save an estimated \$38 for every \$1 invested. Reducing children's exposure to the marketing of EDNP foods and beverages would constitute a significant environmental change, but one which is feasible and cost-effective to implement, and has been widely endorsed. The WHO ECHO report has recommended that governments develop regulations on marketing to limit the consumption of foods and beverages high in fat, sugar and salt by infants and young children.

## EVIDENCE SUMMARY TABLE

STRATEGIES & SETTINGS	POPULATION		
	Preschool –aged children (0-5 years)	Primary school-aged children (5-12 years)	Secondary school aged young people (13-18 years)
Setting: Childcare /pre-school	[Weak-to-moderate evidence] (i) high parental involvement; (ii) parents encouraging their children to drink water; (iii) including specific diet/PA components in programs; and (iv) ensuring consistency of educational material across settings.	Not applicable	Not applicable
Setting: School education	Not applicable	<p><b>[Strong Evidence]</b> (i) physical activity-only interventions delivered in schools with home involvement and for (ii) combined diet–physical activity interventions delivered in schools when both home and community components are also included. (iii) targeting either diet or physical activity singly; (iv) combining interventions delivered in schools with home or community components; and (v) combining interventions delivered in the community with a school component.</p> <p><b>[Moderate Evidence]</b> (i) organised physical activities during breaks, before and after school, (ii) improved availability of physical activity opportunities in and around the school environment; (iii) increased physical education lesson time; (iv) improved availability or accessibility of healthy food options; (v) restricted availability and accessibility of unhealthy food options; and (vi) sedentary behaviour interventions with parental involvement</p>	<b>Lack of evidence</b> for consistently effective interventions. Broader community-wide approach, incorporating interventions which target environments and upstream prevention strategies ( Environmental change, social norms, tackling marketing of EDNP foods including SSBs).
Strategy: school canteens/food services	Not applicable	<p><b>[Strong Evidence]</b> Multi-component interventions, particularly interventions of longer duration, that include changes to the nutrition environment</p>	<b>[Moderate Evidence]</b> Educational interventions on food intake; multi-component interventions
	Promising emerging evidence supports: (i) interventions to target portion size; (ii) audit and feedback to support implementation of healthy school canteens; and (iii) investing in more intense/ higher ‘dose’ programs to support healthy food provision in schools; ((iv) broad implementation of healthy food procurement policies to increase the overall demand for healthier products, and to drive the reformulation of foods by food manufacturers.		
Strategy: sugar sweetened beverages [SSBs] [reduce consumption]	<b>Most cost-effective intervention</b> overall and would save an estimated \$55 for every \$1 invested. Strong public support (69%). Recommended by WHO Commission on Ending Childhood Obesity [ECHO]		
Strategy: marketing of energy dense nutrient poor [EDNP] foods [reduce exposure]	<b>Second most cost-effective intervention</b> overall and would save an estimated \$38 for every \$1 invested. Recommended by WHO Commission on Ending Childhood Obesity [ECHO]		



## EVIDENCE SUMMARY TABLE

STRATEGIES & SETTINGS	POPULATION		
	Preschool –aged children (0-5 years)	Primary school-aged children (5-12 years)	Secondary school aged young people (13-18 years)
<b>Strategy: Active travel</b>	Not applicable	<p><b>[Moderate Evidence]</b> Early intervention during the transition from primary to secondary school, followed by interventions to promote maintenance of active travel through adolescence <i>NSW active travel charter for children</i></p>	<p><b>[Moderate Evidence]</b> Early intervention during the transition from primary to secondary school, followed by interventions to promote maintenance of active travel through adolescence <i>NSW active travel charter for children</i></p>
<b>Setting: Home and Family</b>	<p><b>[Strong Evidence]</b> Programs focused on reductions in TV viewing / screen time in <i>younger</i> children. Design specifications for effective interventions: (i) consistency of educational material across settings; (ii) capacity building of parents; (iii) parents encouraging their children to drink water; and (iv) high level of parental satisfaction and participation</p> <p><b>[Weak-to Moderate Evidence]</b> Interventions to promote healthy family meals can be effective provided they include goal setting, interactive group activities, and interventions focused on cooking and food preparation, cost, shopping, and adolescent influence</p>		
<b>Setting: Community</b>	Insufficient evidence	<p><b>[Moderate Evidence]</b> Community-based initiatives that include a school component. <b>Note:</b> More promising local evidence exists for NSW from the <i>Good for Kids - Good for Life</i> Program Evaluation (see case study in full report)</p>	Insufficient evidence
<b>Setting: Primary Health Care and Health Services</b>	<p><b>[Strong Evidence]</b> <b>0 -5 years</b> Treatment / management (but not prevention) of paediatric overweight and obesity with modest improvements</p> <p><b>0-2-years</b> EPOCH styled intervention increased breastfeeding duration and a reduction in TV viewing</p> <p><b>[Moderate Evidence]</b> <b>3-5-years</b> Parental engagement, behaviour change techniques, skill building, links to community resources</p>	<p><b>[Strong Evidence]</b> Treatment / management (but not prevention) of paediatric overweight and obesity with modest improvements</p>	
<b>Strategy: Social Marketing and Mass Media Campaigns</b>	Effective if well designed, implemented, resourced, and evaluated. Evidence is limited to mass media campaigns		

## Glossary

BMI	Body mass index is a measure of weight adjusted for height. It is calculated as weight in kilograms divided by the square of height in meters. In growing children, BMI varies with age and sex; to be meaningful in children BMI must therefore be compared to a reference-standard that accounts for child age and sex.
zBMI	BMI z-scores, also called BMI standard deviation (s.d.) scores, are measures of relative weight adjusted for child age and sex. BMI z-scores correspond to growth chart percentiles, and can be converted into their equivalent BMI-for-age percentiles by comparison to a normal distribution table.
CI	Confidence interval - a range of values so defined that there is a specified probability that the value of a parameter lies within it (for example 95% CI)
Cost-effective from a societal perspective	Cost-effective from a societal perspective means that the health-care costs and productivity savings that accrue from reducing obesity outweigh the direct investment required to deliver the intervention when assessed over the full lifetime of the target population
CVD	Cardiovascular disease
ES	Effect size. A quantitative measure of the strength of a phenomenon such as a program or intervention. For example, two measures of effect size that are commonly used are the standardized mean difference (SMD), used for continuous measures such as a pain intensity rating scale, and number needed to treat (NNT), which is used for binary outcomes such as responder vs non-responder.
'Strong evidence'	'Strong evidence' indicates high confidence that the evidence reflects the true effect and further research is very unlikely to change our confidence in the estimate of the effect
'Moderate evidence'	'Moderate evidence' indicates moderate confidence and further research may change our confidence and the estimate
'Weak evidence'	'Weak evidence' indicates low confidence and further research is likely to change our confidence and the estimate
'Insufficient evidence'	'Insufficient' indicates that either a body of evidence is unavailable or there was a paucity of studies of reliable quality for the setting / strategy in question
HEAL	Healthy Eating and Active Living strategy
MHN	Make Healthy Normal – the brand name of the campaign developed under the HEAL Strategy in NSW

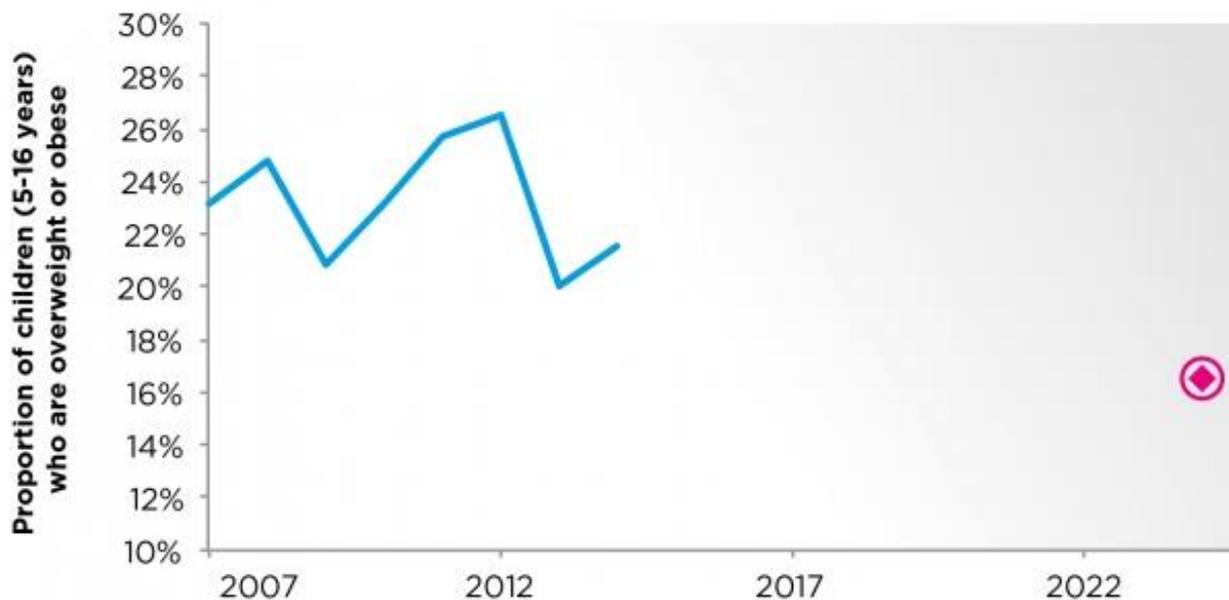
MoH	NSW Ministry of Health
MVPA	Moderate-to-vigorous physical activity
OPH	NSW Office of Preventive Health
PA	Physical activity
PANORG	Physical Activity Nutrition Obesity Research Group; a public health research group within the Prevention Research Collaboration (Public Health) based at the Charles Perkins Centre, the University of Sydney.
RCT	Randomised controlled trial
SMD	The standardized mean difference is used as a summary statistic in meta-analysis when the studies all assess the same outcome but measure it in a variety of ways (for example, all studies measure depression but they use different psychometric scales). In this circumstance it is necessary to standardize the results of the studies to a uniform scale before they can be combined. The standardized mean difference expresses the size of the intervention effect in each study relative to the variability observed in that study; in reality the intervention effect is a difference in means and not a mean of differences.

$$\text{SMD} = \frac{\text{Difference in mean outcome between groups}}{\text{Standard deviation of outcome among participants}}$$

## 2.0 BACKGROUND AND INTRODUCTION

### 2.1 Background

Prevention of childhood overweight and obesity is a priority for the NSW Government and has recently been identified as a Premier's Priority<sup>1</sup>. A NSW Government target has been set to reduce the prevalence of childhood overweight and obesity by an absolute change of 5% in the next ten years (Figure 1). The NSW Office of Preventive Health (OPH) required a rapid review to further update a previous evidence review published in 2012<sup>2</sup>. The new rapid review has a focus on obesity prevention in children (0-18 years). The Physical Activity Nutrition Obesity Research Group (PANORG) was selected to undertake the rapid review. PANORG is funded by the NSW Ministry of Health and is part of the Prevention Research Collaboration (PRC) at the University of Sydney.



Source NSW Health, Population Health Survey (adjusted baseline), ages 5-16

Figure 1 Tackling Childhood Obesity - A NSW Government target has been set to reduce the prevalence of childhood overweight and obesity by 5% in the next ten years.

### 2.2 Strategic Context

The World Health Organisation (WHO) has stated that obesity can be prevented through 'multisectoral action that simultaneously addresses different sectors that contribute to the production, distribution and marketing of food, while concurrently shaping an environment that facilitates and promotes adequate levels of physical activity'<sup>3</sup>. This however, is no easy feat to accomplish. The Director-General of WHO established the high-level Commission on Ending Childhood Obesity (ECHO). The Commission was tasked with producing a report specifying which approaches and combinations of interventions are likely to be most effective in tackling childhood and adolescent obesity in different contexts around the world and outlining a comprehensive strategy, including policy options and an accountability framework to address this growing epidemic. The recommendations set out the WHO ECHO final report<sup>4</sup> are featured as **Appendix 1**.

Despite isolated areas of improvement, no country to date has been successful in reversing its obesity epidemic, although isolated improvements have been achieved<sup>5</sup>. NSW can claim to be one of the few jurisdictions in the world to have shown such improvement. This NSW optimism, in an otherwise gloomy global scenario, has arguably been possible because NSW has in place the kind of long-term strategic approach identified by WHO<sup>3</sup>. Independent modelling of the NSW Healthy Eating Active Living (HEAL) Strategy (designed to address obesity in NSW) indicates that sector-wide health, social and economic benefits from successful implementation of that strategy will be substantial if specified targets are achieved<sup>6</sup>. Further, sub-group analyses using objective measures of BMI from the NSW Schools Physical Activity and Nutrition Survey (SPANS) provide evidence (comparing 2015 data with 2010), that improvements have been achieved in the proportion of overweight NSW students in years K, 4 and 6 with apparent stabilization of the overall combined overweight and obesity rate for children age 5-16<sup>a</sup>. These modest improvements have been achieved after substantial government investment in a range of obesity prevention and management programs in the early childhood and primary school ages (e.g., Munch and Move, Supported Play Groups, Go4Fun) and in the school setting (e.g., Crunch and Sip, Live Life Well @ School).

Whilst this NSW success is a major and rare achievement in obesity prevention, there is little room for complacency as these gains can easily be reversed; in 2015 there were increases in the proportion of NSW secondary students who were overweight or obese compared with 2010. It is now well understood that there is no single or simple solution to the obesity epidemic and that comprehensive, sustained, intensive and multi-pronged approaches are required to tackle this epidemic<sup>7, 8</sup>. The NSW government, through the Premier's commitment in selecting childhood obesity as a priority in the State Plan<sup>1</sup> is arguably in a prime position to provide leadership that can have benefits globally as well as nationally in tackling this expensive and life-threatening epidemic. The NSW target to reduce child overweight and obesity by 5% within 10 years (by 2025) is ambitious. Maintaining the current portfolio of programs and interventions in NSW at the existing intensity ('business as usual'), could lead to reduction in child overweight and obesity in the range of 0.0% — 0.3% per annum. Meeting the target will require a paradigm shift with substantially enhanced investment for a comprehensive set of initiatives, delivered at scale and sustained for a decade.

## 2.3 Report format

This report comprises several sections. **Section 3** describes the aim of this report. **Section 4** describes the methods, sources of evidence and the appraisal thereof. **Section 5** focusses on the specified research questions under consideration and maps the relevant evidence against each question. **Section 6** provides a concise summary of the evidence and the policy implications. **Section 7** describes the challenges in considering the evidence. **Appendices** include a tabulation of the more important studies used in the review, details of the search strategy used as well information about the terms of reference for the rapid review.

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<sup>a</sup> preliminary data, Hardy, L. et al. PANORG, University of Sydney- publication pending

### 3.1 Rapid evidence review

This rapid evidence review is designed to provide a concise summary of evidence that answers specific policy questions presented in a policy-relevant format tailored to the needs of the NSW government. It updates a previous evidence review prepared for MoH in 2012<sup>2</sup> but with a more specific focus on obesity prevention in children and young people aged 0-18 years rather than the full life-course.

### 3.2 Research questions to be addressed

The review addresses the following research questions:

#### **Question 1:**

What does the new evidence (published since 2011) indicate about the effectiveness of population-level and/or settings-based obesity prevention strategies targeting the following three age groups: 0-5 years (pre-school), 5-12 years (primary school), and 13-18 years (high school)?

#### **Question 2:**

What has been shown to work (or not work) in school-based interventions – and what are the characteristics of the effective strategies? In particular:

- 2.1 What is the evidence on the likely effectiveness in NSW of childhood obesity prevention interventions that promote and/or support active travel to school, especially school initiated travel plans?
- 2.2 What is the evidence on the likely effectiveness in NSW of childhood obesity prevention interventions implemented within the high school setting, especially those addressing foods sold and/or promoted through school canteens?

#### **Question 3:**

What is the evidence on the effectiveness of social marketing and population-level communication strategies aimed at children and young people aged 0-18years?

In particular:

- 3.1 What does the evidence demonstrate are the desirable features of social marketing and communication strategies that have been shown to be effective?
- 3.2 What are the characteristics of social marketing and communication strategies that were not effective?

#### **Question 4:**

Based on the findings of this 2015 review update, AND drawing on the earlier findings of the 2012 review, what does the combined body of evidence indicate are likely to be the most promising interventions for the prevention childhood obesity in NSW? In particular:

- 4.1 Which population-level interventions / actions have demonstrated evidence of obesity prevention impacts (i.e. weight related outcome measures)?
- 4.2 Which population-level interventions / actions have evidence of impact on relevant behavioral outcomes (e.g. nutrition, physical activity)?
- 4.3 What are the important outstanding gaps in the combined body of evidence?

**Question 5:**

Overall, how similar and/or different are the conclusions to be drawn from the updated 2015 evidence compared to the earlier conclusions drawn from the 2012 review? (If there are any important changes to the conclusions drawn resulting from the updated evidence, what are the main differences and why?)

The depth and scope of the review is defined overall and for each of the three questions in the agreed scope of work (Appendix 7).

### **3.3 Purpose and audience for the review**

The purpose of this review is to outline what additional evidence has become available in the last five years on childhood obesity prevention strategies – with particular focus on those that have demonstrated effectiveness, and/ or show particular promise for intervening at a population level and/or children’s settings in NSW.

The findings of this new rapid review are expected to assist in guiding further development of obesity prevention initiatives within the NSW Office of Preventive Health and the Centre for Population Health, NSW Ministry of Health, and to inform ongoing policy dialogues with other NSW Government departments and external agencies.

## 4.0 METHODS

### 4.1 Search strategy

Initial searches focussed on higher-quality evidence reviews (meta-analyses and systematic reviews of randomised trials or of longitudinal studies) published in the English language in the last 5 years. We took particular care, as requested, to search for evidence from Australia, New Zealand, Canada and the UK. We implemented a comprehensive search strategy using electronic databases (i.e., Medline, Pre Medline, Cochrane database of systematic reviews, PubMed, NHS Economic Evaluation Database, Health Technology Assessment, and Scopus). We also searched Google Scholar, examining the first three pages of results for any relevant papers, including reviews, primary studies, and commentaries. This was supplemented with a search of papers that had cited any of the identified relevant papers.

#### *Databases*

Search terms used were consistent with the US National Library Medical Subject Headings (MeSH®) Thesaurus (with modifications as required for specific databases). For grey literature, searches were undertaken using selected key words within the advanced search functions of Google / Google Scholar; the search was limited to a maximum of the first 200 results, in keeping with recent guidance<sup>9</sup>.

#### *Eligibility criteria*

- Study type:** meta-analyses and systematic reviews of randomised trials or of longitudinal studies
- Publication date:** published in English since January 2011
- Population of interest:** children and young people aged 0-18 years
- Intervention study aims:** to be included studies needed to report/ assess evidence of effectiveness (i.e. evaluation of intervention impacts and outcomes).
- Impacts and outcomes:** to be included studies needed to report
  - Objectively or subjectively measured physical activity and eating behaviours. Physical activity-related outcomes could include intensity levels, duration of physical activity, frequency of physical activity or sedentary behaviour (e.g. screen time), or related knowledge in these. Eating behaviours could include types of food eaten (e.g. vegetables, fruits, EDNP foods), diet quality (food indices), breakfast programs, meals eaten out, fast food or take-away food consumption, portion size, or nutrition-related knowledge; and
  - Objectively or subjectively measured weight outcomes. These included weight, BMI, waist circumference or anthropometric measures.

#### *Screening and appraisal of evidence*

The search strategy focussed on higher quality evidence reviews (meta-analyses and systematic reviews of randomised trials or of longitudinal studies). Studies published since January 2011 were retrieved; 340 full text papers were retrieved and assessed in detail. All systematic reviews used as the basis for key findings and conclusions of this rapid review were further assessed for quality independently by at least two reviewers using the AMSTAR<sup>b</sup> (Assessing the Methodology Quality of Systematic Reviews) criteria. This method includes assessment of bias, methods used to combine studies, and possible conflicts of interest or funding bias; reviews

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<sup>b</sup> [http://amstar.ca/Amstar\\_Checklist.php](http://amstar.ca/Amstar_Checklist.php)

are assessed as high (AMSTAR score 9–11), moderate (AMSTAR score 5–8); or low quality (AMSTAR score 0–4). The search strategy and PRISMA flow diagram is shown in detail in **Appendix 5**.

## 5.0 ADDRESSING THE REVIEW QUESTIONS

### *Introductory notes to this section*

- This section maps the retrieved research evidence to the research questions under consideration.
- The primary and secondary school setting is dealt with separately in section 5.2; please refer to that section for the detailed discussion of evidence.
- Synthesising evidence to compare how well specific interventions work at preventing obesity is challenging because interventions are not consistently implemented leading to a high level of heterogeneity in any grouped assessment.
- Despite these limitations due to heterogeneity, it is clear from the evidence reviewed in this section that intervening to prevent obesity in children can work. Effects are often small but meaningful in terms of potential to prevent obesity. Not everything works equally well in all groups of children and there are age variations and possibly gender differences in effectiveness of interventions.
- Any single intervention is likely to have only a small overall impact on its own. A systemic, sustained portfolio of cumulative initiatives, delivered at scale, is needed to tackle overweight and obesity.
- Interventions that change the physical activity and food and drink environments (and do not rely on conscious elements such as willpower or motivation) not only have greater impact but are also more cost-effective than the ‘conscious’ interventions.
- Recent analyses suggest that almost all interventions proposed to tackle obesity are cost-effective for society: savings on health-care costs and higher productivity outweigh the direct investment required to delivering the interventions when assessed over the full lifetime of the target population.

### 5.1 What does the new evidence indicate about the effectiveness of population-level and/or settings-based obesity prevention strategies targeting the following three age groups: 0-5 years, 5-12 years, and 13-18 years?

#### 5.1.1 Overview of population- and settings-based strategies for 0-18-year-olds

Four recent high-quality<sup>c</sup> systematic reviews provide an *overall* evidentiary basis for addressing this research question<sup>10-13</sup>; these are supplemented as appropriate with additional studies in the more detailed sections (5.1.2 – 5.1.11) that follow. Wang and colleagues updated in 2015<sup>11</sup> their earlier systematic review of 2013<sup>10</sup> and reported on the effectiveness of all childhood obesity prevention programmes (in high-income countries) targeting diet, physical activity (PA) or a combination of both behaviours, for children aged 2-18 implemented in a wide range settings or designs (e.g. school, home, primary care, childcare, community, and consumer health informatics<sup>11</sup>). The systematic review examined studies implemented in any setting (or design) that tested obesity prevention interventions in high-income countries. Studies up to April 2013 were assessed. These high quality reviews were funded by the US Agency for Healthcare Research and Quality and the National Institutes of Health<sup>10, 11</sup>. The review was a synthesis of 147 articles (139 intervention studies) of which 115 studies were mainly school-based, although other settings could have been involved. Most were conducted in the United States and within the past decade. Strength of evidence (SOE) was high for physical activity-only interventions delivered in schools with home involvement or combined diet–physical activity interventions delivered in schools with both home and community components. SOE was moderate for school-based interventions targeting either diet or physical activity; combined

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<sup>c</sup> AMSTAR score of 9 or above

interventions delivered in schools with home or community components and combined interventions delivered in the community with a school component. SOE was low for combined interventions in childcare or home settings. In short, the researchers found at least moderately strong evidence for the effectiveness of school-based interventions for the prevention of childhood obesity; they found that definitive evidence was not, as yet, available for programmes in other settings or of other design types, especially environmental, policy and consumer health informatics-oriented interventions<sup>11</sup>.

Peirson and colleagues updated a Cochrane review in their 2015 systematic review and meta-analysis of overweight and obesity prevention programs; studies up to August 2013 were assessed<sup>12</sup>. Prevention interventions in mixed-weight populations of children and adolescents showed a small effect, compared with the control groups, in terms of a lowered BMI and a reduced prevalence of overweight and obesity. For overweight or obese children and youth, these changes were not clinically meaningful. Sixteen studies were found to show a significant benefit of intervention compared with the control groups in terms of a reduced BMI; characteristic of efficacious interventions are shown in **Table 1**. Of these 16 studies, 14 programs were located in educational settings, 15 involved group sessions, 4 incorporated family involvement and 6 specified that staff training was provided. Intervention duration ranged from 12 weeks to 3 years. Ten programs lasted 1 year or less and 8 were in place for 6 months or less. Most interventions (n = 13) were offered to mixed-sex groups and more than half (n = 9) involved children who were elementary school age. Intervention type varied (diet (n = 4), exercise (n = 5), diet plus exercise (n = 5) and lifestyle (n = 2)) as did location (Europe (n = 7), United States (n = 4), Australia (n = 2), China (n = 1), Egypt (n = 1) and Israel (n = 1)). Many efficacious interventions lasted less than 1 year, involved children who were elementary school age and were implemented in educational settings, but the researchers concluded that there was too much variation across programs to isolate any determining features of effectiveness<sup>12</sup>.

**Table 1 Characteristics of efficacious interventions for children and young people aged 0-18 years (Pierson et al. 2015)<sup>d</sup>**Source: Peirson et al. 2015<sup>12</sup>

Study	Sex	Target age, yr	Intervention duration	Estimated no. or frequency of sessions	Type of intervention	Intervention setting	Group sessions	Family involvement	Staff training
Amaro et al., 2006 <sup>39</sup>	M + F	6–12	24 wk	1x/wk	Diet	E	Yes	—	—
Barkin et al., 2012 <sup>83</sup>	M + F	0–5	12 wk	1x/wk	Diet + exercise	N	Yes	Yes	—
Campbell et al., 2013 <sup>109</sup>	M + F	0–5	15 mo	6 2-h sessions	Diet	N	Yes	Yes	—
de Ruyter et al., 2012 <sup>84</sup>	M + F	6–12	1.5 yr	Daily beverage consumption	Diet	E	—	—	—
El Ansari et al., 2010 <sup>62</sup>	M + F	13–18	3 mo	2x/wk	Exercise	E	Yes	—	—
Haerens et al., 2006 <sup>52</sup>	M + F	13–18	2 yr	Unclear	Diet + exercise	E	Yes	—	Yes
Healthy Study Group et al., 2010 <sup>57</sup>	M + F	6–12	3 yr	Unclear	Diet + exercise	E	Yes	Yes	Yes
Lazaar et al., 2007 <sup>40</sup>	M + F	6–12	6 mo	2x/wk	Exercise	E	Yes	—	—
Li et al., 2010 <sup>59</sup>	M + F	6–12	1 yr	2x/d	Exercise	E	Yes	—	—
Llargues et al., 2012 <sup>95</sup>	M + F	6–12	2 yr	Unclear	Diet + exercise	E	Yes	—	Yes
Lubans et al., 2011 <sup>81</sup>	M	13–18	6 mo	Unclear	Exercise	E	Yes	—	—
Nemet et al., 2011 <sup>104</sup>	M + F	0–5	10 mo	Daily	Diet + exercise	E	Yes	—	Yes
Neumark-Sztainer et al., 2003 <sup>50</sup>	F	13–18	16 wk	> 4x/wk	Lifestyle	E	Yes	—	Yes
Rosario et al., 2013 <sup>115</sup>	M + F	6–12	2 yr	12 sessions	Diet	E	Yes	—	Yes
Story et al., 2003 <sup>36</sup>	F	6–12	3 mo	2x/wk	Lifestyle	E + other	Yes	Yes	—
Thivel et al., 2011 <sup>103</sup>	M + F	6–12	6 mo	2 h/wk	Exercise	E	Yes	—	—

Note: E = educational, F = female, M = male, N = noneducational.

Waters et al. updated in 2013 their Cochrane review that examined (i) the effectiveness of evaluated interventions intended to prevent obesity in children, assessed by change in BMI; and (ii) the characteristics of the programs and strategies to answer the questions “What works for whom, why and for what cost?”<sup>13</sup>. The majority of eligible studies targeted children aged 6-12 years; a meta-analysis that included 37 studies of 27,946 young people found that programs were effective at reducing adiposity, although not all individual interventions were effective, and there was a high level of heterogeneity.

Overall, children in the intervention group had a standardised mean difference in adiposity (measured as BMI or zBMI) of  $-0.15\text{kg}/\text{m}^2$  (95% CI  $-0.21$  to  $-0.09$ ). Intervention effects by age subgroups were  $-0.26\text{kg}/\text{m}^2$  (95% CI:  $-0.53$  to  $0.00$ ) (0-5 years),  $-0.15\text{kg}/\text{m}^2$  (95% CI  $-0.23$  to  $-0.08$ ) (6-12 years), and  $-0.09\text{kg}/\text{m}^2$  (95% CI  $-0.20$  to  $0.03$ ) (13-18 years); non-significant for adolescents. Heterogeneity was apparent in all three age groups and could not be explained by randomisation status or by the type, duration or setting of the intervention. No evidence of adverse outcomes such as unhealthy dieting practices, increased prevalence of underweight or body image sensitivities was found in the eight studies that did examine the potential for adverse effects. Interventions did not appear to increase health inequalities although this was examined in fewer studies.

The authors concluded that there is strong evidence to support beneficial effects of child obesity prevention programmes on BMI, particularly for programs targeted to children aged six to 12 years. Despite the challenge posed by the heterogeneity of programs studied, the authors also identified the most promising policies and strategies as follows:

<sup>d</sup> Note that references within Table 1 are from Peirson et al. and do not refer to references shown at the end of this rapid review report

- School curriculum that includes healthy eating, physical activity and body image.
- Increased sessions for physical activity and the development of fundamental movement skills throughout the school week.
- Improvements in nutritional quality of the food supply in schools.
- Environments and cultural practices that support children eating healthier foods and being active throughout each day.
- Support for teachers and other staff to implement health promotion strategies and activities (e.g. professional development and capacity building activities).
- Parental support and home activities that encourage children to be more active, eat more nutritious foods and spend less time in screen based activities.

In March 2015, the UK National Institute for Health and Care Excellence (NICE) published guidelines on preventing excess weight gain in children and adults, together with evidence reviews supporting the guidelines. Whilst the specific NICE guideline (NH7) does not itself cover prevention of childhood obesity, the core systematic review underpinning it (examining studies from 2005 up to November 2013) included a relevant evidence synthesis which examined the strength of associations between behaviours and weight outcomes<sup>14</sup>. This evidence synthesis provides a strong rationale for interventions to address screen time and SSBs, and moderate evidence to support interventions that can address fat and dietary sugars, food prepared outside the home, and sleep<sup>14</sup>. Interventions to reduce screen time are also supported by the recent systematic review reported by Friedrich and colleagues<sup>15</sup>.

A very recent report by the WHO ECHO provides a model comprehensive strategic approach, strategic objectives and policy options<sup>4</sup>. The objectives and options are consistent with the evidence synthesis presented in this rapid evidence review and are included as **Appendix 1**.

### 5.1.2 Programs and interventions for children aged 0-5 years

Interventions in the childcare setting are discussed separately in section 5.1.3.

#### *Australasian world-first obesity prevention initiatives in early childhood*

Several high quality RCTs of obesity prevention in children aged 0-5 years have been undertaken. Four of these are from Australia and New Zealand. The Healthy Beginnings Trial is an RCT of a home visiting intervention to new mothers in a socially disadvantaged region of Sydney, which begins in late pregnancy and continues to age 2 years<sup>16-18</sup>. The Infant Feeding Activity and Nutrition Trial (InFANT) study, based in Melbourne, is a cluster RCT of anticipatory guidance and discussion provided to existing mothers' groups, running from when the child is aged 3 to 18 months<sup>19, 20</sup>. The NOURISH study, based in Brisbane and Adelaide, is an RCT of two modules of anticipatory guidance via parent groups, occurring when the child is aged 4-7 months and again at 13-16 months<sup>21, 22</sup>. Finally, the Prevention of Obesity in Infancy study is a four arm RCT involving additional parental support (including home visits) around food, activity and breastfeeding, or sleep, or a combination of both; the study duration is from late pregnancy to when the child is aged 2 years<sup>23</sup>. These four trials are the very first high-quality RCTs focussing on obesity prevention interventions in the first 2 years after birth - arguably the most difficult period to assess - and the largest to date in this age group.

The investigators of these four trials came together in 2009 to form the EPOCH prospective meta-analysis collaboration<sup>24</sup>. Shared participant data cross the four separate trials has been used to examine whether innovative interventions to prevent childhood obesity influence BMI at ages 18-24 months. To date, EPOCH interventions have resulted in improvements in BMI at ages 18-24 months, as well as increased breastfeeding duration and a reduction in TV viewing. This approach, involving the largest trials in the 0-2 age group (total N>2000), remains a world first<sup>24</sup>.

#### *Other evidence for children aged 0-5 years*

The systematic review of interventions to prevent and manage overweight or obesity in preschool children, reported by Ling et al., examined studies from 1996 to February 2015<sup>25</sup>. Consistent with evidence reported in section 5.1.8, management interventions showed greater effects in weight loss compared to prevention interventions which were sub-optimal. The review found that management interventions should focus on parents as the "agents of change" for physical activity and nutrition while integrating behavioural therapy techniques and interactive education. It is clearly essential to actively involve parents in an overweight/ obesity management intervention although evidence on the required intensity of this involvement requires further investigation<sup>25</sup>.

The 2015 review conducted by Peirson and colleagues<sup>12</sup> reported two efficacious interventions for this age group (Barkin et al., 2012<sup>26</sup>; and Campbell et al. 2013<sup>27</sup>). The characteristics of these interventions are shown in Table 2

**Table 2 Characteristics of efficacious non-education interventions targeting children aged 0-5 years (from Peirson)**

Study	Gender	Intervention Duration	Estimated Frequency	Intervention Type	Group sessions	Family involvement	Staff Training
Barkin et al. 2012 <sup>26</sup>	M + F	12 weeks	1 x /wk	Diet + PA	Yes	Yes	—
Campbell et al. 2013 <sup>27</sup>	M + F	15 months	6 x 2-h sessions	Diet	Yes	Yes	—

Source: Peirson et al. 2015<sup>12</sup>

The 2012 review by Summerbell et al. examined the development and implementation of interventions for the prevention of overweight and obesity in young children aged 4 — 6 years<sup>28</sup>. This so-called "ToyBox" review was itself built upon four reviews: three reviews of educational strategies and psychological approaches explaining young children's acquisition and formation of energy-balance related behaviours as well as a systematic review of behavioural models underpinning the prevention of obesity in this age group. The Summerbell review sets out

general considerations and program design specifications for the prevention of obesity in this age group<sup>28</sup> as shown in **Table 3**.

The 2014 high quality systematic review by Laws et al. examined the effectiveness of interventions to prevent obesity or improve obesity related behaviours in children 0-5 years from socioeconomically disadvantaged or Indigenous families<sup>29</sup>. Thirty-two studies were identified, with only two (both low quality) in Indigenous groups. Fourteen studies had a primary aim to prevent obesity. Mean differences between intervention and control groups ranged from -0.29 kg/m<sup>2</sup> to -0.54 kg/m<sup>2</sup> for BMI and -2.9 to -25.6% for the prevalence of overweight/ obesity. Interventions initiated in infancy (under two years) had a positive impact on obesity related behaviours (e.g. diet quality) but few measured the longer-term impact on healthy weight gain. Findings amongst pre-schoolers (3-5 years) were mixed, with the more successful interventions requiring high levels of parental engagement, use of behaviour change techniques, a focus on skill building and links to community resources. Less than 10% of studies were high quality<sup>29</sup>.

### **5.1.3 *Childcare setting***

There is weak-to-moderate evidence for the effectiveness of childhood obesity interventions in the childcare setting. Available evidence suggests that interventions can impact weight outcomes and that the likely success factors are high parental involvement, parents encouraging their children to drink water in preference to SSBs, including specific diet/PA components and ensuring consistency of educational material with other settings.

In addition to the more general reviews reported in section 5.1.1<sup>10, 11</sup>, four setting-specific systematic reviews are considered here. Zhou and colleagues reviewed 15 RCTs to April 2012. Seven studies reported improvements in adiposity. Six (of 13) interventions that included a dietary component reported improved intake or eating behaviours. Eight (of 12) interventions that included PA components reported improved levels of PA or physical fitness<sup>30</sup>. The 2015 review by Morris et al. focussed on parental involvement in childcare, reporting four factors that were linked to weight changes: (i) consistency of educational material across settings; (ii) capacity building of parents; (iii) parents encouraging their children to drink water in preference to SSBs; and (iv) parental satisfaction and participation. The study authors concluded that partnership between parents and childcare may be effective<sup>31</sup>. Nixon and colleagues 2012 review also emphasised the value of high levels of parental involvement as well as interactive learning methods<sup>32</sup>.

**Table 3 Principles and program design specifications for prevention of obesity in 4-6-year-old children**

***General principles***

- Limited number of evidence-based interventions with a clear and simple message
- Main target should be parents and carers, with support from community and schools
- Include parental components, such as role modelling, especially for fathers/male carers, and incorporate PA
- Ensure resource relevance, considering access and literacy levels of parents and children
- Outcomes for evaluation should be focussed on children

***Program design specifications***

- Combine physical activity and nutrition interventions using clear and simple messages
- Non-food rewards for children achieving positive behaviour change
- Incorporate role modelling components (older peers, teacher, parents)
- Use a common framework which can be tailored to the target population

***Physical activity and sedentary behaviour***

- Sensitive to children's confidence to participate in different physical activities
- School based interventions built into (not before or after) the usual school day
- Promotion of at least 60 minutes physical activity per day, including weekends
- Include screen time limits (less than 2 hours per day) in recommendations
- Encourage playful, enjoyable physical activity for children in a variety of environments

***Healthy eating***

- Raise awareness in parents, carers and teachers about familiarisation with healthy foods at a young age and strategies for fussy eaters
- Food availability – increase healthy food and drink items, limit EDNP foods, snacks and SSB's.
- Implement strategies (e.g., menu planning, tasting sessions, and food preparation) to introduce more healthy foods at home and at school.
- Involve children in discussions and activities at home and school to identify barriers to choosing healthy foods and how these might be overcome.

***Obesity prevention message framing when developing interventions for 4-6 year olds***

- Promote active transport (walking / cycling / scooter) for short distances
- Encourage visits to active spaces and places
- Discourage/limit screen time, avoiding screen use in the bedroom
- Encourage non-competitive participation in physical activity
- Encourage parents to provide appropriate clothing for indoor and outdoor activity
- Develop active play enhancing all weather play areas in kindergartens and schools
- Provide game equipment during lesson breaks and encourage children to be active
- Change sedentary activities to be active, in classrooms and at home
- Encourage eating together as a family unit
- Discourage eating in the presence of screens (TV, tablets, game consoles)
- Encourage a variety of healthy foods, discourage EDNP foods, snacks and SSBs

Source: Adapted from Summerbell et al.<sup>28</sup>

#### ***5.1.4 Programs and interventions for children aged 5-12 years***

Children in this age group are developing swiftly and forming behaviours which they are likely to maintain into later life. Schools are the primary setting for programs and interventions targeting children and young people, due to the time they spend within this setting. A comprehensive description of primary school-based interventions is provided in section 5.2 and includes active travel between school and home. In the wider community, an environment which supports physical activity and active travel is an essential component in improving health behaviours of children<sup>33</sup>. Afterschool programs which promote physical activity and healthy eating have been found to have a positive, moderate effect on reducing BMI<sup>33, 34</sup>, and single-behaviour interventions during these hours may be more effective<sup>35</sup>. Sports and community groups have an important role in encouraging participation in organised sports. Children who participate in organised sports are more physically active and also more likely to consume fruits, vegetables and milk and avoid SSBs in an energy balanced diet<sup>36</sup>. Sedentary behaviour interventions have been found to have small but significant effects on reducing BMI in children<sup>37</sup>, with consistent findings from restrictions of TV viewing time<sup>38</sup>. Reaching 5-12 year olds is best achieved through parental involvement, making the home and family setting an essential part of a multi-component intervention to address childhood obesity<sup>38, 39</sup>. Parental involvement in nutritional interventions is efficacious as they control the food available to children.

### **5.1.5 Programs and interventions for young people aged 13-18 years**

Refer to section 5.2.2 for discussion of the secondary school setting. Targeting adolescents specifically with obesity prevention / education programs appears not to be as effective as a taking a broader community-wide approach<sup>40</sup>, incorporating interventions which target environments and upstream prevention strategies noted elsewhere in this report (for example, tackling marketing of EDNP foods including SSBs).

Young people or adolescents (13-18 years old) pose a challenge for obesity prevention program designers with current evidence offering inconclusive findings on what is effective. Peer relationships are a salient characteristic of promising interventions with adolescents, while parental involvement has reduced influence compared to younger age groups. Interventions which target environments and upstream prevention strategies appear to be more effective than adolescent education programs. A 2015 review of adolescent obesity *treatments* found that supervised exercise sessions were effective at reducing BMI, but did not modify total physical activity. Complex interventions which strengthen behaviour management skills and provide material or informational support can influence behaviours of overweight or obese adolescents<sup>41</sup>.

### **5.1.6 Home and family-centred strategies**

There is strong evidence for the home and family setting as a context to address reductions in TV viewing / screen time in younger children. There is weak to moderate evidence for other interventions. Intervention success is generally found to be higher in younger compared to older children. Four success factors have been identified for designing more effective interventions: (i) consistency of educational material across settings; (ii) capacity building of parents; (iii) parents encouraging their children to drink water in preference to SSBs; and (iv) parental satisfaction and participation. The most promising obesity prevention interventions for children under 2 years of age appear to be those that focus on diet and responsive feeding. Interventions to promote healthy family meals can be effective; suggested program design specifications include goal setting, interactive group activities, and intervention targets included cooking and food preparation, cost, shopping, and adolescent influence.

A substantial body of relevant evidence for home and family-centred intervention was retrieved, including 24 systematic reviews<sup>10, 31, 34, 37, 39, 42-60</sup>. Redsell and colleagues review concluded that the most promising obesity prevention interventions for children under 2 years of age are those that focus on diet and responsive feeding; future interventions should consider the option of advising some families to offer lower protein formula milk together with behavioural change components<sup>42</sup>. Morris et al. identified four success factors for effectiveness: consistency of educational material across settings; capacity building of parents; parents encouraging their children to drink water in preference to SSBs; and parental satisfaction and participation. These researchers emphasise the importance of partnership between parents and early childhood education and care (ECEC) for obesity prevention<sup>31</sup>.

Kader and colleagues focussed on four intervention types: face-to-face counselling, group education, information sent home, and telephone counselling. Face-to-face or telephone counselling was effective in changing children's diet, with weak evidence only for improvement in PA. Sending information home was not effective; group education was deemed more effective than counselling, especially so with low-SES groups; and intervention effectiveness was generally found to be higher in younger compared to older children<sup>43</sup>. Jang et al. reviewed seven programs that targeted parents to manage childhood overweight and obesity. The majority of these programs demonstrated improvement in child BMI but the study cautions that families of diverse race/ethnicity were not well served, programs were provided by highly trained professionals, and there was a high attrition rate, thus limiting generalisability<sup>44</sup>. Upton and colleagues' 2014 review focussed on family-based programs implemented in the UK; it found insufficient evidence to determine how the inclusion of parents and the wider family may impact on effectiveness<sup>48</sup>.

Dwyer and colleagues examined interventions designed to promote healthy family meals. Four interventions resulted in greater family meal frequency. Intervention settings were diverse and included the home, community, medical settings, the workplace, and the internet. Common strategies were goal setting, interactive group activities, and intervention targets included cooking and food preparation, cost, shopping, and adolescent influence. Barriers to be addressed in future intervention development and research include time and scheduling challenges, cost, food preferences, increasing youth involvement in mealtime, tailoring interventions to family characteristics, and providing support for families experiencing time-related barriers<sup>45</sup>; Martin-Biggers et al. noted that more frequent family meals are associated with greater consumption of healthy foods in children and adolescents, and may decrease their risk of overweight or obesity. Frequent family meals may also protect against eating disorders and negative health behaviours in adolescents<sup>49</sup>. Williams's systematic review of breakfast cereal consumption, reported in 2014, found a lack of evidence on which to determine the effectiveness of intervention programs in this area<sup>47</sup>.

Marsh et al. systematically reviewed randomized controlled trials of interventions with a family component that targeted reduction of sedentary time, including TV viewing, video games and computer use, in children. Interventions that included a parental component of medium-to-high intensity were consistently associated with statistically significant changes in sedentary behaviours in pre-school ages rather than in older children<sup>37</sup>. Ewald and colleagues review compared parent-only interventions with interventions that also included the child (overweight/obese children aged 5-12 years) and reported at least 6 months follow-up. Whilst attrition rates were higher, parent-only groups were either more effective than or similarly effective as child-only or parent-child interventions. One study examined programme costs and found parent-only interventions also to be cheaper<sup>50</sup>.

Dellert et al. conducted a meta-analysis to examine the effect of interventions with parents and children on children's physical activity and BMI. Most studies were in children aged 9-13 years with few studies only of younger or older subjects. A significant effect on physical activity but not on BMI was found when interventions included both parents and their children. To improve physical activity levels of children, interventions need to be targeted at parents and children together, rather than including just children. Although weaker, there was also a significant effect on BMI but only when children received an intervention without their parents' involvement. The researchers speculate that children's concern about peers' perceptions of BMI is more important than that of parents' perceptions about weight, and this may explain why interventions with children alone impacted BMI<sup>51</sup>.

### **5.1.7 Community-based strategies**

There is moderate systematic review evidence for the effectiveness of community-based initiatives that include a school component. Improvements have generally been limited to weight change in primary school-aged children, with limited evidence of changes in healthy eating or physical activity in the other age groups. There is more promising evidence of effectiveness from one community-based program implemented in NSW that has not as yet been incorporated in systematic reviews; a case study of this program is presented in Table 5.

A number of reviews have found moderate evidence for the effectiveness of community-based initiatives that include a school component<sup>61-63</sup>. The effects have generally been limited to weight change in primary school-aged children, with limited or no evidence of changes in healthy eating or physical activity or in preschool-aged children or adolescents. Further, there is insufficient evidence on the efficacy of community-based programs that do not include a school component. The characteristics of community based programs shown in Table 4 are based on included studies in the systematic review conducted by Bleich and colleagues<sup>63</sup>.

In their narrative review, Hillier and colleagues argue that community-based, complex interventions with a focus on upstream determinants of health (specifically, healthy eating, sedentary behaviour, and physical activity) are likely to be most effective in addressing childhood obesity<sup>40</sup>. They do note, however, a number of challenges inherent in the design and evaluation of such interventions, including recognising that traditional experimental study designs (i.e. RCTs) may not be appropriate, identifying and measuring an appropriate outcome(s), identifying, engaging with, and maintaining relationships with critical partners, and ensuring health inequalities are addressed

and not exacerbated. Determinants of implementation success for intersectoral community-based childhood obesity interventions was examined by van der Kleij and colleagues who found that strong collaboration between community partners and having adequate resources and time had the most evidence for their importance<sup>64</sup>. However, the authors note that there were no explicit links made or testing of between determinants and implementation success in the primary studies and thus their conclusions are tentative at best. They call for future research to explicitly address implementation success factors to fill this gap.

**Table 4 Characteristics of community-based childhood obesity prevention programs in selected research studies**

First Author, Year, Country	Setting(s)	RCT	Sample Size	Sample Age (Range or Mean y)	Girls (%)	Intervention Time: Elements Included in the Intervention	Follow-up Period <sup>a</sup> (mo)
Chang, 2010, United States <sup>20</sup>	Community, school, primary care, and child-care components	No	4595	2–17	NR	24 mo: social marketing, strategic partnerships, knowledge mobilization, strategies in multiple sectors	NR
Chomitz, 2010, United States <sup>24</sup>	Community, school	No	1858	8	48	36 mo: city policies, community awareness campaigns, physical education enhancements, food service reforms, farm-to-school-to-home programs, family outreach, BMI and fitness reports	36
de Silva-Sanigorski, 2010, Australia <sup>21</sup>	Community, home, primary care, child care	No	43 811	2–3.5	49	48 mo: community capacity building and environmental changes to increase healthy eating and active play	48
Economos, 2007, United States <sup>29</sup>	Community, school, home	No	1178	7	NR	10 mo: physical activity options and availability of healthy foods before, during, and after school; social marketing; family outreach and engagement	36
Eiholzer, 2010, Switzerland <sup>25</sup>	Community only	Yes	46	13	0	4 mo: resistance exercise program	12
Klesges, 2010 <sup>28</sup>	Community, home	Yes	303	9	100	20 mo: group behavioral counseling (obesity prevention program) or self-esteem and social efficacy (alternative intervention)	24
Robinson, 2010, United States <sup>27</sup>	Community, home	Yes	261	9	100	24 mo: dance classes and reduced screen use; health education	24
Sallis, 2003, United States <sup>25</sup>	Community, school	Yes	24 schools (mean enrollment: 1109)	NR	49	24 mo: physical education, physical promotion throughout school day, changes to school food service, social marketing	24
Singh, 2009, Netherlands <sup>28</sup>	Community, school	Yes	1108	13	53	8 mo: education in biology and physical activity, environmental change options for schools (physical education classes, changes to school cafeteria)	20

The sample size of each study represents the number of children included in the analysis with both baseline and follow-up data available. NR, not reported.  
<sup>a</sup> From start of intervention.

Source: Bleich et al. (2013)<sup>63</sup>

**Table 5 Good for Kids - Good for Life Program (GFK) - a case study of success in NSW, Australia**

In NSW, the *Good for Kids - Good for Life* Program (GFK) provides useful information on which to build the next generation of community based programs<sup>65, 66</sup>. GFK interventions were implemented through primary schools, child care services, community services, sports clubs, GPs, Aboriginal Health Workers and health services and were supported by a social marketing strategy. Evaluation of GFK found that centre-based childcare services in the intervention region were significantly more likely to provide only plain milk and water for children ( $P = 0.018$ ) and to engage parents in nutrition policy or programmes ( $P = 0.002$ ). They were also more likely ( $P = 0.056$ ) to have nutrition policy on home packed food. In addition, menus of services that provided lunch were significantly more likely to comply with healthy eating guidelines for sweetened drinks ( $P < 0.001$ ), fruit ( $P < 0.001$ ) and vegetables ( $P = 0.01$ ). GFK was able to modify policy and practice in a large number of child-care services so that they were more supportive of healthy eating<sup>65</sup>. GFK communication campaigns increased and maintained awareness of childhood obesity prevention messages which were delivered equitably to diverse socio-demographic groups within the intervention region<sup>66</sup>. The evaluation indicated that the adoption rate of programs by organisations/ settings was good and that interventions impacted overweight and obesity.

Adoption rate

- Schools 69%;
- Child care 80%;
- Community services 80%;
- Community sports clubs 41%; and
- GPs 30%

The prevalence of combined overweight and obesity among 5-10-year-olds were reduced by 3.3% among boys and by 7.4% among girls<sup>e</sup>.

<sup>e</sup> Unpublished data; Wiggers, J. Special presentation, Charles Perkins Centre, Sydney, 26 October 2015

### 5.1.8 Primary health care/ health service-based strategies

There is strong evidence for the effectiveness of interventions in the primary health care setting for the treatment of paediatric overweight and obesity, with modest results. Success factors for interventions appear to be: (i) training for health professionals before intervention delivery; (ii) including behaviour change components (for healthy diet, physical activity and sedentary behaviour); (iii) effecting behaviour change via a combination of counselling, education, written resources, support and motivation; and (iv) tailoring intervention intensity according to whether behavioural, anthropometric or metabolic changes are the clinical priority.

There is weak evidence for primary care-based childhood obesity prevention interventions and existing programs are very resource intensive.

Wang and colleagues 2015 review examined primary care-based or aligned interventions (to April 2013) including (i) primary-care only-based (one quasi-experimental study showing no reduction in obesity rates); (ii) home-based with primary care and health informatics component (one RCT, no effect on BMI); (iii) primary care-based with a home component (two RCTs, one with significant impact on BMI). The study authors concluded that the strength of evidence was insufficient to suggest effectiveness for these primary-care interventions<sup>11</sup>.

In 2015, Peirson and colleagues updated an existing Cochrane review<sup>13</sup>, examining primary care-relevant behavioural (diet, exercise and lifestyle) interventions for preventing overweight and obesity in healthy normal or mixed-weight children or youth aged 0–18 years. Studies up to August 2013 were examined<sup>12</sup>. Interventions showed a small but significant effect on BMI, a reduction in BMI (mean difference  $-0.09$  kg/m<sup>2</sup>, 95% CI  $-0.16$  to  $-0.03$ ,  $I^2 = 76\%$ ) and a reduced prevalence of overweight and obesity (risk ratio (RR);  $RR_{\text{intervention}} - RR_{\text{control}}$  0.94, 95% CI 0.89 to 0.99,  $I^2 = 0\%$ ; number needed to treat = 51, 95% CI 29 to 289)<sup>12</sup>.

In 2015, Seburg et al.<sup>67</sup> conducted a review of 31 studies which were primarily RCT's and focused on *treatment* of child overweight and obesity. They identified eight studies which had significant effects on child weight outcomes. All effective interventions focused specifically on weight management and monitored changes in physical activity, nutrition and sedentary behaviours. There was limited evidence for the efficacy of primary health care in the prevention of overweight and obesity in children and young people; however treatment interventions were found to yield modest results. Primary care interventions were efficacious when using multiple approach delivery modes<sup>67</sup>, including the use of technology<sup>68</sup>. This is consistent with the findings of Sargent and colleagues, whose 2011 systematic review included 12 studies reporting at least one significant intervention effect<sup>69</sup>; analysis of the 12 efficacious interventions provided evidence to support (i) training for health professionals before intervention delivery; (ii) behaviour change options (including healthy diet, activity and sedentary behaviour); (iii) effecting behaviour change via a combination of counselling, education, written resources, support and motivation; and (iv) tailoring intervention intensity according to whether behavioural, anthropometric or metabolic changes are the priority<sup>69</sup>.

The 2015 Lancet Obesity Series<sup>68</sup> highlights that primary health care providers are poorly prepared to treat paediatric obesity. Sustainable treatment of paediatric obesity involves integration of clinical and community approaches which are family centred<sup>67, 68, 70</sup>. Evidence for primary care based childhood obesity prevention interventions is limited<sup>10</sup> and interventions are very resource intensive<sup>67</sup>. Training doctors and nurses in behaviour change counselling, especially during early childhood where interactions with primary care professionals is high, may increase prevention practices<sup>71</sup>. Ruotsalainen et al., in 10 of the 14 studies analysed in their 2015 systematic review of PA-focussed interventions, found significant improvement in BMI or zBMI of adolescents in the intervention groups<sup>41</sup>; effects on BMI were modest but were greater with interventions that used supervised exercise. Settings of successful interventions were more specifically described as primary care/hospital-based (3 studies); home-/family-based (3); school-based/-recruited (2); web-based (1); and media-recruited (1). The authors concluded that interventions that include a component for promoting physical activity with or without supervised exercise can affect subsequent physical activity and BMI among overweight or obese adolescents (12-18-year-olds)<sup>41</sup>.

Bhuyan and colleagues 2015 systematic review examined studies to October 2014 in an analysis of primary care physician (PCP) mediated interventions targeting childhood obesity<sup>70</sup>; from nine eligible studies included, PCP-mediated interventions comprised behavioural, educational and technological interventions or a combination of these. Most interventions led to positive changes in BMI, healthier lifestyles and increased satisfaction among parents. PCPs participated in screening and diagnosing, making referrals for further intervention, providing nutrition counselling, and promoting physical activity. PCPs, dietitians and nurses were often part of the healthcare team. Study authors concluded that PCP-mediated interventions have the potential to effectively curb childhood obesity; however, there is a need for training of PCPs in new types of interventions such as the use of technology<sup>70</sup>.

Ligthart et al. conducted a meta-analysis to assess the effect of multidisciplinary intervention (MI) programs for overweight and obese children on quality of life (QoL)<sup>72</sup>. Eleven studies (to July 2014) were included, studying a total of 997 children aged 3–18 years. No significant differences were found between MI and control interventions on short-term QoL outcomes (mean difference (MD) 1.73, 95 % CI -0.26 to 3.73 on a 0–100 scale). Long-term results showed a non-significant trend toward a higher QoL in children following an MI program compared with control interventions (MD 4.40 95 % CI -0.12 to 8.92). The authors concluded that there is insufficient evidence that MI programs, aimed to reduce weight in overweight and obese children, improve QoL<sup>72</sup>. The authors have separately commented on cost-effectiveness, noting that program costs varied from £49.52 to £898.69 per child and four of the six programs were cost-effective and might lead to less indirect costs, since most studies report small, but non-significant improvements in QoL<sup>73</sup>. Foster and colleagues review of treatment interventions for overweight or obesity in preschool-age children (to July 2014) found some evidence (two RCTs) that multidisciplinary, intensive interventions have some evidence of efficacy in reducing adiposity in preschool-age children<sup>74</sup>.

### **5.1.9 Equity and ethical perspectives on prevention strategies**

There is weak evidence that community-based initiatives at the least do not worsen health inequalities and may actually improve them and that school-based interventions do not exacerbate inequalities. There is weak-to-moderate evidence for the effectiveness of programs targeting socioeconomically disadvantaged children under 2 years of age.

Beauchamp and colleagues' systematic 2014 review of obesity prevention according to socioeconomic position (SEP) reported that studies that were shown to be effective in lower SEP participants primarily included community-based strategies or policies aimed at structural changes to the environment. Interventions targeting individual-level behaviour change appeared less successful in lower SEP population<sup>75</sup>. There is some concern that obesity prevention initiatives may exacerbate existing health inequalities<sup>40</sup>. However, Hillier-Brown and colleagues found consistent evidence that community-based initiatives at the least do not worsen health inequalities and may actually improve them<sup>61</sup>. Additionally, Bambra and colleagues found that interventions that aim to prevent, reduce, or manage obesity in children do not exacerbate inequalities, with most evidence available for targeted, school-based, environmental, and empowerment interventions<sup>76</sup>. They do note, however, that few studies on societal-level interventions could be included in their review due to weak study designs.

We identified three reviews that looked at the effectiveness of obesity prevention interventions in children from disadvantaged communities. Towns and colleagues reviewed the evidence around obesity prevention in North American Aboriginal children and found there was insufficient evidence of effectiveness<sup>77</sup>. The authors suggest that this may be due to broader social and economic factors, which are likely to affect Aboriginal children more due to their increased likelihood that they live in more disadvantaged environments. Laws and colleagues similarly found insufficient evidence, with only two relevant studies on Indigenous children under 5 years of age identified in their review<sup>29</sup>.

With regards to socioeconomically disadvantaged children under 5 years of age, Laws and colleagues found modest but promising evidence of beneficial effects on obesity prevention interventions<sup>29</sup>. Interventions that targeted children under 2 years of age had positive impacts on some obesity-related behaviours like diet quality but few studies measured the long-term impact on weight. Further, evidence in pre-school-aged children was mixed but some features of more effective interventions could be identified: high levels of parental engagement, use of behaviour change techniques, a focus on skill building, and links to community resources. However, the authors note that all of their results are tempered by the low quality of most of the included primary studies.

Finally, Robinson and colleagues reviewed pre-school- and school-based obesity prevention interventions targeted at African American children<sup>78</sup>. They found moderate evidence supporting improvements in nutrition and limited evidence of beneficial effects on physical activity and weight. However, as with many of the above reviews, the authors note that their conclusions should be treated with caution due to the small number of studies and due to the relatively weak study designs used in the primary studies.

Very few obesity prevention studies report assessing the possible harm or unintended consequences (e.g., prevalence of underweight, unhealthy eating practices, teasing, stigmatisation, body image perceptions, satisfaction, and self-worth) of the interventions. A recent review by Waters et al. found that only eight of the 36 community-based obesity prevention studies included any measures of harm although among these studies there was no or only very minor harm reported. Obesity prevention interventions should incorporate safeguards and ensure evaluation of unintended consequences as well as intended outcomes.

### 5.1.10 Strategies to reduce children's exposure to marketing of EDNP foods

Research evidence shows that unhealthy food marketing contributes to the high prevalence of childhood overweight and obesity. Policy action reducing marketing of EDNP foods is rated as the second most cost-effective intervention and would save an estimated \$38 for every \$1 invested. Reducing children's exposure to the marketing of EDNP foods and beverages would constitute a significant environmental change, but one which is feasible and cost-effective to implement, and has been widely endorsed. WHO ECHO has recommended that governments 'develop regulations on the marketing of complementary foods and beverages, in line with WHO recommendations, to limit the consumption of foods and beverages high in fat, sugar and salt by infants and young children'<sup>4</sup>.

Reducing children's exposure to the marketing of EDNP foods and beverages would constitute a significant environmental change, but one which is feasible and cost-effective to implement, and has been widely endorsed. Many factors influence children's eating patterns and behaviour but the consistent finding from recent reviews and assessments is that exposure marketing of EDNP foods and beverages has a significant impact on the amount and type of these foods and beverages that children consume<sup>79-82</sup>. Extensive research in the NSW and Australian context, (particularly studies on outdoor advertising around schools<sup>83</sup>, community sports sponsorship<sup>84</sup>, and television food marketing<sup>85</sup>), has revealed that marketing of EDNP foods to children is prevalent, exposure levels remain high and it has now infiltrated social media<sup>86</sup> where children and youth congregate. This has occurred despite pledges from food companies to reduce the level of marketing of unhealthy foods directed to children<sup>87, 88</sup>.

#### WHO Director-General - on marketing to children

"Industry must have no say on the technical guidance issued by WHO. And industry cannot participate in the formulation of public health policies. Both areas are prone to conflicts of interest. Both must be protected from influence by industries with a vested interest. ....The biggest harm comes from the marketing of sugar-rich non-alcoholic beverages and ultra-processed, energy-dense, and nutrient-poor foods, which are often the cheapest and most readily available, especially in poorer communities. As noted in the (ECHO) report, these industries seek voluntary agreements and strongly oppose regulatory approaches. Both industries are powerful economic operators. Economic power readily translates into political power. Let them make their promises. Welcome their proposals to reformulate their products. Then watch very closely and hold them accountable for what actually happens."

WHO Director-General address to the Commission on Ending Childhood Obesity (ECHO) 22 June 2015

<http://www.who.int/dg/speeches/2015/commission-child-obesity-meeting/en/>

Detailed analyses have also been undertaken on how to reduce food marketing to children at international, national and state levels<sup>89-91</sup>. Some form of regulation is the only effective means of reducing children's exposure to marketing of EDNP foods. Media literacy skills have been proposed as a means of mitigating the risk of exposure but it has little support as children do not appear to use any new knowledge to protect themselves from the influence of marketing<sup>92, 93</sup>. Counter-marketing strategies, which are known to work in tobacco control<sup>94</sup> have also been proposed but there is limited, evidence of effectiveness in relation to overweight and obesity<sup>95</sup>. A recent systematic review on the effectiveness of statutory and self-regulatory actions to reduce the volume, exposure or wider impact of advertising for EDNP foods to children found that voluntary industry self-regulatory schemes produced little overall improvements<sup>9</sup>. Statutory regulation could reduce the volume of and children's exposure to advertising for EDNP foods, and has the potential to impact more widely<sup>95</sup> but effective regulation of marketing in new media is more problematic. The cost-effectiveness of this approach to limiting food marketing to children has been established in Australia and internationally<sup>96, 97</sup> and found to be one of the most cost-effective single obesity prevention strategies.

There is no question that children in NSW are exposed to marketing of EDNP foods frequently on a daily basis and that the marketing is designed to engage them and influence their awareness, attitudes, food preferences and choices. We know that food marketing works through a sequence of effects, building and reinforcing each other and does not rely on the immediate effects of a single exposure<sup>98</sup>. Strategies to address food marketing to children in Australia need to be cognisant of the key times that children are exposed to marketing on television and the breadth of media now used to promote EDNP foods. Television marketing of EDNP foods has been found to

increase in peak family viewing time which occurs outside designated children's programming timeslots<sup>99</sup>. Marketers are making use of a variety of techniques that appeal to children, including premium offers, promotional characters, and the emotional appeal of fun<sup>100</sup>. Further, although television continues to dominate as the primary marketing channel, food marketers are making use of every available communication channel (i.e., TV, magazines, outdoor advertising, food labels, point of purchase promotions, celebrity endorsement, games and digital media), which is reducing the cost of marketing while simultaneously increasing exposure<sup>80</sup>.

### *Options for policy action on EDNP marketing in Australia*

There is strong agreement from many health agencies and organisations across the world that children should be protected from the potential harms of food marketing and firm community support for some form of action<sup>101-104</sup>. The need for government leadership has been explicitly recommended by WHO ECHO<sup>4</sup> and reinforced by the documented failures and limitations of no regulation and industry self-regulatory efforts in Australia<sup>105, 106</sup>.

The only effective way of achieving this is a statutory regulatory framework that is monitored and enforced. In line with recommendations from WHO<sup>8</sup> and the National Preventative Health Taskforce<sup>5</sup>, a number of Australian health and obesity NGOs have agreed<sup>107</sup> that such a framework should:

- Prioritise the protection of children from the influence of unhealthy food marketing.
- Significantly reduce children's exposure to food advertising that promotes unhealthy foods.
- Apply to any unhealthy food advertisement that is intended or likely to appeal to children (whether or not the advertisement is also intended or likely to appeal to older age groups) and apply to all advertisements screened on television between 7-9am and 4-9pm weekdays and 7am-9pm on weekends, independent of whether they are shown in a designated children's program or not.
- Apply to all media and forms of marketing, including TV, radio and print advertising, online marketing, food company websites, social media, sports sponsorship, on-pack and in-store promotions and outdoor advertising, which is directed to children aged under 16 years or to which a high number of children under 16 years are likely to be exposed.
- Include limiting persuasive techniques that are used to promote unhealthy food to children such as the use of promotional characters and premium offers.
- Use independently-developed and consistent nutrition criteria to ensure only healthy foods are promoted to children, such as the nutrient profiling scoring criteria in the Australia New Zealand Food Standards Code, Standard 1.2.7 - Nutrition, Health and Related Claims.
- Include independent, clear and transparent monitoring and enforcement processes.
- Ensure open and transparent regulatory and governance processes which are easy for the public to engage with.
- Subject regulations to regular reviews to ensure they cover emerging technologies and techniques used to reach children.
- Include significant and meaningful penalties that deter companies from breaching regulations.

### *Action areas of particular relevance to NSW Government*

While many of the actions aimed at regulating EDNP food marketing within traditional media such as TV are outside state jurisdiction, outdoor advertising and sports sponsorship are areas that state governments are in a position to address. The issue of sponsorship of sporting groups and events by marketers of EDNP foods and beverages has been examined by a program of Australian research<sup>84, 108, 109</sup> which clearly shows the impact of sponsorship on the child's and family's awareness and attitudes to the food products of the sponsor. Current [sports sponsorship guidelines](#) from the NSW Government Office of Sport are generic and provide no indication of specific concerns around sponsorship by EDNP food producers. A 2015 briefing paper on [ethical sponsorship and advertising in sport](#) produced for the Australian Clearinghouse for Sport raises the issues around sponsorship by junk food companies of sporting groups and events and provides no clear guidance on these matters.

Research has also shown a high level of EDNP food marketing around schools in Australia with a [study within Sydney and Wollongong](#) showing that primary schools had an average of 57 food billboards nearby, with 80% of food advertisements for unhealthy foods, like soft drink, alcohol and ice cream. The issue of outdoor advertising including its potential deleterious impact on health messaging for children was the subject of [House of Representatives Standing Committee review in 2011](#). The Committee expressed a desire to limit the amount of inappropriate messaging from such outdoor marketing but recommended statutory regulations only be considered if the proposed self-regulatory process such as the Responsible Children's Marketing Initiative (RCMI) was found to be ineffective. Monitoring of adherence to these codes through complaints to the Australian Communications and Media Authority has previously been shown to be ineffectual and the RCMI incompletely implemented in a [recent study](#).

Previous limitations around criteria for defining which foods should be covered by regulation to restrict their marketing have now been addressed. It is now possible to define unhealthy food by reference to foods and beverages not eligible to carry health claims as determined by the nutrient profiling scoring criterion in Australia New Zealand Food Standards Code, [Standard 1.2.7 - Nutrition, Health and Related Claims](#)<sup>110</sup>. In addition, the Australian Bureau of Statistics recently categorised foods recorded during the 2011/12 National Nutrition and Physical Activity Survey as being "core" or "discretionary" on the basis of food grouping within the AUSNUT nutrition analysis database.

It is also important that the marketing of [EDNP foods within new media is carefully monitored](#) to assess the trends and nature of this exposure and to identify possible points of intervention.

(A more detailed outline of opportunities to address food marketing to children at state government level is provided in **Appendix 2**).

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<sup>f</sup> This section includes web links to key documents for ease of reference

### 5.1.11 Strategies to reduce consumption of sugar-sweetened beverages (SSBs)

There is strong and convincing evidence that consumption of SSBs is detrimental to health. Policy action on SSBs is identified as the single most cost-effective intervention and would save an estimated \$55 for every \$1 invested. There is strong public support for such a measure in Australia, with 69% of grocery buyers reporting they were in favour of a tax on soft drinks to reduce the cost of healthy food, with parents being more supportive than non-parents. The WHO Commission on Ending Childhood Obesity (ECHO) has recommended that governments consider fiscal policies, such as taxes to reduce the consumption of unhealthy foods such as sugar-sweetened non-alcoholic beverages and EDNP foods<sup>4</sup>.

#### Size of the SSB problem and the harm to children's health

There is convincing evidence that consumption of SSBs in particular is detrimental to health<sup>111</sup>. SSBs which are high in sugars and have no nutrient value are associated with increased risk of weight gain in both adults and children. Data on sugar consumption among Australian children is presented below:

- 47% of children (aged 2- 16 years) consumed SSBs daily 2007 Australian National Children's Nutrition and Physical Activity Survey<sup>112</sup>.
- Younger age groups were more likely to consume SSBs, with 78% of 12-17 year olds and 75% of 18- 24 year olds reporting consumption of SSBs in the previous week<sup>113</sup>.
- Among very young children (16-24 months) in a 2006 Western Sydney study, cordials were consumed on a daily basis by 41% of children and soft drinks were consumed on alternate days by 29% of children<sup>114</sup>.
- Thirty per cent of secondary students reported (2009-10) consuming four or more cups (1L or more) of soft drink, cordial or sports drink per week. The prevalence of consuming four or more cups of these beverages increased during adolescence<sup>115</sup>.

**Table 6 Daily consumption of sugar-sweetened beverages and 100% fruit juice among children, including mean daily intake across all children and among children that consume each beverage.**

	Consumed by % of children	Mean daily intake (across all children)	Mean daily intake (among children that consume the specific beverage)
Fruit juice	37%	112 g/day (1/2 cup)	301 mL/day (1.2 standard glasses)
Sugar-sweetened soft drink	25%	107 g/day (1/3 can)	436 mL/day (1.2 cans/1.7 standard glasses)
Fruit drink	10%	Not reported	1.2 standard glasses (mL/day not reported)
Cordial	20%	Not reported	1.7 standard glasses (mL/day not reported)
Sports drinks and/or flavoured water	2%	12 g/day (0.2 standard glasses)	620 mL/day (2.5 standard glasses)

Source: 2007 Australian National Children's Nutrition and Physical Activity Survey Mortensen (2010)<sup>116</sup>

#### Strategies to reduce SSB consumption

The Obesity Policy Coalition (OPC) has synthesised the evidence on SSB policy action for the Australian context<sup>117</sup>. Due to the complexity of factors influencing SSB consumption, tackling it requires "a coordinated set of policy measures, targeting both individual and environmental drivers of consumption"<sup>117</sup>. OPC advises that this set of policy measures will require Federal Government leadership in order to achieve consistent and widespread implementation<sup>117</sup>. A program of integrated strategies is recommended, including five elements:

1. Pricing and economic tools to reduce consumption of SSBs and promote consumption of water;
2. Effective controls to reduce children's exposure to marketing for SSBs, including through sport;
3. Effective social marketing campaigns to foster public awareness of health implications of SSB consumption;
4. Phasing out of SSB availability in schools and children's settings;
5. Reduced availability and promotion in workplaces, health care settings and public institutions.

The first 4 of these elements are the most relevant to children and are discussed in the next section.

### ***Pricing and economic tools***

Price influences what we eat and it is one factor that can be highly effective in influencing consumption of SSBs. WHO has urged governments to consider fiscal strategies, to improve the affordability of healthier food products and discourage the consumption of less healthy options so that they achieve goals for improved health and contained obesity rates by 2020<sup>118</sup>. In July 2015, Public Health England (PHE) presented evidence for a tax on SSBs to The House of Commons. PHE indicated the need to tackle SSB promotions and advertising and to reduce the sugar content of foods. In July 2015, the British Medical Association called for a 20% tax on SSBs and in October 2015 and an evidence session convened at the House of Commons indicated that such taxes have led to decreased SSB purchases in five countries<sup>119</sup>. The evidence review has now been published<sup>120</sup>.

In Australia, the OPC highlight evidence that a tax on SSBs has the potential to

- Effectively discourage consumption of a product that contributes substantially to the poor diets and chronic disease risk of Australians;
- Decrease sales of unhealthy beverages and influence demand for healthier alternatives, such as water and low fat milk;
- Encourage beverage manufacturers to reformulate their beverages to reduce sugar content;
- Convey the message that the government recognizes that these products are a matter of concern for public health; and
- Raise considerable revenue which may contribute to health promotion initiatives.<sup>117</sup>

Appendix 3 presents an overview of the international evidence of effectiveness of food and beverage taxes. Closer to home, modelling using current consumption and cross-price elasticity data in Australia and comparable jurisdictions has estimated that a price increase of 20% on SSBs is likely to result in population level decreases in energy consumption and BMI, with a resultant increase in life years and sustained reductions in incidence of diabetes, cardiovascular disease and some cancers, resulting in thousands of healthy life years gained and millions of dollars saved in healthcare costs<sup>121</sup>. A recent systematic review concluded that in order to maximize success and effect, food taxes and subsidies should be a minimum of 10 to 15% and preferably used in tandem<sup>122</sup>. While these reviews and modelling studies did not focus on children *per se*, other modelling conducted recently in the UK<sup>123</sup> and Ireland<sup>124</sup> predict that a 10% (Ireland)<sup>124</sup> and 20% (UK)<sup>123</sup> tax on SSBs would reduce the overall prevalence of obesity by 1.3% with greater effects among young people than other age groups, and no significant differences between income groups. In their 2015 study, Gortmaker and colleagues concluded that an SSB excise tax to prevent childhood obesity in the US would have a net cost saving of US\$55 for every dollar invested<sup>125</sup>.

### ***Challenges to the taxation of SSBs***

- Challenges to the taxation of SSBs include food industry 'work-arounds' and economic recessions. Industry work-arounds include: creating unhealthy substitutes which may not be covered by the tax (e.g., sweetened tea) and arguing that such taxes are ineffective, unfair, and lead to unemployment; however the burden of ill-health is paid by society<sup>126</sup>.
- 
- Another challenge is less enthusiasm to raise taxes in countries caught in economic recession<sup>126</sup>.

### ***The case in favour of policy action to tax SSBs***

The case in favour of policy action to tax SSBs includes the following.

- SSBs are a readily definable category of grocery, which makes the imposition and administration of a tax straightforward. Australia's existing tax framework could be amended, making it relatively inexpensive to administer<sup>117</sup>.
- The cost effectiveness of a SSB excise tax in the US is greater than that seen for published clinical interventions to treat obesity, estimated to save \$55 for every dollar spent, avert disability-adjusted life years, increase quality adjusted life years, and produce yearly tax revenue (\$12.5 billion for the US)<sup>125</sup>.
- Australians of low socioeconomic status (SES) are unfairly affected by high rates of diet-related illnesses and therefore they are likely to experience greater dietary improvements. Concerns over inequity would be further ameliorated if revenue was used to support healthy eating initiatives and subsidies on healthy foods for low-SES households<sup>117, 127</sup>.
- There is strong public support<sup>8</sup> for such a measure, with 69% of grocery buyers reporting they were in favour of a tax on soft drinks to reduce the cost of healthy food, with parents more supportive than non-parents<sup>117</sup>.
- Messages that focus on the harmful effect of SSB consumption on children may be useful in framing the discussion around SSB tax proposals<sup>128</sup>.
- Sugar-free drinks may become more profitable, shifting demand towards these drinks so that public health and private profit might for actually push in the same direction<sup>126</sup>.

### ***Reducing SSB marketing***

'Big food' spends tens of millions of dollars per year in Australia alone, employing increasingly sophisticated campaigns and technologies. Strategies to reduce children's exposure to marketing of EDNP foods overall are discussed in section 5.1.10; supplementary arguments for restricting marketing of SSBs are presented below.

Problematic SSB marketing strategies to be addressed include

- TV advertising; this is a large contributor to children's overall exposure to beverage marketing, however it is largely unregulated. Its use of self-regulatory codes is an ineffective tool for reducing children's exposure<sup>117</sup>.
- Online marketing<sup>117</sup>.
- Social media<sup>117</sup>.
- Games and apps accessible on tablets and smart phones<sup>117</sup>.
- Energy drink associations with extreme sports and youth oriented risk-taking themed campaigns;
- Sponsorship of children's sports and community events<sup>117</sup>.
- Use of characters and spokespeople, branding, product size, supermarket product placement and discounting – all of which influence preference for high sugar product selection or consumption. For example: the use of characters or 'spokes characters' can increase preference for or consumption of high sugar foods in young children (aged 3 to 7 years)<sup>129</sup>.
- Emerging research also suggests harmful effects from marketing strategies such as sponsorship, integrated digital and online marketing influences on preferences, purchasing and/or consumption<sup>129</sup>.
- Price discounting can have a significant impact on increasing sales of high sugar products<sup>129</sup>.
- End of aisle displays can significantly increase purchases of carbonated soft drinks<sup>129</sup>.

### **The following evidence-based policy actions are recommended<sup>117</sup>**

- Removing television advertising of energy dense, nutrient poor products like SSBs during children's peak viewing times. This would be one of the most cost-effective population-based policy measures for influencing health.

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<sup>8</sup> See <http://search.informit.com.au/documentSummary;dn=786412793691680;res=IELAPA>

- “Improved regulation that is independent, expedient, responsive, covers children’s peak viewing times and is capable of imposing meaningful sanctions is necessary to reduce harms from exposure to marketing of sugary drinks”.
- Engagement by the Australian Communications and Media Authority (ACMA) with broadcasters to reform broadcasting codes under the Broadcasting Services Act 1992.
- Government leadership, particularly at State level, to develop and implement sponsorship guidelines and fund financial incentives to discourage children’s sports organisations from accepting unhealthy beverage and food sponsorship and to encourage partnerships with other healthier sponsorships.

### *Effective social marketing campaigns*

The effectiveness of social marketing and communication strategies overall is discussed in section 5.3. The media coverage of SSBs is distorted, promoting unsubstantiated messages about the health benefits of SSBs. Both Federal and State Government leadership is needed to use social marketing in addressing EDNP products such as SSBs<sup>117</sup>.

### *Phasing out of SSB availability in schools and children’s settings*

The effectiveness of school-based interventions overall is discussed in detail in section 5.2. The Commonwealth Government’s 2010 Guidelines for healthy food and drinks supplied in school canteens, aimed to provide nationally consistent guidelines, building on state and territory based school canteen initiatives<sup>130</sup>. SSBs are not recommended for sale in school canteens under these guidelines. Several Australian states have adopted policies banning the sale of SSBs in schools, however lack of compliance and full implementation have weakened the positive effects of these strategies. For example, an evaluation in 2010 found that SSBs still appear on school menus despite a policy stating schools should be free from such drinks<sup>131</sup>.

Some promising results have emerged from recent research conducted in the United States. There is accumulating evidence that prohibiting or limiting SSBs in US schools has an impact on overall intake of SSBs. A recent systematic review of interventions to reduce SSB consumption found that school-based education programmes focusing on reducing SSB consumption can be effective<sup>132</sup>. Peer support and changes to the school environment to support these programs can improve their effectiveness. Delivering more suitable drinks to the home was also shown to have a big impact on reducing SSB consumption and body weight<sup>132</sup>.

Taber et al. reported that policy changes in 33 US States targeting concession stands were associated with 0.09 fewer servings of soda per day among students (95% CI = -0.17, -0.01); the association was more pronounced among non-Hispanic Blacks (0.19 fewer servings per day)<sup>133</sup>. Huang et al. found that a state-mandated ban on soft drinks implemented in Connecticut did not lead to compensation for the limited availability at school with increased SSB consumption at home<sup>134</sup>. Compared with children attending schools with an administrative policy of no availability of sweetened beverages and reporting not purchasing sweetened beverages, children in schools where the policy allowed beverages to be available and were purchased by the child were three times more likely to report consuming either occasionally or frequently<sup>135</sup>. District SSB policy in 64 middle schools was a significant predictor of SSB exposure ( $\beta = -9.50$ ,  $p < .0002$ ) and SSB exposure was a significant predictor of SSB consumption *at school* ( $\beta = .157$ ,  $p < .001$ )<sup>136</sup>. Two US studies had less encouraging results, one finding that overall SSB consumption in public schools was not associated with state policy on banning SSBs or soda<sup>137</sup>; another finding that SSB consumption did not change significantly following implementation of a healthier beverages policy<sup>138</sup>.

Schools should make sure that healthy options are available (e.g., water fountains or cold water dispensers must be accessible). It is also important to consider restricting the promotion and ready availability of SSBs within the school grounds. The OPC state that “An Australia-wide school-based initiative to keep SSBs out of school settings including tuck shops, school events, activities such as celebrations and sports days, vending machines and foods used in the class, is one important aspect of such a coordinated approach”<sup>117</sup>.

## 5.2 What has been shown to work (or not work) in school-based interventions – and what are the characteristics of the effective strategies?

The overall evidence for school-based interventions indicates that *multi-component* interventions are the most effective. Programs that have been shown to work have included one or more combinations of (i) both home and community components, (ii) both diet and physical activity components, (iii) parental involvement and (iv) environmental as well as educational components. Physical activity (only) focussed programs can also be effective. Effective environmental components include (i) organised physical activities during breaks, before and after school, (ii) improved availability of physical activity opportunities in and around the school environment; (iii) increased physical education lesson time; (iv) improved availability or accessibility of healthy food options; and (v) restricted availability and accessibility of unhealthy food options.

### *Overview of school-based interventions*

Wang and colleagues' 2015 systematic review found (i) strong evidence that school-based interventions which are combined with both home and community components prevent obesity, (ii) strong evidence that PA-only interventions prevent obesity, (iii) moderate evidence that diet–PA combined interventions prevent obesity; and (iv) moderate evidence that school-based interventions with an added community component prevent obesity<sup>11</sup>. Overall, the majority of the reviews indicate that these interventions are effective in favourably changing behaviour and anthropometric measurements. These favourable results come with a note of caution, because of some concerns about the quality evidence<sup>139</sup> and the short (or even absence of) follow-up evaluation in some studies<sup>139, 140</sup>. The evidence suggests that multi-component interventions are the most effective<sup>140-144</sup>. Examples of such interventions are those that include a diet and physical activity component<sup>142</sup>, include parents wherever possible<sup>141</sup>; and/or those that incorporate an education<sup>142</sup> and an environmental component<sup>141</sup>. With regards to educational interventions, computer-tailored personalized education shows promise<sup>144</sup>. Effective environmental components include organised physical activities during breaks, or before and after school, improved availability of physical activity opportunities in and around the school environment; increased physical education lesson time; improved availability or accessibility of healthy food options; and restricted availability and accessibility of unhealthy food options.<sup>144</sup>

### *5.2.1 Primary school setting*

There is growing evidence that school-based interventions that include a physical activity component may be effective. In general school-based interventions that are comprehensive, combining education and environmental components rather than using one component in isolation and invested in for at least one year duration are more likely to be effective. Dose of intervention (based on total summary measure of intensity, frequency and duration) appears to be an important factor — higher dose interventions provided stronger evidence of favourable effects on skin-fold thickness, fitness and high-density lipoprotein cholesterol; additional high quality research is needed to form conclusive evidence for impact on other weight-related measures, blood pressure, triglycerides, and low-density lipoprotein cholesterol markers<sup>145</sup>. School-based interventions promoting physical activity and fitness in children and adolescents have been the topic of 14 reviews<sup>35, 54, 144-155</sup>. Eight reviews examined the impact on body weight<sup>54, 144-146, 149-151, 154</sup> of which three reviews<sup>146, 150, 154</sup> reported favourable impacts on BMI based on a combined total of 15 studies.

### ***After-school interventions – primary school***

A 2012 review reported by Branscum and Sharma spanned the period 2006 to 2011<sup>140</sup>. Children in the interventions ranged from kindergarten to middle schoolers and the average age range was from 9 to 10 years. Most of the interventions targeted both physical activity and dietary behaviours. Among those that focused on only one dimension, physical activity was targeted more than diet. The duration of the interventions greatly varied, but many were short-term or brief. Most of the interventions focused on short-term changes, and rarely did any perform adequate process or follow-up evaluation. Overall, interventions resulted in modest changes in behaviours and behavioural antecedents, and results were mixed and generally unfavourable with regards to indicators of obesity<sup>140</sup>.

### ***5.2.2 Secondary school setting***

#### ***Physical activity interventions in secondary schools***

The 2012 systematic review of USA-based interventions reported by Krishnaswami and colleagues included two studies in secondary-age children with positive impacts in reducing or preventing gain in BMI. One program based on social cognitive theory used motivational interviewing delivered by college-aged mentors; the other used interventions to increase PA in physical education classes and throughout the school day as well as nutrition interventions to provide and market low-fat foods at all school food sources, including cafeteria breakfasts and lunches, a la carte sources, school stores, and bag lunches (but there was no classroom health education component). The interventions were effective in increasing PA at school among boys but not girls and were not effective in reducing fat intake at school. The program led to a reduction in reported BMI for boys but not girls. Other outcomes positively impacted by school-based interventions include PA behaviour change maintenance<sup>147</sup>, time spent doing MVPA<sup>148</sup>, fitness<sup>145</sup> and sedentary behaviour<sup>150</sup>.

Several reviews report interventions that increased PA without achieving impact on weight-related measures. Dobbins et al. reported evidence that school-based PA interventions are effective at increasing duration of PA from 5-45mins/day reducing time spent watching TV from 5-60 minutes and increasing cardiovascular fitness<sup>151</sup>. Children exposed to a school-based PA intervention were found to be three times more likely to engage in MVPA during the school day than those not exposed. School-based interventions were not found to have any effect on increasing PA among adolescents. Lonsdale et al. found students in the physical education setting spent 24% more lesson time in MVPA compared with students in usual practice conditions<sup>148</sup>. In a review by Kriemler, school-based interventions were predominantly effective in increasing PA. Kriemler et al. also conclude that combining educational, curricular and environmental elements seem to be more effective than isolated education interventions<sup>153</sup>. Lai et al. found 10 of 13 studies reviewed showed PA school based interventions produced a sustained change in PA behaviour of children and adolescents. In a specific review of the built environment within the school setting, Williams et al. found inconclusive evidence of an association between the built environment within the school (playground equipment, school fields, showers, gymnasiums) and BMI<sup>156</sup>.

#### ***Physical activity interventions in various other settings***

In various settings, including school, home and community, Metcalf et al. investigated the effectiveness of interventions, with duration of at least four weeks, on PA levels. The reviewers found strong evidence that PA interventions have only a small effect on children's overall activity levels, which they conclude might explain why such interventions have had limited success in reducing weight or body composition<sup>157</sup>. Again in various settings, including travel to school, Waters et al. found some evidence of an effect on adiposity, specifically BMI, and skin fold thickness, in 18 of 39 studies with primary aged children<sup>13</sup>; studies with youth were fewer and less clear. Baranowski et al. conducted a systematic review of studies specifically using information and communication technology-based interventions to promote PA behaviour change in children and adolescents, finding a positive effect in at least one psychosocial or behavioural PA outcome<sup>158</sup>.

### ***After-school interventions – secondary school***

Two systematic reviews examined interventions conducted in the hours immediately after school<sup>35, 149</sup>. Guerra and colleagues' review spanned April 2009 to September 2012, including 11 studies in a meta-analysis. Studies were analysed according to three outcomes: BMI (11 trials, n = 4,273, -0.02, 95% CI: -0.13 to 0.17, p = 0.8); body weight (5 trials, n = 1,330, -0.07, 95% CI: -0.18 to 0.04, p = 0.2); and blood pressure (6 trials, n = 1,549), including systolic (0.11, 95% CI: -0.10 to 0.31, p = 0.3) and diastolic pressure (-0.00, 95% CI: -0.10 to 0.10, p = 0.9). Whilst there are potential benefits from PA interventions in the school environment, the studied interventions did not have a statistically significant effect on overweight, obesity or hypertension. It is difficult to generalize from these results because the duration, intensity and type of PA used in the interventions varied greatly<sup>149</sup>. Atkin et al. reviewed studies from January 1990 to March 2010; of 9 studies (10 papers) only 4 included children aged 11 + years and only one included adolescents aged 11-15 (which did reportedly increase PA and self-efficacy). Overall the review suggested that single-behaviour interventions are more effective in promoting PA<sup>35</sup>. There were too few studies of adequate duration and quality to draw other conclusions about potentially effective/ineffective intervention programs<sup>35</sup>.

Authors of the reviews for the secondary school setting typically note that findings should be interpreted with caution for several reasons including lack of studies, bias<sup>147</sup>, low quality studies<sup>145</sup> and methodological variations<sup>149</sup>.

### ***Combined PA & dietary interventions***

Thirteen systematic reviews provided evidence to assess the impact of school-based childhood obesity prevention targeting nutrition and PA/ obesity in secondary (high) schools.<sup>54, 139-144, 152, 155, 159-162</sup> Two of these reviews were meta-analyses that examined the effects of school-based childhood obesity prevention programs targeting nutrition and PA on weight<sup>159, 161</sup>. One meta-analysis (of 27 studies, with mixed ages) when confining the analysis only to the 22 RCTs, found a favourable significant net effect on BMI<sup>159</sup>; the other meta-analysis (of two studies only) showed a statistically significant beneficial effect of school-based intervention programs on obesity status of schoolchildren RR 0.58, 95% CI (0.43-0.78) and suggested 42% reduction in prevalence of obesity among schoolchildren through the school-based intervention programs<sup>161</sup>. The results of these meta-analyses emphasise the heterogeneity of interventions and results, and indicate that school nutrition and PA interventions can produce desirable changes in weight status, but these may be small in degree, and not obtainable in every program.

Lavelle et al. found that school-based interventions with either PA alone or in combination with nutrition interventions were associated with significant improvements in BMI<sup>160</sup>. Sobol-Goldberg found that the school-based programs with the largest effects were comprehensive, included both PA and nutrition information as well as environmental and behavioural components, and were implemented for a duration of at least one year<sup>162</sup>. De Bourdeaudhuij et al. reviewed the evidence for school-based interventions in European countries, which included or specifically focused on PA behaviour and weight related outcomes<sup>144</sup>. The results suggest that combining education and environmental interventions, including both diet and PA (focussing on both sides of the energy balance) are more effective than single interventions. Similar findings were reported by Verstraeten et al. in a review of low and middle income countries<sup>54</sup>. Inman et al. similarly suggest that combining diet and PA interventions may prevent obesity in children in the long term<sup>152</sup>. In a review of US studies, Khambalia similarly found a significant reduction in weight from interventions that combined diet and PA, and also a family component<sup>143</sup>. Parental involvement was also found by Van Lippevelde to have a positive effect on children's behaviour, particularly home-related determinants, however the evidence was limited<sup>54</sup>.

### 5.2.3 School food services and environments including school canteens

Nutrition interventions can have a positive impact on dietary behaviors, and in some cases on body weight/BMI. Program success factors appear to centre on (i) changing the availability of foods at school; (ii) incorporating a mix of educational and environmental interventions; and (iii) ensuring sustained duration of interventions. Healthy core foods with a Health Star Rating (HSR) of  $\geq 3.5$  can be confidently promoted in public settings as healthier choices. A known limitation of the HSR system is that it does not address serving size so some core food categories may also need to incorporate serving size limits or qualitative guidance along with the  $\geq 3.5$  stars recommendation.

The scope of relevant reviews that were identified varied in focus, and were clustered and labelled as follows: (i) school nutrition environment interventions; (ii) school nutritional education initiatives; (iii) mix of school educational and environmental initiatives; and (iv) mix of school nutritional and PA interventions. Each cluster was examined separately, and is presented separately below.

Importantly, most reviews did not focus uniquely on adolescents or secondary schools, and in fact covered a range of ages or school years. The reviews identified were largely based on European and US studies, where the context of school meals and canteens can differ from that in Australia. These characteristics may influence the interpretation and applicability of findings to primary and secondary schools in NSW. Nevertheless, the findings are generally consistent, indicating that multi-component interventions, particularly interventions of longer duration that include changes to the nutrition environment, can be effective in influencing weight status, and specific food consumption patterns.

Three systematic reviews that examined *dietary interventions in schools* were identified<sup>163-165</sup>. One of these reviews focused on both educational and environmental interventions, and considered primary and high school interventions separately<sup>165</sup>, the other two reviews focused either on the food environment<sup>163</sup> or nutrition education<sup>164</sup>, and covered both primary and high school settings. All three reviews considered dietary behaviour and body weight/BMI as outcomes.

In the review focused on the food environment<sup>163</sup>, 17 of the 18 *nutrition environment interventions*, which typically involved changes in availability of foods in school canteens, reported a positive outcome on either BMI, or change in BMI (this was the case in 2 ecological studies examining the impact of state policies); or the healthfulness of food sold or consumed, in the case of the other studies. Overall, this review found very clear evidence that changing the availability of foods influenced purchases, consumption patterns, and, in some cases where measured, weight. While all studies were conducted in the US, there were variations between studies, in terms of whether there were restrictions or complete bans on some food items, whether changes were in canteens or vending machines, and the balance of focus on changing healthy or unhealthy food availability, or both.

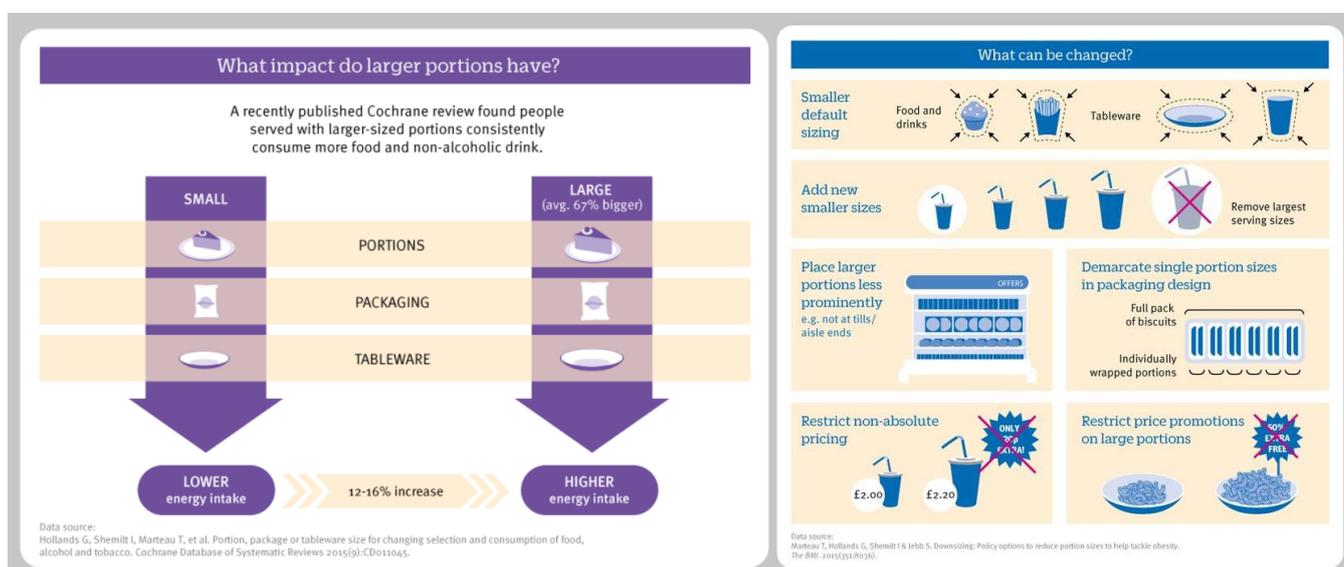
Likewise, the review on *nutrition education interventions* showed positive effects on both anthropometry and fruit and vegetable intake<sup>164</sup> (as only a few studies covered other food consumption outcomes, these outcomes were not considered in the review). Of the 9 studies judged as having high quality methodology and interventions with duration 1-3 years, most showed reductions in prevalence of overweight and obesity. While defined as a review on nutrition education, in fact around half of the studies involved a nutrition environment component (such as food provision, social marketing); and half of the studies used multiple strategies (which often included an environmental component). Ten of the 12 multi-strategic interventions, with a mix of classroom activities, parental involvement, and school nutrition policy, were effective, in terms of weight or eating fruit and vegetables<sup>164</sup>.

The review that explicitly examined primary and high school interventions separately and considered both educational *and* environmental interventions found that among adolescents there was moderate evidence of effect for educational interventions on food intake and limited evidence of effect for multi-component programmes (as the studies were all in the European Union, this tended to involve changes in food lunches provided at school in addition to education) on food intake (usually food intake at school). The specific eating

behaviours measured varied across studies, but included fat consumption and overall food intake. The review did not specifically analyse effectiveness for consumption of different food groups; and noted that effects on anthropometrics were generally not measured<sup>165</sup>.

A recent Cochrane review assessed the effects of interventions involving exposure to different sizes or sets of physical dimensions of a portion, package, individual unit or item of tableware on unregulated selection or consumption of food amongst children and adults<sup>166</sup>. The review found moderate quality evidence that exposure to larger sizes increased quantities of food consumed among children (SMD 0.21, 95% CI 0.10 to 0.31). The size of this effect suggests that, if sustained reductions in exposure to larger-sized food portions, packages and tableware could be achieved across the whole diet, this could reduce average daily energy consumed from food by between 144 and 228 kcal (8.5% to 13.5% from a baseline of 1689 kcal) among children and adults (based on UK population). It is uncertain whether reducing portions at the smaller end of the size range can be as effective in reducing food consumption as reductions at the larger end of the range<sup>166</sup>. Specifications of the interventions to target portion size are summarised in Figure 2 shown and detailed in **Table 7** below.

**Figure 2** The impact of larger portion sizes and the related policy options



Source: BMJ 2015<sup>167</sup>

### Using the national Health Star Rating system

The alignment of NSW Healthy Food Provision Policy with Australia's Health Star Rating (HSR) system has recently been examined<sup>168</sup>. Healthy core foods with a HSR of  $\geq 3.5$  can be confidently promoted in public settings as healthier choices. The HSR system has the potential to support provision of healthier food in NSW public settings. The system could offer a simpler way to assess the nutritional quality of packaged food and beverages than the current approach which often requires end users to interpret complex nutritional information on products to determine their 'traffic light' rating. Further work is required to assess the utility of using the HSR system for EDNP foods in public settings in NSW. The HSR may be useful to indicate a healthier EDNP food or beverage choice. However, as current intake of EDNP foods and beverages is significantly higher than recommended, caution should be taken when applying a HSR cut-off as the overall goal is to limit their consumption. Limiting the availability of EDNP foods and beverages more generally in NSW public settings will be required. A known limitation of the HSR system is that it does not address serving size so some core food categories may also need to incorporate serving size limits or qualitative guidance along with the  $\geq 3.5$  stars recommendation. As the HSR is only applicable to packaged foods and not freshly prepared or food service products, it would need to be introduced into public settings as part of a broader set of guidelines to promote healthy food and beverage provision<sup>168</sup>.

**Table 7** Specification of interventions designed to target portion size

## PHYSICAL ENVIRONMENT

### *Food and drink*

**Sizing**—Make default serving sizes smaller for energy dense foods and drinks—e.g., reduce size of single serve confectionery and serving size of chips and cakes in canteens

**Availability**—Reduce availability of larger portion and package sizes†—e.g., remove largest serving size of drinks; increase availability of smaller portion and package sizes—e.g., offer option of smaller portions to diners in restaurants

**Placement**—Make larger portion sizes in stores and cafes less accessible†—e.g., portion size limits at checkouts, aisle ends, and special displays

**Design**—Demarcate single portion sizes in packaging through wrapping or visual cues†—e.g., individual wrapping of biscuits

**Marketing**—Restrict portion and package sizes used in advertisements and other marketing

### *Tableware (plates, cups, glasses, and cutlery)*

**Sizing**—Make smaller tableware the default for self service and served foods and drinks†

**Availability**—Increase availability of smaller tableware and reduce availability of larger tableware for home use

**Design**—Develop tableware that maximises the mechanisms underlying the portion size effect—e.g., shallow plates, straight sided glasses, cutlery that holds smaller mouthfuls

## ECONOMIC ENVIRONMENT

**Restrict pricing practices** whereby larger portion and package sizes cost less in relative (and sometimes absolute) monetary terms than smaller sizes†

**Restrict price promotions** on larger portion and package sizes†

**Price tableware in relation to size**

Source: based on Marteau et al.<sup>167</sup>; and Hollands et al. (2015)<sup>166</sup>

† Actions most consistent with systematic review evidence<sup>166</sup>

### Implementing healthy school canteens – better investment, better feedback, better results

Important recent evidence has been reported from the evaluation of the 'Fresh Tastes @ School NSW Healthy School Canteen Strategy'<sup>169, 170</sup>. The analysis included (i) assessment of the effectiveness and cost-effectiveness of three implementation strategies in increasing the proportion of school canteens that have menus complying with the healthy canteen policy; and (ii) the variation in impact according to the 'dose' of intervention (low-, moderate- and higher-intensity supportive interventions).

These studies from the Hunter New England Local Health District and University of Newcastle indicate that investing in a more intense/ higher 'dose' of program interventions led to markedly improved outcomes as measured by compliance with selected canteen policy indicators – **Table 8**.

**Table 8 Intervention 'dose' as determinant of effective healthy school canteen policy implementation**

Higher-intensity intervention	Moderate-intensity intervention	Low-intensity intervention
<ul style="list-style-type: none"> <li>✓ 1.5 FTE supporting 35 schools (12-14 month period)</li> <li>✓ Policy implementation support every two months (via email, telephone or in person)</li> <li>✓ Executive support</li> <li>✓ Consensus processes</li> <li>✓ Canteen manager training</li> <li>✓ Site visits</li> <li>✓ Tools and resources including a resource kit</li> <li>✓ Menu audit /feedback each term for the 12 month period (4)</li> <li>✓ Certificates of recognition for compliant schools</li> <li>✓ Marketing - newsletters</li> </ul>	<ul style="list-style-type: none"> <li>✓ 0.8 FTE supporting 28 schools (9 month period)</li> <li>✓ Executive engagement</li> <li>✓ Consensus processes</li> <li>✓ Canteen manager training Workshop + ongoing support with SMS and email</li> <li>✓ Resource kit</li> <li>✓ Maximum of one menu audit/ feedback each term for the intervention period</li> <li>✓ Marketing – newsletters</li> </ul>	<ul style="list-style-type: none"> <li>✓ 0.8 FTE supporting 36 schools (12 month period)</li> <li>✓ Email contact and telephone support calls to all schools</li> <li>✓ One-off face-to-face meeting with some schools</li> <li>✓ Fresh Tastes @ School policy hard copy resources/materials to all schools</li> <li>✓ Maximum of four menu audit/ feedback sessions;                             <ul style="list-style-type: none"> <li>- Each session followed by (i) written report; and (ii) telephone feedback</li> </ul> </li> </ul>

**% Canteen Menus with No Red Items at Post-Intervention**

Intensity	Intervention (%)	Control (%)
High Intensity	70%	3%
Moderate Intensity	43%	8%
Low intensity	35%	13%

**% Canteen Menus with >50% Green Items at Post-Intervention**

Intensity	Intervention (%)	Control (%)
High Intensity	81%	27%
Moderate Intensity	61%	29%
Low intensity	45%	29%

### ***Procurement and reformulation policy to improve supply of healthy food***

There is systematic review evidence that healthy food procurement policies in schools (as well as in worksites, hospitals, care homes, correctional facilities, government institutions, and remote communities) increase markers of healthy eating and have the potential to drive the reformulation of foods<sup>171</sup>. The Cochrane review by Waters and colleagues has identified improvements in nutritional quality of the food supply in schools as a promising strategy<sup>13</sup>. Reformulating commonly eaten food products is a key emerging strategy to improve the food supply and help address rising rates of obesity and chronic disease. An Australian study of reformulation collected data on 120 child-oriented food products for the two-year period 2009-2011. Nearly half (n = 53) of all products were at least moderately reformulated and just over one third (n = 42) were substantially reformulated. Applying nutrient criteria revealed five products (6%) that were positively reformulated and none that had undergone negative reformulation. The authors conclude that whilst nutrient composition changes in a number of food products directed to children are apparent, there is a need to develop comprehensive, targeted and standardised reformulation benchmarks to assess the extent of reformulation occurring in the food supply<sup>172</sup>.

#### 5.2.4 Active travel strategies

A growing evidence base suggests that interventions to promote the uptake and maintenance of active travel through the adolescent period may offer protection against the development of excess BMI. There is consistent moderate evidence that active strategies can result in modest increases in PA and fitness, with active travellers accumulating more daily MVPA than those using motorised transport in the majority of studies. New evidence from one UK longitudinal study of over 2000 pupils demonstrated that a consistently or predominantly active travel pattern was associated with a lower BMI for boys; an effect on girls BMI was not apparent. The high tracking of active travel from childhood through adolescence (in the UK study, from age 12 through age 17 years) suggests that early intervention during the transition from primary to secondary school followed by promotion of maintenance of active travel through adolescence may be of greatest benefit. The [NSW Active Travel Charter for Children](#) is the latest resource developed by the NSW Office of Preventive Health for helping schools, parents and carers to develop an active travel plan to encourage active travel for children<sup>173</sup>. Given the accumulating evidence on the positive contribution of active travel for schoolchildren, the *NSW Active Travel Charter for Children* is an important and highly recommended initiative for consideration.

A longitudinal study in 6–8 year old children in Canada found that sustained active travel was associated with a more healthy BMI trajectory across the early school years<sup>174, 175</sup>, whilst in Brazil, both cross-sectional and prospective associations between active travel (walking/cycling) and central body fat were observed in males only<sup>176</sup>. A very recent study (December 2015) examined travel mode to school at ages 12, 14 and 16 years, and measured height, weight and body composition at age 17 in a large cohort of English schoolchildren (n=2,026). There was substantial tracking in active travel through adolescence, with 38.5% of males and 32.3% of females consistently walking or cycling to school. In males, a consistently or predominantly active travel pattern was associated with a lower BMI SD score at age 17 (consistently active: adjusted  $\beta=-0.23$ ; 95% CI  $-0.40, -0.06$ ; active at two time points: adjusted  $\beta=-0.30$ ; 95% CI  $-0.50, -0.10$ ) compared to those with a consistently passive pattern. No associations were seen in females.

Active travel to school shows some potential for having a small positive effect on PA. The quality of the evidence is limited by heterogeneity in intervention designs and implementation. As the quality of interventions improves, we may see some evidence of an effect on obesity, however at present findings remain inconclusive.

Bassett reviewed the impact of school-based policies as well as and changes to the built environment impact on energy expenditure<sup>177</sup>. Of the various policies and environment changes examined, the largest effects were seen in three types of interventions – (i) active commuting, (ii) mandatory physical education and (iii) classroom activity breaks.

Eight systematic reviews have specifically investigated children's obesity prevention in the area of active travel to school<sup>178-185</sup>. Chillon et al. identified 14 studies focused on active travel to school. Mode and frequency of active travel was the primary outcome measure and most of the included studies reported a small positive effect on active travel (varying from a 3%-64% increase)<sup>178</sup>. PA and BMI were considered as secondary outcomes in this review. In a review of the evidence for independent mobility and active travel, Schoeppe et al. found while active travel to school was significantly associated with PA, the association between active travel to school and weight status was inconsistent<sup>184</sup>. Saunders et al. made similar supposition that active travel may have a positive effect on health outcomes in children, however there was little robust evidence of an effect of active travel on reducing obesity<sup>183</sup>.

A NICE review examined modifiable diet and PA behaviours for maintaining healthy weight and preventing excess weight gain in children and adults, active commuting, walking and cycling<sup>14</sup>. The review found that evidence for a relationship between active travel and weight related outcomes in children was inconclusive; no evidence of a relationship between walking or cycling and weight related outcomes was found<sup>14</sup>. Larouche et al. published a systematic review of 68 studies (including walking and cycling to school programs and walking school buses) that investigated PA, weight and cardiovascular fitness as primary outcomes<sup>179</sup>. There was moderate quality of evidence that active school travellers were more active than inactive commuters, and that active school travel interventions

lead to increases in PA. In addition, there was low level of evidence of association between active school travel and obesity markers and cardiovascular fitness. Xu et al. found moderate evidence of an effect of active travel to school on body weight and strong evidence of an effect of active travel on cardiovascular health, however failed to differentiate findings in adults from those with children <sup>185</sup>.

A few earlier reviews that specifically considered active travel have also been included. Davison et al., Faulkner et al. and Lee et al. all found that while children commuted by active travel means had higher daily levels of PA and cardiovascular fitness than children who didn't actively commute, there was little support for an association between active commuting and children's BMI <sup>186-188</sup>.

Investigating the influence of built environment features on child and adolescent PA, McGrath found that in studies using GPS data to measure youth walking to school, small increases in activity were found comparative to transport by car or bus<sup>182</sup>. Reviewing studies using objective GIS and accelerometer data, McCrorie et al. found three studies investigating PA and active travel, together with other influences such as green space, general land use and built environments. A significant positive linear relationship was found between distance walked to school and overall daily PA, while MVPA was higher during the journey to school compared with playground-related activity <sup>181</sup>.

### ***Policies and practices to guide active school travel***

Active school travel depends on a number of factors that will including the physical environment of the school neighbourhood, social-cultural characteristics, individual factors and polices determining the built environment. School characteristics including the location of the school, school enrolment level and population density in the immediate area of the school have been consistently linked with active commuting participation<sup>186</sup>. The design characteristics of the physical environment are critical for facilitating the uptake of active travel. Environmental predictors of children's transport to school include road and side walk infrastructure, traffic volume, traffic safety, access to public transport, distance to school, urban or rural setting, weather and topography (especially hills) <sup>186, 189 187, 189-191</sup>. Increasing the availability of walking and cycling infrastructure, providing traffic calming measures and greater access to public transport, including transport policies that facilitate the linking of active travel and public transport use will alleviate many of the barriers<sup>190</sup>.

Individual home characteristics and attitudes towards active travel are also strong predictors of active school travel. Family car ownership and parents commuting behaviours often dictate whether young children travel by active means to school. Parent concern over children's safety is also a strong predictor of uptake of active travel. Wide community involvement (schools, parents and community partner organisations) is also necessary for success for any active travel to school intervention<sup>178</sup>. Programs that promote active transport together with disincentives for car use may also encourage greater walking and cycling.

The key to an effective active travel plans appears to be strong community participation, local government support and intersectoral partnership with the schools which will rely on school based programs together with area and population wide strategies for increasing active travel<sup>190</sup>. A number of policies and intervention approaches are therefore needed to enable active school travel. The following polices have been suggested:<sup>192</sup>

1. Zoning and development polices to protect open space.
2. Complete streets policies, involving safety measures.
3. Transportation network interlining public transport with active travel.
4. Bicycle and transit friendly infrastructure and incentive policies to encourage active travel.
5. Policy based safe routes to school interventions.

## **5.3 What is the evidence on the effectiveness of social marketing and population-level communication strategies aimed at children and young people aged 0-18 years?**

### ***5.3.1 Evidence on the effectiveness of social marketing and communication strategies***

We identified five eligible systematic reviews for inclusion in this section examining social marketing strategies. In general, results suggest that social marketing campaigns targeting children can be effective if well designed,

implemented, resourced, and evaluated. However, it should be noted that the available evidence is limited, with much of it relating specifically to mass media campaigns.

There is some supportive evidence showing the effectiveness of mass media campaigns targeting adults, especially in relation to PA campaigns<sup>193, 194</sup>. For example, a meta-analysis of PA mass media campaigns targeting adults found that they were effective in promoting moderate intensity walking but not in helping people achieve sufficient levels of PA<sup>193</sup>. Some reservations have been identified<sup>194</sup>, which cast some doubt on the value of applying a meta-analytic approach in this instance. Further, it is not known what effect, if any, such campaigns have on children and adolescents.

It is increasingly recognised that social marketing campaigns should target upstream factors (i.e. the social determinants of health), rather than downstream factors (i.e. the behaviour of individuals)<sup>195</sup>. Indeed, PA campaigns targeted at changing social norms have been shown to be more effective in reducing sedentary behaviour in adults<sup>193</sup>. On the other hand, meta-analyses of overweight and obesity social media interventions for the general population showed no effect on PA or weight and a minor, but significant, decrease in dietary fat consumption<sup>196</sup>. The studies included in this review made only limited use of social media, with most only using it to host a discussion board.

Gracia-Marco and colleagues<sup>195</sup> reviewed childhood obesity prevention interventions against their inclusion of the *social marketing benchmark criteria*, as defined by the UK National Social Marketing Centre<sup>197</sup>, hypothesising that more effective campaigns would include a greater number of the criteria. However, they found no association between the number of Benchmark Criteria and effectiveness. On the other hand, PA campaigns that include at least five of seven major principles of effective design (namely formative research, audience segmentation, theoretical-basis, message design, channel placement, process evaluation and sensitive outcome evaluation) have been shown to have an increased likelihood of effectiveness<sup>198</sup>. WHO proposed several features of successful mass media campaigns in 2000 that are still relevant today (Table 9)<sup>199</sup>. As explained by Bauman and Bellew<sup>200</sup>, the attributes outlined by WHO are very similar to the current understanding of social marketing.

**Table 9 World Health Organization’s features of successful public health campaigns**

<b>Feature</b>	<b>Explanation</b>
<b>Adequate duration and persistency</b>	Campaigns should be sustained over several years, not one-off
<b>Slow, staged approach</b>	Campaigns should be serial, targeting different strategies but building on preceding campaigns
<b>Legislative action</b>	Environmental and policy campaign supports should be enacted to support the campaign
<b>Education</b>	Effectively communicated information can encourage a change without leading to negative perceptions of having change imposed without clear reason
<b>Shared responsibility</b>	Intersectoral partnerships, including roles for community, government, non-government organisations, and other agencies can support campaigns

**Source:** adapted from WHO<sup>199</sup> and Bauman and Bellew<sup>200</sup>

A review of mass media health communication campaigns combined with the distribution of health-related products (e.g. condoms, nicotine-replacement therapy, and pedometers) by Robinson and colleagues<sup>201</sup> found that such campaigns were generally effective at bringing about behaviour change. Those campaigns that self-identified as social marketing campaigns were found to have a larger effect on behaviour than campaigns that did not self-identify as such. Larger effects were noted for campaigns that used a higher number of communication channels, had a longer duration of campaign, and provided the relevant health-related product for free<sup>201</sup>.

A recent experimental and formative study found that, for adults, mass media campaigns that emphasise the negative health consequences of overweight and obesity brought about stronger cognitive and emotional

responses, at least in the short term<sup>202</sup>. However, the authors caution that pre-testing of such messaging would be needed to minimise the risk of negative impacts, such as increased stigmatisation and body dissatisfaction. It is unknown whether these results would be replicated in a study with children and adolescents or with parents specifically.

### ***5.3.2 Defining characteristics of effective and ineffective social marketing and communication strategies***

Published peer review evidence on the characteristics of ineffective social marketing campaigns is limited. Available evidence indicates that campaigns that do not follow the major principles of effective design (as mentioned above and described by Noar<sup>203</sup>) are less likely to be effective. Additionally, single event campaigns, such as the Walk to Work Day and the Healthy Kids Challenge tend to result only in short-term reported behaviour changes<sup>204, 205</sup>.

## 5.4 Other evidence: local government, systems approaches, retail environment

The review team examined the evidence with respect to the local government setting. The database of retrieved studies was searched but did not reveal any additional relevant information. A supplementary rapid search using the terms 'local government' and 'obesity' (any field) yielded 11 studies with some relevance. Whilst they do not contribute specifically to the main findings of this review they are included here for completeness and in response to additional queries from the advisory committee to OPH/MoH for this project.

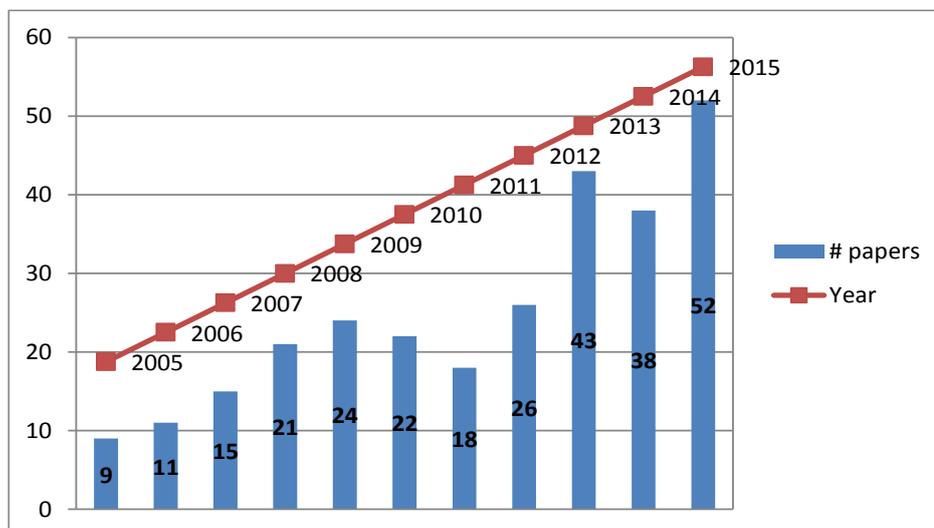
**Table 10 The Local Government Setting and obesity prevention – insights from a selection of recent studies**

Reference	Key points
Reeve, B., et al., State and municipal innovations in obesity policy: why localities remain a necessary laboratory for innovation. <i>Am J Public Health</i> , 2015. 105(3): p. 442-50.	<b>USA.</b> Municipal and state governments are surging ahead in obesity prevention, providing a testing ground for innovative policies and shifting social norms in the process. Local innovation advances prevention policy, but faces legal and political constraints-constitutional challenges, pre-emption, charges of paternalism, lack of evidence, and widening health inequalities. These arguments can be met with astute framing, empirical evidence, and policy design, enabling local governments to remain at the forefront in transforming obesogenic environments.
McKinnon, R.A., et al., Let's Move! Cities, Towns and Counties: Working with Local Elected Officials to Improve Community Food and Physical Activity Environments. <i>Public Health Rep</i> , 2015. 130(5): p. 426-30.	<b>USA.</b> Championed by Michelle Obama, Let's Move! Cities, Towns and Counties (LMCTC) commenced in the USA July 2012 (earlier soft launch 2010); LMCTC is a voluntary initiative designed to help local elected officials adopt long-term, sustainable approaches to address childhood obesity. As of June 2015, approximately 500 cities, towns, and counties in the USA were participating from all 50 states. The paper identifies 10 key lessons.
Kozica, S.L., et al., Optimizing Implementation of Obesity Prevention Programs: A Qualitative Investigation Within a Large-Scale Randomized Controlled Trial. <i>J Rural Health</i> , 2015.	<b>Australia.</b> Focus: 41 small rural towns in Australia; this study investigated factors influencing the implementation of obesity prevention programs, including adoption, program delivery, community uptake, and continuation, specifically within rural settings. Stakeholders highlighted the need to build local rural capacity through developing supportive university partnerships, generating local program ownership and promoting active feedback to all program partners.
Hatala, J.J. and T.T. Fields, Factors associated with local public health agency participation in obesity prevention in southern States. <i>South Med J</i> , 2015. 108(5): p. 283-9.	<b>USA.</b> This study analysed factors predicting participation of local public health agencies (LPHAs) in prevention programs. It revealed that more LPHAs in Southern States were engaged in nearly all of the 10 essential public health functions related to obesity prevention compared with non-Southern States. The (only) two predictive factors were presence of community-based organizations and staffing levels
OPAL Collective, Practitioner insights on obesity prevention: the voice of South Australian OPAL workers. <i>Health Promot Int</i> , 2015.	<b>Australia.</b> OPAL staff was guided by an external facilitator using inquiring questions to reflect on their health promotion practice within local government. Three central themes were identified as intrinsic to effective practice: shared clarity; practitioner implementation skill and sensitivity required to deal with the 'politics' of obesity prevention; and the power of relationship building/management.
Zwald, M.L., et al., Understanding Municipal Officials' Involvement in Transportation Policies Supportive of Walking and Bicycling. <i>J Public Health Manag Pract</i> , 2014.	<b>USA.</b> This study examined municipal officials' involvement in transportation policies that were supportive of walking and bicycling. Involvement by a municipal official was associated with: greater perceived importance of economic development and traffic congestion in job responsibilities; greater perceived resident support of local government to address economic development, and residence of the municipal official. Lack of collaboration was a barrier to local transportation policy participation.
Sautkina, E., et al., Lost in translation? Theory, policy and practice in systems-based environmental approaches to obesity prevention in the Healthy Towns programme in England. <i>Health Place</i> , 2014. 29: p. 60-6.	<b>England.</b> This study examined how system-wide approaches to obesity prevention were 'theorised' and translated into practice. Simplifying the complex task of understanding systems approaches in the context of uncertainty over programme aims and objectives, and lack of clear direction from central government led to local reliance on traditional multi-component approaches to programme delivery. Clear, practical guidance on implementation should form a central part of future system-wide approaches to obesity prevention.
Rube, K., et al., Developing built environment programs in local health departments: lessons learned from a nationwide mentoring program. <i>Am J Public Health</i> , 2014. 104(5): p. e10-8.	<b>USA.</b> In 2011-12, the New York City Department of Health and Mental Hygiene (DOHMH) facilitated a built environment peer mentoring program for 14 local health departments (LHDs) nationwide. Objectives included: supporting LHDs in their efforts to achieve built environment goals; offering examples from DOHMH's built environment work to guide LHDs; and building a healthy built environment learning network. The study identified lessons learned that can guide LHDs in developing successful healthy built environment agendas.
Martin, J., et al., Benchmarking government action for obesity prevention—an innovative advocacy strategy. <i>Obes Res Clin Pract</i> , 2014. 8(4): p. e388-98.	<b>Australia.</b> The authors developed a benchmarking tool for government action on obesity prevention, implemented it across Australian jurisdictions. The "Obesity Action Award", enabled identification of leading government action on obesity prevention and key characteristics associated with success. Their tool is recommended for other multi-state/country comparisons.
Hawkes, C., A.L. Ahern, and S.A. Jebb, A stakeholder analysis of the perceived outcomes of developing and implementing England's obesity strategy 2008-2011. <i>BMC Public Health</i> , 2014. 14: p. 441.	<b>England.</b> This study assesses implementation of the obesity strategy in England 2008-2011, Healthy Weight, Healthy Lives (HWHL) and supports population-based focus of obesity strategies. To stimulate comprehensive, inter-sectoral action, obesity strategies need to take a population-based, multi-faceted approach, be implemented through a clear governance structure, follow a systematic process of aligning goals, objectives and agendas between government departments and sectors with a stake in obesity, and have a clear system of reporting changes in obesity rates against a target. To design effective policies and build the case for continued investment, obesity strategies also need to incorporate a national framework for learning and evaluation from the outset.
Clark, R., Armstrong, R., Waters, E. Local government and obesity prevention: An evidence resource. Interventions to prevent obesity in early years settings; tackling food insecurity and built environment changes to support PA. 2011 CO-OPS Secretariat <a href="http://www.co-ops.net.au/File.axd?id=cdf85f-4672-450f-b77f-0a08215fc0e0">http://www.co-ops.net.au/File.axd?id=cdf85f-4672-450f-b77f-0a08215fc0e0</a> .	<b>Australia.</b> This resource maps local government roles and responsibilities and provides a simplified summary of evidence for those working in or with local governments.

### Systems approaches

There is an increasingly apparent emphasis in the published literature on ‘systems’ approaches to obesity prevention. For example a simple search in PubMed for the ‘systems’ in the title and ‘obesity’ in the abstract shows an increase from only nine ‘hits’ in 2005 to 52 in 2015 (Figure 3). The review team examined the database of retrieved studies for records with relevance to systems approaches. Nineteen papers and reports were noted; whilst they do not contribute specifically to the main findings of this review they are included for completeness as Appendix 7. The seminal work by Butland and colleagues (Foresight)<sup>7</sup> provided the widely-used systems map of the influences on obesity which has transformed and deepened understanding of the obesity epidemic. Sautkina and colleagues analysis of the Healthy Towns programme in England and Hawkes and colleagues analysis of the implementation of England's obesity strategy Healthy Weight, Healthy Lives (HWHL) 2008-2011 (see Table 10) suggest there is a need to retain the comprehensive, systems approach to obesity prevention, whilst ensuring that clear, practical guidance on implementation is provided to avoid the complexity inherent in systems thinking becoming a barrier to progress and that a framework for learning and evaluation is put in place from the outset.

Figure 3 Increasing number of papers on systems approaches to obesity, 2005-2015



### EDNP foods in the Retail Environment

The Healthy Food Environment scoping review conducted by Hector et al. (in press) focused on policy options in pricing, promotion and the retail environment that could improve healthy eating and contribute to a reduction in overweight and obesity at the population level<sup>206</sup>. EDNP foods and beverages are ubiquitous in the retail environment and predominate over healthier options. This scoping review indicates (especially with regard to children and adolescents) that changing the mix of the neighbourhood food environment to one that is healthier may have a larger impact than restricting the density of new fast food outlets *per se*. This might be achieved by (i) using incentives for ‘healthier profile’ retail stores and prepared food outlets (i.e., having a high ratio of healthy versus less healthy food options) to locate near schools and in lower SES areas; and/or (ii) changing the healthiness profile of existing stores and prepared food outlets. The establishment of new supermarkets in ‘food deserts’ does not appear to contribute to an increase in healthy diets overall or a reduction in obesity as supermarkets are a primary source of EDNP foods and beverages, as well as healthier produce. Children are susceptible to the persuasive elements on packaged foods and there is evidence that these elements need to be regulated on packaged foods and beverages in relation to product healthiness. Additionally in the retail environment evidence supports reducing exposure to less healthy snacks and SSBs via (i) shelf space allocation, (ii) location on shelves (such as removing products marketed to children from their eye-level), and (iii) restricting placement in end-of-aisle bins and at checkouts.

## 5.5 What does the combined body of evidence indicate are likely to be the most promising interventions for the prevention of childhood obesity in NSW?

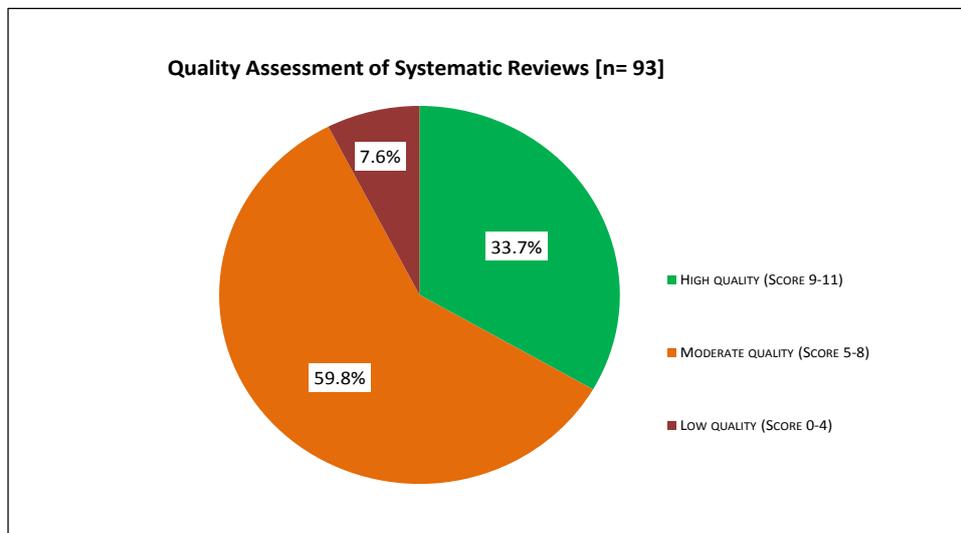
The most promising interventions are described and tabulated in the section [The Evidence At-a-Glance](#).

## 5.6 Overall, how similar and/or different are the conclusions from the updated evidence compared to the earlier conclusions from the 2012 review?

### 5.6.1 Evidence evolution and comparison with 2012 review

The promising approaches to obesity prevention identified in the 2012 review<sup>2</sup> retain their place in this 2016 update. A vast amount of new research has been published since 2011, including a large number of systematic reviews - as shown in the PRISMA flow chart (Appendix 5). The overall quality of systematic reviews was acceptable with assessments of 34% (n=31) high quality, 59% (n= 55) moderate quality and 8% (n= 7) lower quality; reviews scoring less than four on the AMSTAR checklist<sup>h</sup> were excluded from the analysis (Figure 4).

**Figure 4 Quality assessment of systematic research studies used in this evidence review**



Thanks to the growing evidence base, compared to our 2012 review, we have been able to:

- Characterise the strength of evidence for effectiveness of interventions with much greater precision.
- Include important new evidence on the cost-effectiveness of interventions (see section 6.2) and identify the most cost-effective interventions overall (i.e., reducing SSB consumption and restricting the marketing of EDNP food and beverages to young people).
- Confirm that voluntary agreements by industry to restrict marketing to children and adolescents have not been effective in affording protection from harmful exposure.
- Identify NSW as one of the few jurisdictions in the world to have achieved an improvement in childhood obesity rates with modest improvements in the proportion of overweight students in years K, 4 and 6.
- Provide local evidence of effective programs in NSW (i.e., the community-based program Good for Kids and Fresh Tastes @ School) through well evaluated case studies.
- Demonstrate that no single solution creates sufficient impact to reverse obesity: only a systemic, sustained, comprehensive portfolio of cumulative initiatives, delivered at scale, is likely to be effective in tackling overweight and obesity.
- Identify gaps in knowledge and future priorities for research.

<sup>h</sup> <http://amstar.ca/index.php>

### 6.1 Overall summary of evidence

The most promising interventions for the prevention of childhood obesity in NSW are described on pages 6-10 of this report ([The Evidence At-a-Glance, Evidence Summary Table](#)). Meeting the NSW Government target to reduce child overweight and obesity by 5% within 10 years (by 2025) will require a paradigm shift, with substantially enhanced investment for a comprehensive set of initiatives, delivered at scale and sustained for the decade.

Comparing 2015 with 2010 data, NSW is one of the few jurisdictions in the world to have achieved an improvement in childhood obesity rates with modest improvements in the proportion of overweight students in years K, 4 and 6 and apparent stabilization of the overall combined overweight and obesity rate for children age 5-16 years.

These modest improvements have been achieved after substantial government investment in a portfolio of obesity prevention and management programs. Maintaining this current portfolio of programs and interventions in NSW at the existing intensity ('business as usual'), might in the best case scenario, lead to improvements in the prevalence of child overweight and obesity in the range of 0.0% — 0.3% per annum.

No single solution creates sufficient impact to reverse obesity: only a comprehensive, systemic program of multiple interventions is likely to be effective.

Policy action on SSBs is identified as the single most cost-effective intervention and would save an estimated \$55 for every \$1 invested. There is strong public support for such a measure in Australia, with 69% of grocery buyers reporting they were in favour of a tax on soft drinks to reduce the cost of healthy food, with parents being more supportive than non-parents.

Policy action reducing marketing of EDNP foods is rated as the second most cost-effective intervention and would save an estimated \$38 for every \$1 invested.

All policy options recommended in this report are highly cost-effective from a societal perspective, and some policy options would generate revenue as well as delivering health gains. All policy actions should be considered for inclusion in the comprehensive approach that will be required for the 2025 target to be achieved.

### 6.2 Cost effectiveness of interventions

The database of all records retrieved for this review was searched to examine all evidence of cost-effectiveness, whether systematic review or other design, resulting in 18 relevant studies<sup>17, 50, 73, 96, 97, 121, 122, 125, 207-216</sup>.

The economic analysis produced by the McKinsey Global Institute found that almost all of the 74 obesity interventions examined are highly cost-effective from a societal perspective: savings on health-care costs and higher productivity outweigh the direct investment required to deliver the interventions when assessed over the full lifetime of the target population. The modelling was based on the UK population and showed that a comprehensive, scaled up program could reverse rising obesity, saving about \$1.2 billion (USD) a year for the National Health Service (NHS). The cost-effectiveness assessment was based on WHO definitions: investing less than one times per capita GDP to save a disability-adjusted life year (DALY) is highly cost-effective, investing one to three times per capita GDP is cost-effective, and more than three times per capita GDP is not cost-effective<sup>212</sup>.

Gortmaker and colleagues have reported specifically on the cost effectiveness of childhood obesity interventions<sup>125, 209</sup>. Cost-effectiveness models of implementing of interventions nationwide in the USA were estimated for a simulated cohort representative of its 2015 population over 10 years (2015-2025). A societal perspective was used and future outcomes were discounted at 3%. Four childhood obesity interventions were examined with costs shown in 2014 U.S. dollars (Tables 11, 12):

- (i) a SSB excise tax (SSB).
- (ii) eliminating tax subsidy of TV advertising to children (TV AD).
- (iii) early care and education policy change (ECE).
- (iv) active physical education (Active PE).

**Table 11 Short Term Population Reach, Cost and Outcomes for Four Childhood Obesity Interventions in the U.S.**

Intervention	Population reach (millions)	First year intervention cost \$U.S. millions (UI)	Per person BMI unit reduction (UI)	Cost per unit BMI reduction \$U.S. (UI)
Sugar sweetened beverage excise tax <sup>28</sup> (SSB) all ages	313	\$51 (\$36, \$66)	0.08 (0.03, 0.20) (adult)	\$3.16 (\$1.24, \$8.14)
Ages 2–19 years only	74	\$51 (\$36, \$66)	0.16 (0.06, 0.37) (ages 2–19 years)	\$8.54 (\$3.33, \$24.2)
Reduce tax subsidy of TV advertising <sup>29</sup> (TV AD)	74	\$1.1 (\$0.69, \$1.42)	0.028 (0.011, 0.046)	\$1.16 (\$0.51, \$2.63)
Early care and education policy changes <sup>31</sup> (ECE)	3.7	\$4.8 (\$–6.0, \$12.6)	0.02 (0.01, 0.04)	\$57.80 (°, \$138)
State policy for active physical education <sup>30</sup> (PE)	17.6	\$71 (\$51, \$96)	0.02 (0.003, 0.05)	\$401 (\$148, \$3,100)

Source: Gortmaker et al. (2015)<sup>125</sup>

Notes:

Costs are in 2014 U.S. dollars.

<sup>a</sup> It is customary not to report negative incremental cost effectiveness ratios because they cannot be interpreted.

UI, 95% Uncertainty Interval.

As shown in Table 11, population reach varied widely, and cost per BMI change ranged from \$1.16 (TV AD) to \$401 (Active PE). At 10 years, assuming maintenance of the intervention effect, three interventions would save net costs, with SSB and TV AD saving \$55 and \$38 for every dollar spent. The SSB intervention would avert DALYs, and both SSB and TV AD would increase quality adjusted life years. Both SSB (\$12.5 billion) and TV AD (\$80 million) would produce yearly tax revenue.

Outcomes were examined for a 10-year timeframe and healthcare cost savings were included (Table 12). For three of the four interventions, there would be potential net cost savings over the 2015–2025 period. The largest estimated savings, a total of \$23.2 (95% Uncertainty Interval UI = \$8.88, \$54.5) billion, were associated with the SSB intervention because this intervention would impact all age groups, and in particular would impact adults who already have obesity-related diseases and their associated healthcare costs. In uncertainty analysis, the likelihood of cost savings at 10 years was quite high (499% following the first 2 years) for both the SSB and TV AD interventions, and an estimated 95% for ECE. The TV AD intervention would result in an estimated \$343 (95% UI = \$129, \$572) million saved over the decade. The ECE intervention would impact a much smaller population, and result in estimated cost savings over the decade of \$43.2 (95% UI = \$4.24, \$133) million. The Active PE intervention would not result in any net cost savings over this period. The SSB intervention would save an estimated \$55 (95% UI = \$21, \$140) for every dollar spent and the TV AD \$38 (95% UI = \$14, \$74). In addition, an estimated 101,000 (95% UI= 35,000, 249,000) DALYs would be averted during 2015–2025 owing to the SSB excise tax. Because the other three interventions are exclusively focused on children, there was limited potential to affect obesity-related morbidity, mortality, and DALYs over the 10-year time horizon because of the low prevalence of obesity-related morbidity and mortality before age 35 years. Likewise, the ECE and Active PE interventions would have minimal impact on adult quality-adjusted life years (QALYs) within the modelling timeframe. Two of the interventions would generate tax revenue. The SSB intervention would generate approximately \$12.5 billion per year nationally, and

the TV AD intervention would raise about \$80 million per year. These tax revenues were not included in the net societal costs of the intervention (Table 11), but these revenues could be used to pay for other initiatives.

**Table 12 Estimated 10-Year Cost Effectiveness and Economic Outcomes for Selected Childhood Obesity Interventions; U.S., 2015–2025**

Intervention	Health care costs U.S. \$ millions (UI)	Probability of net cost saving	Net costs U.S.\$ millions (UI)	DALYs averted <sup>d</sup> (UI)	QALYs gained <sup>b</sup> (UI)	Net cost saved per \$ spent (UI)
Sugar-sweetened beverage excise tax <sup>28</sup> (SSB), all ages	-\$23,600 (-\$54,900, -\$9,330)	1.00	-\$23,200 (-\$54,500, -\$8,880)	101,000 (35,000, 249,000)	871,000 (342,000, 2,030,000)	\$55 (\$21, \$140)
Reduce tax subsidy of TV advertising <sup>29</sup> (TV AD)	-\$352 (-\$81, -138)	1.00	-\$343 (-\$572, -\$129)	— <sup>a</sup>	4,540 (1,750, 7,500)	\$38 (\$14, \$74)
Early care and education policy changes <sup>31</sup> (ECE)	-\$52 (-\$134, -\$14)	0.95	-\$43.2 (-\$133, -\$4.24)	— <sup>a</sup>	— <sup>b</sup>	\$6 (-\$52, \$66)
State policy for active physical education <sup>30</sup> (Active PE)	-\$61 (-\$153, -\$8)	0.003	\$175 (\$63, \$277)	— <sup>a</sup>	— <sup>b</sup>	—

Source: Gortmaker et al. (2015)<sup>125</sup>

Notes:

a DALYs were only reported for the SSB intervention because significant incidence does not begin until ages  $\geq 35$  years. No DALYs are averted for these childhood interventions within the 10-year follow-up because of the very low incidence of morbidity and mortality at ages  $\leq 35$  years.

b QALYs were only reported for the SSB and TV AD interventions; QALYs were not calculated for the ECE and Active PE interventions because few subjects over the 10 year period will fall into the age range of  $\geq 18$  years where QALY weights are defined.

DALY, disability-adjusted life year; QALY, quality-adjusted life year; UI, 95% uncertainty interval.

The cost-effectiveness of limiting food marketing to children as an obesity prevention strategy - in fact, the most cost-effective single strategy - has been established in Australia and internationally<sup>96, 97</sup>. Removing television advertising of EDNP products like SSBs during children’s peak viewing times would be one of the most cost-effective population-based policy measures for influencing health<sup>216</sup>.

Modelling using current consumption and cross-price elasticity data in Australia and comparable jurisdictions has estimated that a price increase of 20% on SSBs is likely to result in decreases in population energy consumption and BMI. This in turn would lead to sustained reductions in incidence of diabetes, cardiovascular disease and some cancers, resulting in thousands of healthy life years gained and millions of dollars saved in healthcare costs<sup>121</sup>. While this modelling study did not focus on children per se, in a recent review of the most cost-effective interventions, a SSB excise tax was shown to prevent the most cases of childhood obesity and projected to provide net savings to society of \$30.78 for each dollar spent<sup>125, 209</sup>.

Powell et al. noted that higher fast-food prices were associated with lower weight outcomes particularly among adolescents suggesting that raising prices would potentially impact weight outcomes<sup>214</sup>. Lower fruit and vegetable prices were generally found to be associated with lower body weight outcomes among both low-income children and adults suggesting that subsidies that would reduce the cost of fruits and vegetables for lower-socioeconomic populations may be effective in reducing obesity<sup>214</sup>.

The McKinsey (2014) review noted that interventions that change the PA and food and drink environments (and do not rely on conscious elements such as willpower or motivation) not only have greater impact but are also more cost-effective than the ‘conscious’ interventions<sup>212</sup>.

### 6.3 Policy implications

The findings from this evidence review indicate that the results of a single initiative, or even a comprehensive program in a single setting, tend to be modest. On the basis of this recurrent finding, that to date there had been 'slow and patchy'<sup>5</sup> progress at best, a recent series in *The Lancet* (February 2015) revisited the options for action to address childhood obesity<sup>217</sup>. The *Lancet* contributing experts note that many of the actions implemented to date have been overly simple and argue that it is thus not surprising that changes have been modest, or that some actions have not produced observable changes<sup>5</sup>. A more effective approach will require a more comprehensive combination of mutually reinforcing actions<sup>5, 8, 68, 218-220</sup>.

Systematic review evidence to date is modest, in part because review methodologies are typically not designed to show how to achieve optimal effectiveness through building a mix of reinforcing and enabling actions. Review methodologies are designed to select rigorous research studies that have high internal validity, and provide a good indication of actions that can be effective. Therefore, the research studies underpinning reviews are not covering comprehensive, multi-layered system change interventions (as these would not meet the methodological inclusion criteria). Thus, we need to look beyond systematic reviews for direction about how to achieve enhanced effectiveness, or how to find an effective combination of reinforcing actions<sup>221</sup>. There is value in casting a broader net for the consideration of different types of evidence. Firstly, evaluating natural experiments and policy changes can be a significant form of evidence<sup>221</sup>. This was important in the case of tobacco control, with the adoption of actions for increasing taxation and reducing supply, for example. Secondly, evidence on cost-effectiveness, and modelling of effects at population level, provide policy-relevant evidence that is not captured in reviews<sup>221</sup>. Thirdly, our theoretical understanding of the systems influencing obesity, and theories of change, are also significant resources for providing guidance<sup>218</sup>. In fact, the theoretical understanding of obesity and the implications of this for systematic action are well developed<sup>7, 218, 222, 223</sup>. Key lessons from these additional sources of evidence include the following:

#### *Supportive 'enabling' interventions*

Theories indicate that the interdependent interactions between people and their social, cultural and physical environments are fundamental in influencing eating and PA. Environmental features influence obesity indirectly to enable or limit people's behaviours<sup>221</sup>. For example, having access to healthy food choices, and simultaneously having reduced availability of unhealthy food choices, in a context where EDNP foods are not the majority of those promoted, may enable more nutritious food habits to develop. Interventions which create such environments have been termed 'enabler' interventions because although they are acting indirectly, they are essential to underpin the effectiveness of other interventions<sup>222</sup>. The application of a systems approach to understanding obesity reminds us of the importance of the environmental and cross-cutting interventions which provide support for direct action or programs, but for which effectiveness evidence is often not available (or appropriate). That is, the most effective initiatives operate through using multiple change mechanisms, including a mix of individual and environmental change processes<sup>5, 218</sup>.

#### *Sufficient, sustained program intensity*

The previous generation of prevention programs may not have addressed the right levers with sufficient intensity and duration to produce a significant impact on obesity. Evidence specifying the intensity and duration of programs required to produce substantial impacts on overweight and obesity is just beginning to emerge (for example macro level evaluation indicates that the Healthy Children Initiative has achieved modest gains but not as yet the intensity needed to achieve the target to reduce the prevalence of childhood overweight and obesity by 5% in the next ten years to 2025)<sup>1</sup>.

#### *Action in multiple settings*

Actions are needed at all levels of society – individual, family, local, national, national and international - not just in a small number of selected settings. A focus on school settings is important, but children's and parents' choices are shaped by their wider contexts. Thus the home environment, which includes television and other media, commercial environments including food retail and supermarkets, and physical environments including street

lighting, safe road crossings and footpaths, are also significant settings where changes are required in order to support healthier behaviours across the community<sup>222</sup>.

### *Action on multiple behaviours - addressing the right levers*

There is enhanced value in tackling multiple factors and influences, rather than assuming a selected single factor is an adequate basis for producing changes in weight status. For example, a focus on improving children's fundamental movement skills is valuable for promoting interest in sports, but may not be appropriate for all children, or effective in increasing energy expenditure. Similarly, promoting the consumption of fruit and vegetables is an appropriate nutritional goal; however, a change in fruit and vegetable consumption may neither reduce children's consumption of EDNP foods / total energy intake nor impact body weight. Indeed a recent observational study of children's lunchboxes measuring food consumed before a healthy eating intervention and at the 3-month follow-up found a significant increase in calorie intake and increased fruit and vegetable consumption after the intervention. This suggests that the increased fruit and vegetable consumption had not displaced other foods and indicates that a limited focus on fruit and vegetables may be misplaced or insufficient<sup>224</sup>.

A more direct approach to reducing energy intake would be the implementation of strategies to reduce consumption of SSBs. For example, there is now evidence that increasing the price of such beverages, through taxation, can result in reduced consumption (see section 5.1.11). More powerful still in our strategic approach to reducing consumption of EDNP foods would be to reduce children's exposure to marketing of these products (see section 5.1.10).

## 7.0 LIMITATIONS

### 7.1 Limitations of this rapid review

This is a rapid review, conducted in a short time-frame. Whilst every effort was made to approximate a full systematic review and a thorough search was undertaken consistent with the agreed scope of work, it is possible that some relevant studies were missed. Many of the studies included in systematic reviews synthesised in this report were conducted in North America; findings may not always be fully generalisable to an Australian setting and ensuring that local programs are rigorously evaluated is a high priority. In some cases, study subjects for whom the programs and interventions 'worked' were self-selecting and / or the interventions were evaluated under ideal circumstances. It is important to remember that interventions proven to be efficacious in the context of research trials may encounter many barriers in a subsequent real world implementation process.

Strength of evidence needs to be distinguished from the impact and reach of interventions. 'Strong evidence' in this report denotes high confidence that our assessment reflects the true effect and that further research is very unlikely to change our confidence in the estimate of the effect. In many cases, the effect of the recent generation of obesity prevention programs is modest. The next generation of programs can do better provided that lessons learned in the past 5 years are applied, dose/ intensity and duration of interventions are adequately configured, and appropriate research designs, fit for the purpose of evaluating complex programs and interventions, are applied.

## Appendix 1: WHO Final Report and Recommendations of the Commission on Ending Childhood Obesity (ECHO)

This appendix is based on verbatim extracts from the [ECHO Final Report](#) (2016)<sup>4</sup>

- 1 *Implement comprehensive programmes that promote the intake of healthy foods and reduce the intake of unhealthy foods and sugar-sweetened beverages by children and adolescents.***
  - 1.1 Ensure that appropriate and context specific nutrition information and guidelines for both adults and children are developed and disseminated in a simple, understandable and accessible manner to all groups in society.
  - 1.2 Implement an effective tax on sugar-sweetened beverages.
  - 1.3 Implement the Set of Recommendations on the Marketing of Foods and Non-alcoholic Beverages to Children to reduce the exposure of children and adolescents to, and the power of, the marketing of unhealthy foods.
  - 1.4 Develop nutrient-profiles to identify unhealthy foods and beverages.
  - 1.5 Establish cooperation between Member States to reduce the impact of cross-border marketing of unhealthy foods and beverages.
  - 1.6 Implement a standardized global nutrient labelling system.
  - 1.7 Implement interpretive front-of-pack labelling supported by public education of both adults and children for nutrition literacy.
  - 1.8 Require settings such as schools, child-care settings, children’s sports facilities and events to create healthy food environments.
  - 1.9 Increase access to healthy foods in disadvantaged communities.
- 2 *Implement Comprehensive Programmes that Promote Physical Activity and Reduce Sedentary Behaviours in Children and Adolescents.***
  - 2.1 Provide guidance to children and adolescents, their parents, caregivers, teachers and health professionals on healthy body size, physical activity, sleep behaviours and appropriate use of screen-based entertainment.
  - 2.2 Ensure that adequate facilities are available on school premises and in public spaces for physical activity during recreational time for all children (including those with disabilities), with the provision of gender-friendly spaces where appropriate.

**3 *Integrate and Strengthen Guidance for Noncommunicable Disease Prevention with Current Guidance for Preconception and Antenatal Care, to Reduce the Risk of Childhood Obesity.***

- 3.1 Diagnose and manage hyperglycaemia and gestational hypertension.
- 3.2 Monitor and manage appropriate gestational weight gain.
- 3.3 Include an additional focus on appropriate nutrition in guidance and advice for both prospective mothers and fathers before conception and during pregnancy.
- 3.4 Develop clear guidance and support for the promotion of good nutrition, healthy diets and physical activity, and for avoiding the use of and exposure to tobacco, alcohol, drugs and other toxins.

**4 *Provide Guidance on, and Support for, Healthy Diet, Sleep and Physical Activity in Early Childhood to Ensure Children Grow Appropriately and Develop Healthy Habits.***

- 4.1 Enforce regulatory measures such as The International Code of Marketing of Breast-milk Substitutes and subsequent World Health Assembly resolutions.
- 4.2 Ensure all maternity facilities fully practice the Ten Steps to Successful Breastfeeding.
- 4.3 Promote the benefits of breastfeeding for both mother and child through broad-based education to parents and the community at large.
- 4.4 Support mothers to breastfeed, through regulatory measures such as maternity leave, facilities and time for breastfeeding in the work place.
- 4.5 Develop regulations on the marketing of complementary foods and beverages, in line with WHO recommendations, to limit the consumption of foods and beverages high in fat, sugar and salt by infants and young children.
- 4.6 Provide clear guidance and support to caregivers to avoid specific categories of foods (e.g. sugar-sweetened milks and fruit juices or energy-dense, nutrient-poor foods) for the prevention of excess weight gain.
- 4.7 Provide clear guidance and support to caregivers to encourage the consumption of a wide variety of healthy foods.
- 4.8 Provide guidance to caregivers on appropriate nutrition, diet and portion size for this age group.
- 4.9 Ensure only healthy foods, beverages and snacks are served in formal child care settings or institutions.
- 4.10 Ensure food education and understanding are incorporated into the curriculum in formal child-care settings or institutions.
- 4.11 Ensure physical activity is incorporated into the daily routine and curriculum in formal child care settings or institutions.
- 4.12 Provide guidance on appropriate sleep time, sedentary or screen-time, and physical activity or active play for the 2–5 years of age group.
- 4.13 Engage whole-of-community support for caregivers and child care settings to promote healthy lifestyles for young children.

**5 *Implement Comprehensive Programmes that Promote Healthy School Environments, Health and Nutrition Literacy and Physical Activity among School-Age Children and Adolescents.***

- 5.1 Establish standards for meals provided in schools, or foods and beverages sold in schools, that meet healthy nutrition guidelines.
- 5.2 Eliminate the provision or sale of unhealthy foods, such as sugar-sweetened beverages and energy-dense, nutrient-poor foods, in the school environment.
- 5.3 Ensure access to potable water in schools and sports facilities.
- 5.4 Require inclusion of nutrition and health education within the core curriculum of schools.
- 5.5 Improve the nutrition literacy and skills of parents and caregivers.
- 5.6 Make food preparation classes available to children, their parents and caregivers.
- 5.7 Include Quality Physical Education in the school curriculum and provide adequate and appropriate staffing and facilities to support this.

**6 *Provide Family-Based, Multicomponent, Lifestyle Weight Management Services for Children and Young People Who are Obese.***

- 6.1 Develop and support appropriate weight management services for children and adolescents who are overweight or obese that are family-based, multicomponent (including nutrition, physical activity and psychosocial support) and delivered by multi-professional teams with appropriate training and resources, as part of Universal Health Coverage.

***Research evidence shows that unhealthy food marketing contributes to the high prevalence of childhood overweight and obesity***

The causes of childhood obesity are complex and many, and include aspects of our everyday environment. Children's regular and frequent exposure to high levels of marketing of EDNP foods is one such factor. The ubiquitous marketing of unhealthy food creates a negative food culture that undermines nutrition recommendations. This has been well established in research; and documented in well-esteemed reviews and reports (noted below), as well as the subject of WHO recommendations endorsed by the Sixty-third World Health Assembly<sup>90</sup>.

Overall, there is substantial research documenting the extensiveness and persuasive nature of various forms of food marketing in Australia<sup>83-85</sup> (and elsewhere<sup>79</sup>). Importantly, the vast majority of all food and drink marketing, regardless of medium or setting, is for food and drinks high in fat, sugar and/or salt; this has been well documented in the research literature<sup>79, 83-85, 225</sup>.

Research has demonstrated that Australian children are exposed to high levels of unhealthy food marketing across a range of media, including in outdoor advertisements near schools<sup>83</sup>, and through sponsorship arrangements with children's sport<sup>84</sup> and through commercial television, product packaging, websites, and point-of-sale promotions). Further, we know that this food marketing influences children's attitudes<sup>226, 227</sup> and subsequent food consumption<sup>228, 229</sup>. The research shows that there is a logical sequence of effects linking food promotions to individual-level weight outcomes<sup>98</sup>. The impact on weight occurs through a sequence of intermediate effects, including awareness, attitudes, food preferences and consumption, so that the marketing works both directly and indirectly. The frequency and persuasive nature of food marketing across multiple settings and media serve to reinforce awareness and attitudes, and in some cases provide immediate cues for purchase and consumption<sup>230</sup>.

The value of limiting food marketing to children as an obesity prevention strategy has been identified in a range of international and Australian obesity prevention reviews and strategies<sup>4, 89, 90</sup>. Australia's National Preventative Health Taskforce highlighted the importance of restricting inappropriate marketing of unhealthy food and beverages to children as a cost-effective intervention<sup>89</sup>.

***Government needs to play a lead role in setting consistent definitions and policy specifications***

As set out in WHO Recommendations, reducing the impact on children of marketing of foods high in saturated fats, sugar and salt requires reducing children's level of exposure to this marketing, and the persuasive nature of the marketing<sup>90</sup>. In that report and its later report on implementation<sup>91</sup>, the WHO also states that effective implementation of any food marketing policy or initiative depends on clear and consistent definitions of key elements, including what forms of marketing, and what foods or nutritional criteria are covered. The government leadership role is clearly identified in the WHO ECHO 2016 report<sup>4</sup>.

### ***Nutritional criteria are needed***

Clear, explicit and scientifically based criteria for determining what constitutes acceptable 'healthier' foods are needed. This should not be a matter that is left open to industry or community groups to determine. The WHO recommends that where a food classification system already exists, the same system should be used in food marketing policies to avoid inconsistencies and repetition. Thus, the *Australia New Zealand Food Standards Code*, Standard 1.2.7 - Nutrition, Health and Related Claims nutrient profiling system<sup>110</sup>, would be the preferred basis for distinguishing healthy and unhealthy foods for the purposes of restricting food marketing, particularly as it is already included in Australian law. This is a scientifically robust tool and preferable to school canteen criteria which are not sufficiently comprehensive for this purpose. A consistent definition of what constitutes healthy and unhealthy food must be applied across all food companies and products, and different settings and media, for ease of administration and to prevent obvious pitfalls and false claims of responsible marketing.

### ***Industry self-regulation is ineffective, flawed and perpetuates the 'status quo'***

The WHO has recognised that there is a wide range of stakeholders in this issue, and proceeded to recommend that governments take the lead role in policy development as a reflection of their responsibility to protect the public interest and to avoid conflicts of interest that apply to other stakeholders.

While consultations with food industry are important, the evidence in Australia and elsewhere indicates that industry will not itself initiate changes to food marketing that are genuinely responsible, but will make minimal changes and exploit 'loopholes'.<sup>17,18</sup> In Australia, the food and advertising industries have adopted a self-regulatory approach to food marketing to children. In practice, there has been limited uptake of this approach by food companies. Further, to minimise change, they have adopted permissive definitions of foods considered appropriate for marketing to children<sup>17</sup> and definitions of when and where food marketing might occur that do not reduce children's exposure to unhealthy food marketing. An analysis of nutrition criteria adopted by Australian food companies found that their system included 57% more EDNP foods than a professionally developed nutrient profiling system<sup>231</sup>. Another study found actual *increases* in fast food advertisements following the introduction of industry self-regulation<sup>232</sup>.

### ***Restriction of unhealthy sponsorship and marketing in community sports and other outdoor settings is needed***

The NSW Government is in a position to address sponsorship of children's sport, food and drink sales at children's sporting events and venues, outdoor advertising and advertising on government infrastructure. Specific, practical policy options to address sports sponsorship are included in the next section of this appendix. Marketing that focuses on energy-dense, nutrient poor foods and drinks undermines the value of sports and nutritional education initiatives. For example, analyses of outdoor advertising near schools in NSW showed that food and beverage advertising was predominately (80%) for unhealthy products<sup>83</sup>. While a comprehensive approach to limiting food marketing to children would be most effective, the WHO framework to support implementation also allows for a stepwise approach<sup>91</sup>. This is particularly relevant within a federal government system, where state/territories have scope for changes in some but not all settings and media. Clear affirmative action in Australia (and in many countries internationally) to restrict this harmful marketing has been lacking to date. NSW is now in a position to consider taking practical actions in the interests of children's health and well-being.

This section provides specific options for reducing food and drink marketing through sports sponsorship. As noted below, a substantial body of research on current practices and community views has been conducted in NSW and Australia over recent years, providing a sound base for action.

Sports sponsorship is currently a significant form of unhealthy food and drink sponsorship. Sponsorship refers to financial or in-kind assistance to people, organisations or events in return for promotional opportunities. Sport sponsorship forms a connection between the food/drink product or company, and the sport, so that the positive attachment to the latter transfers to the product. The rationale for introducing restrictions on children's sports sponsorship includes these factors:

- Food and drink sponsorship of children's sport is widespread,
- Sports sponsorship affects children's food knowledge and attitudes, and
- There is support from the general community and the sporting community for food sponsorship restrictions.

An Australian survey found that more than two-thirds of children 10-14 years old could name at least one sponsor of their sports club, and 85% believed that food and drink companies sponsored sport to help them out, whilst also understanding that the company was simultaneously advertising<sup>226</sup>. The children thought the food and drink sponsors were 'kind, generous and cool'.

Most children had been given a voucher or certificate from a food or drink company to reward their sport performance<sup>227</sup>. Consistently, sporting officials and parents from junior sports clubs perceived that children were influenced by sponsorship (including sponsorship of elite sporting teams). The majority of Australian parents are concerned about the food marketing to children through sports sponsorship, would support policies to restrict such sponsorship and believe government should play a role in introducing such restrictions, according to various studies<sup>109, 233</sup>.

In further developmental work in this topic, an Australian survey of 46 health and sports professionals participated in a series of surveys and consensus-building processes regarding their views on appropriate standards for food, drink and alcohol promotions at sports<sup>234</sup>. Twenty-three standards were nominated as being important and feasible by most participants. The highest ranked standards related to responsible alcohol practices, availability of healthy food and drinks at sports canteens, smoke-free club facilities, restricting the sale and consumption of alcohol during junior sporting activities, and restricting unhealthy food and beverage company sponsorship<sup>234</sup>.

While it is recognized that sponsorship is an important source of funding for sport, there are ways of rearranging sponsorship to minimize any financial disadvantages to sports clubs. Government could introduce policy or guidelines for sports clubs that limits the type of companies or products that could sponsor sport.

Alternatively, there is scope to introduce a brokerage system, managed through an independent organisation (such as a non-government agency), for managing the collection and distribution of sponsorship funding for sports clubs in a way that is equitable and responsible. Corporate organisations could contribute to the fund, but the brokerage fund would be the sponsor in terms of directing the funds to clubs and any promotions would be in the name of the fund. The corporate donors would receive recognition at a corporate level, rather than grass-roots community level; which is not dissimilar to other social responsibility arrangements. This arrangement creates a level of separation between sponsors and sports clubs and effectively limits promotional activities directed to children. This approach has been developed and investigated by researchers in collaboration with NSW Cancer Council.

A complementary action is to reduce the availability of unhealthy food and drinks at children's sporting events and venues. An Australian survey of food retail at children's sporting clubs indicated that where unhealthy food and drinks were available healthy food/drink policies were lacking and there were clear opportunities to improve the availability and promotion of healthy items. Further, survey respondents believed that governments should provide direction in this regard<sup>235</sup>.

Sponsorship, promotion and availability of unhealthy foods and beverages in community sports undermine the very values and benefits of those sports for young people. Further, these factors increase considerably the burden of persuasive, regular harmful food marketing to children. Opportunities and feasible options for restricting these harmful forms of food and drink marketing are now available and would be consistent with the target for reducing childhood obesity set by the NSW Government.

## Appendix 3

## Effectiveness of food and beverage taxes - international overview (October 2015)

**Acknowledgment:** Information in this Appendix was provided courtesy of The Obesity Policy Coalition



Country/ Date tax introduced	Type of tax	Impact of tax	Opposition to tax
Europe			
<p><b>Denmark (2011)</b></p> <p><b>Food taxes</b></p>	<p>An excise tax of Dkr 16 (approx. \$3.70 AUD) per kg of saturated fat in specific foods with a sat fat content above 2.3%.<sup>i</sup></p> <p>Specific foods subject to the tax were meat, dairy products, edible oils and fats, margarine and blended spreads.</p> <p><u>This tax operated for one year only.</u></p> <p>Denmark also has an excise duty on ice-cream (with the rate varying depending upon the sugar content) and chocolates and sweets.</p>	<p>An analysis of weekly food purchase data for the period January 2009 to December 2011 suggested that the introduction of the tax had some effects on the market for fats, such as butter, blends, margarine and oils, with a decrease in the purchase of these products by 10–20%. It also found that consumers shifted to purchasing relevant products from supermarkets to discount stores (then influencing discount stores to raise their prices higher).<sup>ii</sup></p> <p>Given this study was undertaken very shortly after the tax was introduced it provides evidence of short term effects only. It should also be noted that the level of substitution to other products was not evaluated.<sup>iii</sup></p> <p>Between Nov 2011 and August 2012, the tax on saturated fats raised around Dkr one billion (€134 million, or approx. AUD\$206 million) in revenue.<sup>iv</sup></p> <p>The tax was revoked on economic grounds (due to industry opposition as identified in next column), including that it reduced the profits of food manufacturers, caused job losses, was administratively burdensome and increased cross-border trade.<sup>v</sup></p>	<p>Farmers, retailers, unions, the food industry, the Danish Chamber of commerce and the Agricultural and Food Council argued that the tax would be inefficient, increase cross-border trade, cause job losses and lost revenue in retail trade and be unduly burdensome for industry.<sup>vi</sup></p> <p>The Neoliberal Party argued that the tax would be regressive and cause job losses. It also argued that if the Bill was perfect it would not generate revenue as people would stop buying it.<sup>vii</sup></p> <p>The meat industry and some nutritionists opposed the tax on the basis that people would substitute meat and dairy with high carbohydrate foods. They also argued that the evidence on the health impacts of saturated fats was not strong.<sup>viii</sup></p>

Country/ Date tax introduced	Type of tax	Impact of tax	Opposition to tax
<p><b>Hungary (2011)</b></p> <p><b>Food and beverage tax</b></p>	<p>An excise tax on soft drinks, energy drinks, confectionary, salty snacks, condiments and fruit jams that are high in sugar, fat, salt and/or caffeine.</p> <p>The value of the tax varies by category. Different rates apply per litre of soft drink and energy drink, and per kg of confectionary, salty snacks, condiments and fruit jams.<sup>ix</sup></p> <p>The revenue generated is hypothecated for the health care budget and is currently used to supplement the salaries of health care professionals.<sup>x</sup></p>	<p>An evaluation of the impact of the tax, based upon surveys of the public and manufacturers, was conducted one year after the tax was implemented. It found:</p> <ul style="list-style-type: none"> <li>• 40% of manufacturers had reformulated their products to reduce taxable ingredients.</li> <li>• 27% decrease in the sale of products subject to the tax.</li> <li>• 25-30% fewer products subject to the tax were consumed, compared to one year earlier.</li> <li>• Of those who consumed less of the taxed products, 80% cited the price increase as being the reason.<sup>xi</sup></li> </ul> <p>Between January 2013 and December 2013, these taxes collected Ft 18.9 billion (€61.5 million, or \$69.8 million AUD).<sup>xii</sup></p> <p>An analysis of the impact of food and beverage taxes between November 2013 and June 2014, commissioned by the European Commission, specifically DG Enterprise and Industry, and undertaken by the European Competitiveness and Sustainable Industrial Policy Consortium, ECSIP, led by Ecorys Netherlands (Ecorys report), demonstrated the following:</p> <ul style="list-style-type: none"> <li>• Re Cola: 'Price increased by 3.4% in 2011, 1.2% in 2012 and 0.7% in 2013 while tax alone was expected to raise price by 3.1% in 2011. Demand reduced by 2.7% in 2011, by 7.5% in 2012 and by 6% in 2013. Some evidence of substitution towards non-branded products. Increases in competitiveness indicators but unclear how much, if any, can be contributed to the tax. Retailer margins increased.'</li> <li>• Re Confectionery: 'Price of sugar confectionery and chocolates increased by 9.9% and 10.6%, respectively in 2010- 2012. Tax was expected to raise the price by 5.4% and 4.9%, respectively. No changes in demand for confectionery were observed; demand for chocolates increased after tax but at a slower rate than in pre-tax period studied. No changes in retail margins. Tax coincided with slight decrease in employment in the industry.'</li> <li>• Re Salty snacks: Prices increased by 6.3% in 2011, by 5.4% in 2012 and by 3.3% in 2013. Tax was expected to rise the price by 18% (2011 and 2012 combined). Demand decreased by 7.6% in 2011, 6.2% in 2012 and 0.6% in 2013. Increase in the market share of non-premium brands both pre- and post-tax periods.<sup>xiii</sup></li> </ul>	<p>FoodDrinkEurope (a trade group representing the European food and drinks industry) and the food industry generally opposed the tax on the basis that it would be discriminatory and regressive. They also claimed that the tax would be difficult to collect, economically damaging and have no impact on eating habits.<sup>xiv</sup></p> <p>Hungary's Association of Food Producers complained about the tax on salt, claiming that taking salt out of products can have technical consequences and that much of the salt consumed in Hungary is from foods made at home (rather than packaged foods).<sup>xv</sup></p>

Country/ Date tax introduced	Type of tax	Impact of tax	Opposition to tax
<p><b>France (2012)</b></p> <p><b>Sweetened beverages tax</b></p>	<p>An excise tax on all beverages that are sweetened with sugar or artificial sweeteners.</p> <p>The tax is adjusted annually to inflation and is currently 7.16 per hl, equivalent to around €0.11 or AUD\$0.17 per litre.</p> <p>In 2013, a one euro per litre tax was imposed on energy drinks that contain at least 220mg of caffeine per litre.<sup>xvi</sup></p>	<p>No robust evaluation has been carried out to date, however it has been reported that: “Supermarket sales of soft drinks declined for the first time in many years by 3.3% in the first four months after the introduction of their tax (of approximately EUR 0.07 per litre and resulting in nearly a 5% price increase) on sugar added and artificially sweetened drinks”.<sup>xvii</sup></p> <p>The Ecorys report (2015) demonstrated that in relation to regular Cola: ‘Price increased by 5% in 2012 and by 3.1% in 2013 while the tax itself was expected to increase price by 4.5% in 2012. Increase in the price in 2013 was very large given tax rate was only adjusted to inflation. Demand reduced by 3.3% in 2012 and 3.4% in 2013. Retail margins increase for diet cola, no change for regular cola. Based on available data no changes in the indicators for competitiveness were noted.’<sup>xviii</sup></p> <p>The sweetened beverages tax generates almost €280 million per year (\$437 million AUD).<sup>xix</sup></p> <p>The impact of the energy drink tax does not appear to have been measured.</p>	<p>The French food industry association (ANIA) launched a campaign in 2012 arguing that there was no evidence the tax will improve diets or health outcomes, and therefore should not be framed as a public health initiative.<sup>xx</sup></p> <p>In 2012 it was reported that Coca Cola opposed the then proposed tax on the basis that it created uncertainty, was discriminatory, punished Coca Cola and stigmatised its products.<sup>xxi</sup></p>
<p><b>Finland (2011)</b></p> <p><b>Sweets tax</b></p>	<p>Reimposed an excise tax per kg on sweets (confectionary, chocolate, cocoa-based products, ice-cream etc.) that had been abolished in 1999.</p> <p>It excludes certain products such as biscuits, baked goods, yogurt products, puddings, jellies, mousses and granulated sugar.</p> <p>Incremental increases were proposed each year, in 2014 the tax was the equivalent of \$1.59 (AUD) per kg.</p> <p>Existing soft drink taxes were also broadened to cover a wider range of sugar sweetened beverages (those containing more than 0.5% sugar) and increased. Incremental increases apply to this rate, tax rate currently equivalent to approx. AUD\$0.36 per litre.<sup>xxii</sup></p> <p>The primary purpose of these taxes is to generate revenue.<sup>xxiii</sup></p>	<p>The taxes have not been formally evaluated; however unofficial reports have suggested that they have influenced a decrease in sales and consumption, including a reduction in soft drink sales by up to 4.7%.<sup>xxiv</sup></p> <p>Between 2010 and 2012, the taxes generated over €360 million (\$560 million AUD).</p> <p>The Ecorys report (2015) demonstrated that:</p> <ul style="list-style-type: none"> <li>Soft drink: ‘Price increased by 7.3% in 2011, by 7.3% in 2012, and by 2.7% in 2013, while the tax was expected to increase the price by 1.5% and 0.9% in 2011 and 2012, respectively. Price increases led to a reduction in demand by 0.7% in 2011, by 3.1% in 2012 and by 0.9% in 2013. Almost no change in the trends in competitiveness indicators. Some effects on labour productivity and employment in the industry linked to reduction in demand. Difficult to separate the impact of taxes on alcoholic and non-alcoholic drinks’.<sup>xxv</sup></li> </ul> <p>Confectionary and Ice-cream: ‘The price of confectionery increased by 14.8% in 2011, 6% in 2012 and 3% in 2013. The price of ice-cream increased by 15.7% in 2011, 4.9% in 2012 and by 2.9% in 2013. Prices increased twice as much as can be attributed to the tax. Demand for confectionery fell by 2.6% in 2011, 1.4% in 2012 and by 0.1% in 2013. Demand for ice cream fell by 1.6% in 2011, 0.9% in 2012 and increased by 1.4% in 2013. Demand increased for untaxed products (e.g. frozen desserts, breakfast bars) by 2-10%. No visible impact on market shares of premium and non-premium brands. Small increase in employment in confectionery production but decrease in productivity around the time of tax; decrease in value added of manufacturers directly after the tax; continuing increase in investments; no changes in margins.’<sup>xxvi</sup></p>	<p>The Finnish Association of Biscuits and Confectionary Industries have argued that by targeting such specific products it unfairly discriminates against particular manufacturers in the food industry and distorts competition. It argued for a broader sugar tax across all food and beverages.<sup>xxvii</sup></p> <p>ENSA, represents natural soybean manufacturers and opposes the tax on the basis that soy based drinks are covered by the tax, yet dairy are not.<sup>xxviii</sup></p> <p>Note that the Finnish government had planned a tax increment for 2015 in the sweets tax but rescinded this following a complaint filed with the European Commission by the Finnish Food and Drinks Industries Federation calling into question the lawfulness of aspects of the sweets tax.<sup>xxix</sup></p>

Country/ Date tax introduced	Type of tax	Impact of tax	Opposition to tax
<p><b>Norway</b> <b>(1981, increased 2011)</b></p> <p><b>Soft drinks tax</b></p>	<p>A tax on non-alcoholic beverages containing added sugar or sweeteners. Current rate of 2.81NOK (approx. AUD\$0.46) per litre.<sup>xxx</sup></p> <p>At a different rate, tax also applies to chocolate (17.92 NOK per kg, approx. AUD\$2.95) and sweets (6.94 NOK per kg, approx. AUD\$1.14).<sup>xxxi</sup></p>	<p>Consumption of lemonade and regular soft drink decreased from 4.8 to 2.5 and 2.3 to 1.6 times per week respectively between 2001 and 2008. This trend contrasts with the rise in consumption in other European countries over this time period.<sup>xxxii</sup></p>	<p>Not known, although likely opposition from Unesda, discussed below.</p>
			<p><u>Across Europe</u>, food and beverage taxes have been opposed by Unesda (non-alcoholic beverages industry in Europe) on the basis that these taxes are regressive and unfair, lead to job losses and negatively impact economies, are unlikely to increase government revenue, are ineffective to reduce obesity rates and are paternalistic.</p> <p><i>For more information, see the Unesda sponsored website, Why food and drink taxes won't work, at <a href="http://www.fooddrinktax.eu/">http://www.fooddrinktax.eu/</a></i></p>
<p><b>Mexico, and Berkley and US</b></p>			
<p><b>Mexico (2014)</b></p> <p><b>Sugar sweetened beverages tax</b></p>	<p>1 peso excise tax per litre of Sugar Sweetened Beverage (all non-dairy and non-alcoholic beverages with added sugar, including juice). An 8% value added tax was also applied to high-calorie snacks, i.e. potato chips and cookies.</p> <p>1 peso per litre is equivalent to approximately 10% of the purchase price.</p>	<p>An evaluation by the Mexican National Institute of Public Health and the Carolina Population Centre at the University of North Carolina found an average reduction of 12% in the purchase of taxed beverages from the date the tax was introduced (1 January 2014) to December 2014.<sup>xxxiii</sup></p> <p>Preliminary results from the study found that while purchases reduced across all SES levels, the greatest reduction was among the lowest SES group. It also showed a 4% increase in the purchase of untaxed beverages, particularly purchased bottled water.<sup>xxxiv</sup></p> <p>A survey of 1,500 consumers in Mexico in 2014 found that just over half of the people surveyed had lowered their consumption of sugary drinks since the tax was introduced. 98% said they considered drinking sugary drinks raises their risk for developing diabetes and obesity. Nearly a fifth of the consumer surveyed reported drinking more than three litres of soft drink a week, compared to a quarter that drank that amount in the previous year.<sup>xxxv</sup></p>	<p>In 2014, the SSBs industry in Mexico criticised the tax on the basis that it would be regressive, 'satinises' soft drinks and would not reduce obesity. It undertook a paid a media campaign against the tax, including running a full page ad in Mexican newspapers "You don't fight obesity with taxes".<sup>xxxvi</sup></p> <p>In support of the beverages industry, Televisa, , Mexico's largest TV network owned by a billionaire, refused to air pro-tax ads.<sup>xxxvii</sup></p> <p>Since the tax was introduced, Mexico's soft drink makers association, ANPRAC, has disputed the impact of the tax and drop in consumption. ANPRAC claims that sales have been reduced by 2.5% since the tax was applied, that 1,700 jobs have been lost and estimates that the tax has lowered caloric consumption by only 6.2 calories per day.<sup>xxxviii</sup></p>

Country/ Date tax introduced	Type of tax	Impact of tax	Opposition to tax
<b>Berkley (2014)</b>  <b>Sugar sweetened beverages tax</b>	1-cent-per-ounce excise tax on sugar sweetened beverages	<p>Studies have found that while SSB retail prices may have increased more in Berkeley than in nearby cities following the introduction of the tax, the tax is not being fully passed on to consumers. <sup>xxxix</sup> It is estimated that on average, prices rose by less than half of the amount of the tax. <sup>xl</sup> This may result in less of a reduction in consumption and less health improvement than anticipated. <sup>xli</sup></p> <p>It has been reported that the tax raised US\$116,000 in its first month and that it is anticipated that it will generate US\$1.2 million in 2015. <sup>xlii</sup></p>	<p>The American Beverage Association's spent approximately US\$2 million to try to defeat the tax when proposed. <sup>xliii</sup> It continues to oppose the tax on the basis that it is regressive, singles out SSBs while sugar is across the food chain and will not change consumption behaviour. <sup>xliiv</sup></p>
<b>United States (various)</b>  <b>Sugar sweetened beverages taxes</b>	<p>38 of the states currently impose a sales tax on sugar sweetened beverages as a revenue raising measure.</p> <p>Tax rates average 5% of the sale price, ranging from 1-7%.</p>	<p>Studies of the US taxes have consistently found that the tax (at an average of 5%) is too low to significantly influence consumption and/or obesity rates. <sup>xlv</sup></p>	<p>In the US, the American Beverages Association, Coca-Cola Co and PepsiCo has spent an estimated US\$70 million lobbying against soda taxes and engaging local food companies and industry organisations to oppose taxes at the local level when being introduced.</p> <p>For example, in Philadelphia, lobbyists offered US\$10 million to the local council in exchange for dropping the proposed soda tax in 2011. The council subsequently decided to raise taxes on property rather than soda. Industry arguments focus on cost to industry (administrative costs, job losses etc) and that it unfairly singles out the soda industry. <sup>xlvi</sup></p>
<b>Pacific Islands countries and territories</b> <sup>xlvii</sup>			
<b>(various)</b>  <b>Soft drink taxes</b>	<p>Across the PICTs an average tax of US \$0.15 for a 335 mL can of soft drink applies.</p> <p>Eight PICTs have adopted excise taxes (American Samoa, Cook Islands, Commonwealth of the Northern Mariana Islands, Federated States of Micronesia, French Polynesia, Kiribati, Tonga and Samoa).</p> <p>Four have adopted import tariffs (Republic of the Marshall Islands, Nauru, Palau and Vanuatu).</p> <p>Most of the taxes apply to soft drinks only, although fruit juices are also taxed in Northern Mariana Islands.</p>	<p>Samoa: excise tax generated approximately US\$3.5 million between 2003-2007. <sup>xlviii</sup></p> <p>French Polynesia: between 2002 and 2011 the tax generated approximately \$US10 million. <sup>xlix</sup></p> <p>There is a lack of data evaluating changes in consumption in PICTs, however there is evidence that in Palau, between 2007-2011, there was a reduction in consumption among grade 9-12 students where a water-only campaign" was also introduced in schools. <sup>i</sup> In Tonga, Guam and Fiji consumption has increased despite the existence of taxes. <sup>ii</sup></p> <p>McDonald (2015) reports: "There is preliminary evidence about the effects of some of the SSB tax policies although in many cases the impact of the tax policies is only described anecdotally and has not been formally evaluated. After the introduction of SSB taxes in Nauru, an increased range of available lower-sugar beverages was noted and there was an increased cost of SSBs in Fiji. In French Polynesia, SSBs changed to become more expensive than water After the ban in Tokelau, there was a dramatic reduction in carbonated soft-drink imports and a small increase in imported juice. In Palau, community campaigns and water-only policies in schools (NCD coordinator, personal communication, 2014) have been</p>	<p>Thow et al. (2011) reported:</p> <p>"In Fiji, organized industry opposition to the domestic tax resulted in its removal (the tax was removed in 2007 and reintroduced in 2011). Soft drinks are a low profit margin, high-volume product, and in Fiji manufacturers claimed that the tax completely eroded their profit in a highly competitive market. The role of industry in repealing taxes has been observed elsewhere, particularly the USA (Jacobson and Brownell, 2000). However, importers and manufacturers in Samoa, where the link between the soft drink tax and health had been made explicit, were generally more accepting (and in some cases even supportive) of the tax." <sup>liv</sup></p>

Country/ Date tax introduced	Type of tax	Impact of tax	Opposition to tax
	<p>The Cook Islands tax is the highest, at NZ\$9.80 per kg of sugar in sugar sweetened soft drinks (equivalent to US \$0.30 per 355 mL can)</p> <p>Some of these taxes were introduced for revenue raising purposes, others for public health purposes or both.</p> <p>Note that Tokelau has banned the import of soft drinks.</p> <p><i>For details of tax on each PICT, see Appendix 2</i></p>	<p>associated with reductions in regular soft drink consumption reported by grade 9–12 students.”<sup>iii</sup></p> <p>PICTs that have recently increased their SSB tax are countries with the highest consumption rates (Cook Islands and Tonga). Countries that have had SSB taxes over a long timeframe tend to register more moderate levels of SSB consumption (CNMI, FS&lt;, Kiribati and Vanuatu.<sup>iii</sup></p>	

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<sup>ii</sup> Jensen JD, Smed S. The Danish tax on saturated fat—short run effects on consumption, substitution patterns and consumer prices of fat. Food Policy 2013; 42:18–31

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<sup>xii</sup> WHO. Using price policies to promote healthier diets. Regional Office for Europe. 2015

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## **Appendix 4:      Tabulation of included studies**

Note: AMSTAR was used for quality assessment of selected studies.

AMSTAR scores of 9–11 were deemed high quality; scores of 5–8 were deemed moderate quality; and AMSTAR scores of 0–4 were deemed low quality. Some systematic reviews were not assessed (N/A) if they were included in other reviews published subsequently. Non-systematic or semi-systematic studies were not included in the quality assessment.

## Summary Tabulation: Systematic/ Semi-systematic Reviews<sup>i</sup>

First author, Year	Aim/ Description	Population	Setting/ Intervention Strategy	Main findings	Quality rating	Years included
Avery et al. 2015	To identify interventions that can help to reduce the consumption of SSBs in children resulting in changes in body fatness so that conclusions can be drawn about how future effective interventions may be designed and used by relevant health professionals to address the increasing prevalence of childhood obesity.	2-18 years old	Early childhood, schools, community, home and family	Few RCT's have been undertaken to reduce SSB consumption and reduce childhood obesity. School-based education programs offer promise, incorporating follow-up modules. Changing the school environment to support such educational programs could improve effectiveness	Low	2000 – Aug 2013
Bambra et al. 2015	To systematically review the effectiveness of interventions (individual, community and societal) in reducing socioeconomic inequalities in obesity among (1) children aged 0–18 years (including prenatal) and (2) adults aged ≥18 years, in any setting, in any country, and (3) to establish how such interventions are organised, implemented and delivered.	0 – 18 year olds, adults	School, environment, community, home and family, primary care	These studies suggested that interventions that aim to prevent, reduce or manage obesity do not increase inequalities. For children, there was most evidence of effectiveness for targeted school-delivered, environmental and empowerment interventions.	High	2011 - 2012
Bhuyan et al. 2015	To explore primary care physician mediated interventions targeting childhood obesity and assess the roles played by physicians in the interventions.	2 – 18 year olds	Primary care	Primary care physician mediated interventions have the potential to effectively curb childhood obesity. However, there is a further need for training of PCPs, and explain new types of interventions such as the use of technology.	Low	2007 – October 2014

<sup>i</sup> Most recent reviews first in order; alphabetically ordered within each year.

First author, Year	Aim/ Description	Population	Setting/ Intervention Strategy	Main findings	Quality rating	Years included
Chambers et al. 2015	To investigate the effectiveness of statutory and self-regulatory actions to reduce the volume, exposure or wider impact of advertising for foods high in fat, sugar and salt (HFSS) to children, and 2) the role of educational measures.	0 -18 year olds	Policy/Environment change, advertising, nutrition	Whilst no single intervention can be expected to have a large impact on a child's risk of overweight, at least in the short term, reducing the volume of, and children's exposure to, advertising of foods HFSS is a policy that can be justified as a precautionary measure, and one which serves to help change the social norms around dietary behaviour and appropriate nutrition for children. In the future, researchers should aim to generate evidence on the longer term impacts of interventions and their wider potential to change health behaviour in order to ensure that policymakers can be more confident in the decisions that they take.	Moderate	0 – March 2013
Dudley et al. 2015	1) perform a systematic review of randomised controlled, quasi-experimental and cluster controlled trials examining the school-based teaching interventions that improve the eating habits of primary school children; and 2) perform a meta-analysis to determine the effect of those interventions.	5 – 12 year olds	Primary schools	Experiential learning strategies were associated with the largest effects across the reduced food consumption or energy intake; increased fruit and vegetable consumption or preference; and increased nutritional knowledge outcomes. Reducing sugar consumption and preference was most influenced by cross-curricular approaches embedded in the interventions.	Moderate	1970, 2010-May 2014
Dwyer et al. 2015	To synthesize the literature on strategies to promote family meals among families with school-aged children and adolescents.	Parents, school aged children	Home and family, community, primary care, online	Interventions to promote family meals are limited. While some effective interventions exist, efficacy in promoting family meals is variable. However, interventions reflect diverse possibilities for settings and strategies to consider building upon in further efforts to encourage family meals.	Low	2000 – May 2014
Foster et al. 2015	To systematically review the literature on treatment interventions for overweight or obesity in preschool-age children.	0 – 5 year olds	Home and family, community, primary care, childcare	Multidisciplinary, intensive interventions have some evidence of efficacy in reducing adiposity in pre-school children.	Moderate	1948 – July 2014
Godin et al. 2015	To identify and evaluate the effectiveness of school based prevention programs that have been developed to improve obesity related health behaviours in First Nations, Inuit and Metis (FNIM) youth in Canada.	First Nations, Inuit and Metis, 5-18 year olds	Schools	The majority of these programmes did not result in significant improvements in outcomes related to obesity, healthy eating, or PA among FNIM youth. Need to adhere to guidelines for working with this indigenous population group to ensure cultural sensitivity.	Moderate	2003 - 2014
Hollands et al. 2015	Cochrane systematic review to assess (1) the effects of interventions involving exposure to different sizes or sets of physical dimensions of a portion, package, individual unit or item of tableware on unregulated selection or consumption of food, alcohol or tobacco products in adults and children; and (2) the extent to which these effects may be modified by study, intervention and participant characteristics	Children and Adults	Free range population engaged in consumption of food, alcohol or tobacco products; marketing/ packaging	People consistently consume more food and drink when offered larger-sized portions, packages or tableware than when offered smaller-sized versions. This suggests that policies and practices that successfully reduce the size, availability and appeal of larger-sized portions, packages, individual units and tableware can contribute to meaningful reductions in the quantities of food (including non-alcoholic beverages) people select and consume in the immediate and short term. It is uncertain whether reducing portions at the smaller end of the size range can be as effective in reducing food consumption as reductions at the larger end of the range.	High	0-Jan 2015

First author, Year	Aim/ Description	Population	Setting/ Intervention Strategy	Main findings	Quality rating	Years included
Hung et al. 2015	To evaluate the effectiveness of school-based childhood obesity prevention programs, and to examine program components (moderators)	6-18 year old children	School	School based interventions have not been effective in reducing BMI or skinfold thickness to curb childhood obesity. Multi component strategies make it difficult to examine moderators of effects.	Moderate	1982 - 2010
Jang et al. 2015	To systematically evaluate intervention programs targeting parents to manage childhood overweight and obesity using the Reach, Efficacy, Adopt, Implementation, and Maintenance (RE-AIM) framework.	Parents	Home and family, Parents	Intervention programs targeting parents have the potential to be effective in improving childhood overweight and obesity in the short-term and there is suggestion that this effect may remain up to 2 years. However, intervention programs targeting parents for childhood overweight and obesity have not reached high-risk populations and have demonstrated high attrition.	Moderate	1990 – April 2015
Kader et al. 2015	To determine 1) effectiveness of universal parental support interventions to promote dietary habits, physical activity (PA) or prevent overweight and obesity among children 2–18 years and 2) effectiveness in relation to family socio-economic position.	2-18 year olds	Home and family, parents	Individual long-term counselling is the intervention of choice when it comes to diet, and that diet is more effectively changed through parental counselling than is PA. Group-based activities seem equally effective for diet, PA and obesity prevention. Further, our review confirms that parental support interventions work better the younger the children are. Involving parents through sending home information is not effective. With regard to groups with low SES, group-based approaches of relatively high intensity appear to be effective, but low participation and high attrition remains a challenge.	Moderate	1990 - 2013
Kraak et al. 2015	To identify experimental studies that measured how food companies' mascots and entertainment companies' media characters influence up to 12 diet-related cognitive, behavioural and health outcomes for children	2 – 12 year olds	Marketing	Results suggest that cartoon media character branding can positively increase children's fruit or vegetable intake compared with no character branding. However, familiar media character branding is a more powerful influence on children's food preferences, choices and intake, especially for energy-dense and nutrient-poor foods (e.g. cookies, candy or chocolate) compared with fruits or vegetables.	Moderate	2000 - 2014
Ligthart et al. 2015	To assess the effect of multidisciplinary intervention programs for overweight and obese children on quality of life (QoL).	3 – 18 year olds	Schools, primary care, community, home and family	There is insufficient evidence that multidisciplinary intervention programs, aimed to reduce weight in overweight and obese children, improve QoL.	Moderate	0 – July 2014

First author, Year	Aim/ Description	Population	Setting/ Intervention Strategy	Main findings	Quality rating	Years included
Ling et al. 2015	Systematic review to (i) examine the effects of prevention and management interventions on overweight/obesity among children aged 2-5 years, and (ii) explore factors that may influence intervention effects.	2-5-year-olds	Early childhood, parents	Management interventions showed greater effects in weight loss compared to prevention interventions. Of 12 efficacious interventions identified, 10 included PA and nutrition components, 9 actively involved parents, and only 4 were theory-based. Interactive education was the most common strategy used for parents in prevention interventions, compared to behavioural therapy techniques in management interventions. For children, interactive education and hands-on experiences involving PA and healthy eating were equally used. Future prevention interventions in preschool children should target both parents and children, and focus on PA and nutrition through interactive education and hands-on experiences.	High	1966- 2015 (February)
McGrath et al. 2015	To conduct a systematic review and meta-analysis of studies linking aspects of the built environment with youth moderate-vigorous activity, including walking.	8 – 17 year olds	Community, environment, active travel	Provisioning features expected to encourage play and walking in environments designed primarily for adults had negative effects on young children's activity, potentially linked to parental restriction due to concerns that children cannot independently access these features safely. Evaluation of interventions aimed at improving young children's safe independent access to features is expected to encourage play and walking.	High	2000 – March 2013
Morris et al. 2015	(1) How have parents been incorporated into childhood obesity interventions conducted in ECEC settings and to what extent, if any, does their involvement impact the outcomes of the intervention? (2) What are the methodological limitations of ECEC childhood obesity prevention interventions that have included a parental component? (3) What recommendations can be made for future research?	Early childhood	Early childhood, parents	Four findings were linked to weight changes: (1) when educational material is consistent across settings; (2) capacity building of parents; (3) parents encouraging their children to drink water in preference to SSBs; and (4) parental satisfaction and participation. A partnership between parents and Early Childhood Education and Care may be a powerful force in the prevention of paediatric obesity.	Moderate	2000 – August 2014
Niebylski et al. 2015	Systematically review the evidence to assess the effect of healthy food/beverage subsidies and unhealthy food/beverage taxation.	General population	Community, policy on food & beverage taxation and subsidies	Although moderate in quality, there was consistent evidence that taxation and subsidy intervention influenced dietary behaviours. To maximize success and effect (review suggests that) food taxes and subsidies should be a minimum of 10 to 15% and preferably used in tandem. Implementation of population-wide policies for taxation and subsidies with ongoing evaluation of intended and unintended effects are supported by this review.	Moderate	2003 (June)– 2013 (November)
Pearson et al. 2015	To quantify the effect of PA interventions on adolescent girls by including all intervention studies that provided results for girls separately and compared an intervention with a control or non-PA comparison.	12 - 18 year old girls	Schools	PA interventions for adolescent girls are effective but the effect is small. Subgroup analyses suggest that greater effectiveness appears to result from interventions that are multicomponent, theory based, school based, with girls only or with younger adolescent girls, and target both PA and sedentary behaviour.	High	0 - May 2013

First author, Year	Aim/ Description	Population	Setting/ Intervention Strategy	Main findings	Quality rating	Years included
Peirson et al. 2015	To synthesise the effectiveness of interventions in the prevention of childhood obesity that are feasible for use in primary care or for referral in the community and examines the features of efficacious interventions.	0-18 year olds	Primary care	Behavioural prevention interventions are associated with small improvements in weight outcomes in mixed-weight populations of children and adolescents. No intervention strategy consistently produced benefits.	High	0 – August 2013
Redsell et al. 2015	To identify interventions designed to reduce the risk of overweight/obesity that were delivered antenatally or during the first 2 years of life, with outcomes reported from birth to 7 years of age.	Early childhood	Home and Family, parents	The most promising obesity prevention interventions for children under 2 years of age are those that focus on diet and responsive feeding. Although the number of published studies on obesity prevention interventions for children under 2 years of age has risen exponentially since 2010, interventions for pregnant women with follow-up during early life are rare. This should be a priority for future research.	Moderate	1990 – September 2013
Ruotsalainen et al. 2015	To examine the effects of PA and exercise interventions on BMI, subsequent PA and psychological symptoms for overweight and obese adolescents .	Overweight 12 – 18 year olds	Community, primary care	Interventions were complex, with more than one component and the aspect that effectively promotes PA in obese adolescents was not clear. However, it seems that exercise interventions affect the BMI of overweight or obese adolescents. Interventions that include a component for promoting PA with or without supervised exercise can affect subsequent PA and BMI.	High	1950 - 2013
Seburg et al. 2015	To identify randomized controlled trials of pediatric primary care-based obesity interventions.	0 – 18 year olds	Primary care, parents	Effective interventions were mainly treatment interventions, and tended to focus on multiple behaviours, contain weight management components, and include monitoring of weight-related behaviours (e.g., dietary intake, PA, or sedentary behaviours). Overall, results demonstrate modest support for the efficacy of obesity treatment interventions set in primary care.	Moderate	1990 – October 2013
Shirley et al. 2015	To build on the evidence of effective school-based nutrition or PA interventions and examine recent studies of combinations of obesity prevention programs in US elementary schools.	5 – 12 year olds	Schools, community, home and family, parents	Most studies of programs with two or three components (i.e., PA plus nutrition, PA plus both education and nutrition) reported statistically significant improvements in objective obesity-related outcomes. Studies evaluating programs with community and parental involvement suggest that these components may increase effectiveness. Long-term implementation of programs is important for sustained gains.	Moderate	2007 – December 2012
Van der Kleij et al. 2015	To review the literature that has reported on the determinants of Intersectoral community Approaches targeting Childhood Obesity (IACO) implementation success and failure.	0 – 21 year olds	Schools, community, primary care, parents, Home and family	Although some insights into the effective implementation of IACOs are present, more research is needed. Emphasis should be placed on elucidating the relationship between determinants and implementation success. Research should further focus on developing a 'golden standard' for evaluating and reporting on implementation research.	High	0 – December 2014

First author, Year	Aim/ Description	Population	Setting/ Intervention Strategy	Main findings	Quality rating	Years included
Wang et al. 2015	To systematically evaluate the effectiveness of childhood obesity prevention programmes conducted in high-income countries and implemented in various settings.	2-18 year olds	High income countries, Community, environment	At least moderately strong evidence supports the effectiveness of school-based interventions for preventing childhood obesity. More research is needed to evaluate programmes in other settings or of other design types, especially environmental, policy and consumer health informatics-oriented interventions.	High	0- April 2013
Ward et al. 2015	To identify if childcare educators' practices predict or are associated with pre-schoolers' PA and eating behaviours in childcare centres and to assess the effectiveness of interventions that control educators' practices or behaviours in order to improve pre-schoolers' PA and eating behaviours.	4 – 6 year olds	Child care	Educators may play a positive role in promoting healthy behaviours in children, but this is mainly based on a small number of intervention type studies of low or moderate quality. The influence of specific components of educators' practices on children's healthy eating and PA behaviours remains inconclusive.	High	0 – June 2015
Beauchamp et al. 2014	To identify interventions for obesity prevention that evaluated a change in adiposity according to socioeconomic position (SEP) and to determine the effectiveness of these interventions across different socioeconomic groups	General population (≤ 60 years)	All interventions and settings; Particular focus on lower socioeconomic position (SEP)	A total of 14 studies were analysed, representing a range of study designs and settings. All studies were from developed countries, with eight conducted among children. Three studies were shown to have no effect on anthropometric outcomes and were not further analysed. Interventions shown to be ineffective in lower SEP participants were primarily based on information provision directed at individual behaviour change. Studies that were shown to be effective in lower SEP participants primarily included community-based strategies or policies aimed at structural changes to the environment. Interventions targeting individual-level behaviour change may be less successful in lower SEP populations. It is essential that our efforts to prevent obesity do not leave behind the most disadvantaged members of society	High	0-2012 (September)
Brand et al. 2014	To assess the effectiveness of community-based interventions to promote PA and healthy eating.	Adults and children	Community (non-public or semi-public areas, such as worksites, schools, health care), nutrition, PA	In regards to children, overall, the results of the last indicate moderate evidence for beneficial effects of community-based interventions on weight change among primary school-aged children, but insufficient evidence for preschool children and adolescents.	High	2007-2014
Dellert et al. 2014	Examine the effect of interventions with parents and children on children's PA and BMI.	2-18 year olds	Home and family, parents	Interventions which included both parents and children had a significant effect on PA but not BMI.	Moderate	1990 – 2011
Driessen et al. 2014	To review the evidence for the effect of isolated food environment interventions on both eating behaviours (including food purchasing) and/or body weight.	5- 12 year olds	Schools, canteens, nutrition, SSB, School environment	A school environment supportive of healthy eating is essential to combat heavy marketing of unhealthy food. Modification of the school food environment (including high level policy changes at state or national level) can have a positive impact on eating behaviours.	Moderate	0 – November 2013

First author, Year	Aim/ Description	Population	Setting/ Intervention Strategy	Main findings	Quality rating	Years included
Ewald et al. 2014	This systematic review aims to add to the current knowledge by including comparisons of parent-only groups with parent-child or child-only intervention groups for children aged 5–12 years.	5-12 years old	Parents, nutrition, PA	Parent-only interventions appear to be as effective as parent-child interventions in the treatment of childhood overweight/obesity, and may be less expensive. Reasons for higher attrition rates in parent-only interventions need further investigation.	Moderate	July 2012 – March 2014
Friedrich et al. 2014	To evaluate the effects of intervention program strategies on the time spent on activities such as watching television, playing videogames, and using the computer among schoolchildren.	4-19 year olds	Schools, screen time	Interventions have demonstrated the positive effects of the self-reported decrease of screen time among schoolchildren.	Moderate	1998- Aug 2012
Hiller-Brown et al. 2014	To systematically review studies of the effectiveness of interventions (individual, community and societal) operating via different approaches (targeted or universal) in reducing socio-economic inequalities in obesity-related outcomes amongst children	0-18 years old	Community, school, screen time, PA, nutrition	At the individual level there was indicative evidence that <i>screen time reduction</i> and <i>mentoring health promotion</i> interventions could be effective in reducing inequalities in obesity. For the community level interventions evidence was inconclusive - with some studies suggesting that <i>school-based health promotion activities</i> and <i>community-based group-based programmes</i> were effective in reducing obesity - others not. Societal level evaluations were few. However, there was no evidence to suggest that any of these intervention types increase inequalities and several studies found that interventions could at least prevent the widening of inequalities in obesity.	High	0-October 2012
Ickes et al. 2014	To compare and contrast U.S. and international school-based obesity prevention interventions and highlight efficacious strategies.	5 - 18 year olds	Schools	Interventions implemented in the U.S. and internationally resulted in successful outcomes, including positive changes in student BMI. Yet, varying approaches were used to achieve success, reinforcing the fact that a one-size-fits-all approach is not necessary to impact childhood obesity. However, building on successful interventions, future school-based obesity prevention interventions should integrate culturally specific intervention strategies, aim to incorporate an environmental component, and include parents whenever possible. Consideration should be given to the potential impact of long-term, frequent dosage interventions, and subsequent follow-up should be given attention to determine long-term efficacy.	Low	2002 - December 31, 2013

First author, Year	Aim/ Description	Population	Setting/ Intervention Strategy	Main findings	Quality rating	Years included
Jenkin et al. 2014	This review identifies the most frequently documented persuasive marketing techniques to promote food to children via television.	Not specified	Advertising, marketing, promotion offers, nutrition	The most commonly reported persuasive techniques used on television to promote food to children. These were the use of premium offers, promotional characters, nutrition and health-related claims, the theme of taste, and the emotional appeal of fun. Identifying and documenting these commonly reported persuasive marketing techniques to promote food to children on television is critical for the monitoring and evaluation of advertising codes and industry pledges and the development of further regulation in this area. This has a strong potential to curbing the international obesity epidemic besieging children throughout the world.	High	0-March 2013
Lai et al. 2014	To determine whether typically developing children and adolescents (aged 3–18 years) who have participated in school-based interventions have sustained outcomes in PA, fitness, and/or FMS.	3-18 year olds	Schools, PA	It is likely that PA is a sustainable outcome from interventions in children and adolescents, and there is reasonable evidence that interventions of longer than 1 year and interventions that utilize a theoretical model or framework are effective in producing this sustained impact.	Moderate	1995 - July 26, 2012
Laine et al. 2014	Systematic review of evidence on the cost-effectiveness of population-level interventions to promote PA.	General population	Preventive interventions aimed at promoting and maintaining PA in wide population groups. Multiple settings/ strategies.	The most efficient interventions to increase PA were community rail trails (\$.006/MET-h), pedometers (\$.014/MET-h), and school health education programs (\$.056/MET-h).	Moderate	0- 2013 (August)
Langford et al. 2014	To assess the effectiveness of the Health Promoting Schools (HPS) framework in improving the health and well-being of students and their academic achievement.	4-18 years old	Schools, community, PA, fitness, nutrition and other health promotion	Positive effects were found for interventions on: BMI, PA, physical fitness, fruit and vegetable intake, tobacco use, and being bullied. Intervention effects were generally small but have the potential to produce public health benefits at the population level. There was little evidence of effectiveness for standardised BMI (zBMI) and no evidence of effectiveness for fat intake, alcohol use, drug use, mental health, violence and bullying others; however, only a small number of studies focused on these latter outcomes.	High	0-April 2013
Larouche et al. 2014	to examine differences in PA, body composition and cardiovascular fitness between active and passive travellers	5-18 year olds	Active travel	Observational - those who participated in active school travel were more active. Active school travel interventions lead to increases in PA in school aged children.	Moderate	0 - April 10, 2012

First author, Year	Aim/ Description	Population	Setting/ Intervention Strategy	Main findings	Quality rating	Years included
Laws et al. 2014	To systematically review the literature to examine the effectiveness of interventions to prevent obesity or improve obesity related behaviours in children 0-5 years from socioeconomically disadvantaged or Indigenous families.	0 - 5 year olds	Early childhood	There is an urgent need for further research on effective obesity prevention interventions for Indigenous children. The findings from the growing body of intervention research focusing on obesity prevention amongst young children from socioeconomically disadvantaged families suggest intervention effects are modest but promising.	High	1993 - November 2013
Liao et al. 2014	To assess the overall effect size of sedentary behaviour interventions on BMI reduction and to compare whether interventions that have multiple components have higher mean effect size than interventions with single components	0-18 years old	Sedentary behaviour alone or with PA, nutrition	Results indicated that sedentary behaviour interventions had a significant effect on BMI reduction. The pooled effect sizes of multi-component interventions did not differ from the single-component interventions and neither of them had a significant effect size on its own. Future paediatric obesity interventions may consider focusing on developing strategies to decrease multiple screen-related sedentary behaviours.	High	0-July 2012
Mahmood et al. 2014	To assess the effectiveness of school-based interventions program in reducing the prevalence of overweight or obesity among schoolchildren.	8-13 year olds	Schools	School-based intervention programs are effective in prevention of childhood overweight and obesity problem	High	0 - December 2012
Marsh et al. 2014	To examine the effectiveness of these interventions with respect to decreasing sedentary time, and the secondary aim was to investigate whether level of family involvement/ engagement affects this outcome.	2-18 year olds	Schools, Home and Family, Community, Primary care	This review supports the need for interventions that focus on the family and, more specifically, interventions that involve a parent at more than just a supervisory or administrative level. There is also a need to consider child characteristics and the motivation of the parent, with interventions tailored accordingly. Finally, more research is required to address how food-related behaviours moderate the relationship between screen time and overweight in youth and how such an understanding may be incorporated into future interventions.	Moderate	0 - March 13, 2012
National Institute for Health and Care Excellence (NICE) 2014	To provide a systematic review of systematic reviews to support the partial update of NICE section 1.1.1 guidance on obesity, covering strategies that may help people maintain a healthy weight and prevent excess weight gain	Children Adolescent Adult populations	School, community, general settings, nutrition, PA, canteens, active travel among other interventions	For children and young people, no systematic review level evidence was identified for: walking; cycling; activities of daily living; incidental PA; sedentary time (other than screen time); breaks in sedentary time; consumption of tea and coffee, whole grains, meat, fish, legumes, nuts, a vegetarian/vegan diet, catechins, or caffeine; glycaemic index/load of the diet; eating pattern (e.g. timing during the day (including evening eating) or consistency during the week); PA monitoring, or support.	High	1995 – January 2013

First author, Year	Aim/ Description	Population	Setting/ Intervention Strategy	Main findings	Quality rating	Years included
Robinson et al. 2014	To evaluate the effectiveness of health communication campaigns that use multiple channels, including mass media, and distribute health-related products. The primary outcome of interest was use of distributed health-related products.	Population	Mass media, community	Health communication campaigns that combine mass media and other communication channels with distribution of free or reduced-price health-related products are effective in improving healthy behaviours. This intervention is expected to be applicable across U.S. demographic groups, with appropriate population targeting. The ability to draw more specific conclusions about other important social marketing practices is constrained by limited reporting of intervention components and characteristics.	High	1980 - 2009
Robinson et al. 2014	To assess the effectiveness of pre-school and school-based obesity prevention and/or treatment interventions targeting healthy eating, PA or obesity in African American children and adolescents.	0-18 years old	Schools, preschools, PA, nutrition	The evidence available suggests school-based interventions are effective in promoting healthy nutrition behaviours in African American children. Conclusions overall and, particularly, about effects on PA and obesity are limited due to the small number of studies, differences in assessment approaches and a lack of follow-up assessments	Not rated	1980 – March 2013
Towns et al. 2014	To identify interventions aimed at promoting healthy weights among Aboriginal children and youth.	0-18 year olds	Schools, Home and Family	None of the published evaluations reported significant reductions in obesity or overweight or sustained increases in PA, although some evaluations presented evidence of positive effects on children's diets or on nutrition knowledge or intentions. We conclude that broader structural factors affecting the health of Aboriginal children may limit the effectiveness of these interventions, and that more evidence is required regarding interventions for Aboriginal children in various geographic and cultural contexts in Canada including Inuit and Métis communities.	Low	
Upton et al. 2014	To evaluate family-based child obesity programmes implemented in community settings in the UK to: document extent of family involvement; present evidence of short and long-term effectiveness and assess the methodological rigour of the evidence.	2 – 19 years old	Home and family, parents, community	Family-based weight management programmes implemented in community settings can be effective on a number of weight related outcomes. There is insufficient evidence to suggest how the inclusion of parents and the wider family may impact on the effectiveness of community-based weight management programme for children and young people. The majority of programs lasted 12 weeks and few provided long term evaluations. The methodological rigour of reviewed studies was poor, future studies should improve their design and include longer follow-up periods.	High	

First author, Year	Aim/ Description	Population	Setting/ Intervention Strategy	Main findings	Quality rating	Years included
Vasques et al. 2014	To assess the efficacy of school-based and after-school intervention programs on the BMIs of child and adolescents, addressing the correlation between some moderating variables.	5-19 year olds	School, After-School	Although of low magnitude ( $r = .068$ ), the intervention programs had a positive effect in prevention and decreasing obesity in children. This effect seems to be higher in older children's, involving interventions with PA and nutritional education combined, with parent's participation and with 1-year duration. School or after-school interventions had a similar effect.	Moderate	
Williams, G et al. 2014	To conduct a systematic review of randomised controlled trials (RCTs) examining the use of social media to promote healthy diet and exercise in the general population.	Population	Mass Media	Social media may provide certain advantages for public health interventions; however, studies of social media interventions to date relating to healthy lifestyles tend to show low levels of participation and do not show significant differences between groups in key outcomes.	High	2000 - 2013
Zhou et al. 2014	To systematically review randomised controlled trials of obesity prevention interventions in childcare settings.	Early Childhood	Childcare, nutrition, PA, parents	More research should test changes in the nutrition and PA environment as potentially sustain- able early prevention strategies in childcare facilities. More controlled trials are needed for quantitative analysis among studies testing similar interventions and using consistent outcome measures of both behaviours and adiposity.	Moderate	Jan 2000 – Aug 2012
Abioye et al. 2013	To investigate the effect of mass media campaigns on PA.	Adults	Mass Media, PA	Mass media campaigns may promote walking, but may not reduce sedentary behaviour or lead to achieving sufficient PA. Further research is required to examine the effect of mass media campaigns on other measures and types of PA (such as time spent walking and overall time spent in PA).	High	0 - August 2012
Bollars et al. 2013	To describe the changing nature of marketing methods and recent policy approaches to controlling the marketing of food and beverages to children, and summarise of recent evidence linking advertising and marketing to children's dietary behaviour.	Children Adolescents	EDNP Marketing	Television (TV) remains the most frequently used medium for advertising all types of goods and service, but internet and digital advertising has increased rapidly during the last decade and is expected to be a significant medium in the coming years. Estimates for advertising expenditure in western Europe indicate a decline in spending on TV advertising and a significant rise in spending on internet and other non-traditional digital advertising. Reduced spending on advertising does not, however, mean reduced quantity of advertising. The rise in the number of TV channels and expanding new media has reduced average costs and increased opportunities significantly. In the food and drink sector, the leading categories of food being advertised are soft drinks, sweetened breakfast cereals, biscuits, confectionery, snack foods, ready meals and fast food/quick service outlets. The majority of the food and beverage products featured are high in fat, sugar or salt (HFSS).	Not rated (not SR)	Update 2009-2012

First author, Year	Aim/ Description	Population	Setting/ Intervention Strategy	Main findings	Quality rating	Years included
Bleich et al. 2013	To systematically review community-based childhood obesity prevention programs in the United States and high-income countries.	2 - 18 year olds	Community, diet, PA	The strength of evidence is moderate that community- based childhood obesity prevention programs with a school component focusing on both diet and PA is more effective at preventing obesity or overweight. More research and more consistent methods are needed to understand the comparative effectiveness of these intervention programs.	Moderate	0 - August 11, 2012
Cabrera Escobar et al. 2013	Meta-analysis evaluates the literature on SSB taxes or price increases, and their potential impact on consumption levels, obesity, overweight and BMI.	Children, Adolescents, Adults	Community, policy on SSB taxation or price increases	Nine articles met the criteria for the meta-analysis (6 from the USA and 1 each from Mexico, Brazil and France. All showed negative own-price elasticity (i.e. higher prices are associated with a lower demand for SSBs). Pooled own price-elasticity was -1.299 (95% CI: -1.089 - -1.509). Four articles reported cross-price elasticities, three from the USA and one from Mexico; higher prices for SSBs were associated with an increased demand for alternative beverages such as fruit juice (0.388, 95% CI: 0.009 - 0.767) and milk (0.129, 95% CI: -0.085 - 0.342), and a reduced demand for diet drinks (-0.423, 95% CI: -0.628 - -1.219). Six articles from the USA showed that a higher price could also lead to a decrease in BMI, and decrease the prevalence of overweight and obesity.	Moderate	January 2000 - January 2013
Cairns et al. 2013	To review the international evidence base on (i) the nature and extent of food promotion and non-alcoholic beverages to children; and (ii) the effects of child-oriented food and non- alcoholic beverage promotion on diet, dietary determinants and health.	2-15 year olds	Marketing, nutrition	Unconstrained food marketing continues to promote low nutrition foods and that marketing influences children's food behaviours and diet-related health.	Moderate	1970 - 2008
Dobbins et al. 2013	To summarise evidence of the effectiveness of school-based interventions in promoting PA and fitness in children and adolescents	6-18 years	School, PA	There is some evidence to suggest that school-based PA interventions are effective in increasing the number of children engaged in moderate to vigorous physical activity, as well as how long they spend engaged in these activities. There is also evidence to suggest that these interventions reduce the amount of time spent watching television	High	0-October 2011
Galbraith-Emami & Lobstein 2013	To examine the data available on levels of exposure of children to the advertising of less healthy foods since the introduction of the statutory and voluntary codes on the advertising of food and beverages to children.	Children and Adolescents ~ 0-18-year-olds	Advertising, nutrition (SSBs)	There is a sharp division in the evidence, with scientific, peer-reviewed papers showing that high levels of such advertising of less healthy foods continue to be found in several different countries worldwide. In contrast, the evidence provided in industry-sponsored reports indicates a remarkably high adherence to voluntary codes. The adherence to voluntary codes may not sufficiently reduce the advertising of foods which undermine healthy diets, or reduce children's exposure to this advertising	Moderate	2008 - April 2013
Guerra et al. 2013	To evaluate the effectiveness of interventions that promoted PA in the school environment and reduced overweight and obesity in children and adolescents. The secondary goal was to evaluate the outcome of these interventions on high BP.	6 - 17 year olds	Schools, PA	PA interventions in schools were not found to have a statistically significant influence on BMI, body weight or BP of children.	High	2009 - September 2012

First author, Year	Aim/ Description	Population	Setting/ Intervention Strategy	Main findings	Quality rating	Years included
Ickes et al. 2013	To review recess interventions aimed to improve PA among youth, and make recommendations to develop related best practices.	3 - 12 year olds	Schools, PA	A number of simple, low-cost strategies can be implemented to maximize the amount of recess time students are allotted. Long-term follow-up studies are warranted for each of the recess strategies identified to be effective.	Moderate	1986 - 2011
Lighthart 2013	to systematically outline outcomes on quality of life (QoL) and the cost-effectiveness of multidisciplinary interventions in overweight and obese children	0-18 years old	Multi-disciplinary healthcare settings, PA, nutrition, behavioural therapy	14 RCTs were included, of which ten were effective on weight management. Meta-analysis of the short term QoL outcomes of three effective RCTs showed no significant differences between the groups (MD 1.23, 95%CI -2.32;4.77). The program costs varied from £49.52 to £898.69 per child and four of the six programs were cost-effective following the model of Hollingworth. Multidisciplinary weight management programs for overweight children are cost-effective in 67% of the interventions and might lead to less indirect costs, since most studies report small, but non- significant improvements in quality of life.	Not rated (full paper N/A but see Lighthart et al. 2015 above)	0-April 2012
Lonsdale et al. 2013	(i) Describe the nature of the interventions that have been undertaken (i.e., the theories, strategies, or approaches researchers have used to design their interventions); and (ii) conduct meta-analyses to determine the effectiveness of these interventions.	6 - 13 year olds	Schools, PA	Interventions can increase the proportion of time students spend in MVPA during PE lessons. As most children and adolescents participate in PE, these interventions could lead to substantial public health benefits	Moderate	0 - March 24, 212
Pardo et al. 2013	To identify strategies found in scientific literature, which have been effective (i.e. successful) in increasing adolescents' school-based PA	12- 18 years old	School, PA	Several promising strategies were identified and grouped into five broad intervention guidelines. These guidelines are as follows: (i) design multi-component interventions that foster the empowerment of members of the school community; (ii) develop improvements to Physical Education curricula as a strategy to promote PA to adolescents; (iii) design and implement non-curricular programmes and activities to promote PA; (iv) include computer-tailored interventions during the implementation and monitoring of PA promotion programmes and (v) design and implement specific strategies that respond to the interests and needs of girls.	Moderate	0-2011
Powell et al. 2013	To systematically review recent U.S. studies on the price elasticity of demand for (SSBs), fast food, and fruits and vegetables, as well as the direct associations of prices/taxes with body weight outcomes.	Population (USA)	USA General population; taxation or pricing policy for (SSBs), fast food, fruits and vegetables.	Based on the recent literature, the price elasticity of demand (percentage change in quantity demanded in response to a one percent change in price) was estimated at <b>-1.21 for SSBs</b> <b>-0.52 for fast food</b> <b>-0.49 for fruits and -0.48 for vegetables</b> ; Higher fast-food prices were associated with lower weight outcomes particularly among adolescents suggesting that raising prices would potentially impact weight outcomes. Lower fruit and vegetable prices were generally found to be associated with lower body weight outcomes among both low-income children and adults suggesting that subsidies that would reduce the cost of fruits and vegetables for lower-socioeconomic populations may be effective in reducing obesity. Pricing policy instruments should be considered and evaluated.	Moderate	January 2007 - March 2012.

First author, Year	Aim/ Description	Population	Setting/ Intervention Strategy	Main findings	Quality rating	Years included
Saunders et al. 2013	To assess the health effects of active travel specifically (rather than of PA in general, where the evidence is already well-established)	Population	Active travel	Active travel may have positive effects on health outcomes, but there is little robust evidence to date of the effectiveness of active transport interventions for reducing obesity. Future evaluations of such interventions should include an assessment of their impacts on obesity and other health outcomes.	Moderate	1991 - 2011
Schoppe et al. 2013	Synthesise the evidence for associations of independent mobility and active travel to various destinations with PA, sedentary behaviour and weight status.	3 - 18 year olds	Active Travel	Studies on independent mobility suggested that children who have the freedom to play outdoors and travel actively without adult supervision accumulate more PA than those who do not. Further investigation of children's active travel to leisure-related destinations, measurement of diverse sedentary behaviour beyond simply screen-based activities, and consistent thresholds for objectively measured sedentary behaviour in children will clarify the inconsistent evidence base on associations of active travel with sedentary behaviour and weight status.	Moderate	1991 - 2012
Showell et al. 2013	To systematically review the effectiveness of home-based interventions on weight, intermediate (e.g. diet and PA), and clinical outcomes.	2-18-year olds	Children and adolescents, home and family setting	The strength of evidence is low to support the effectiveness of home-based child obesity prevention programs. Additional research is needed to test interventions in the home setting, particularly those incorporating parenting strategies and addressing environmental influences.	Moderate	0-2012 (August)
Sobol-Golberg et al. 2013	To update the evidence of the effectiveness of school-based programs to reduce childhood obesity	5 - 18 year olds	Schools, PA, nutrition	There is convincing evidence that school-based prevention interventions are at least mildly effective in reducing BMI in children, possibly because these newer studies tended to be longer, more comprehensive and included parental support.	Moderate	2006 - 2012
Sun et al. 2013	To evaluate the effectiveness of school-based PA interventions on fitness, adiposity and cardio-metabolic outcomes among schoolchildren.	5 - 18 year olds	Schools, PA	Dose of school-based PA is an important determinant of trial efficiency. Some large, higher quality RCTs provided strong evidence for interventions to decrease skin-fold thickness, increase fitness and high-density lipoprotein cholesterol. Evidence for BMI, body fat and waist circumference, blood pressure and triglycerides, low-density lipoprotein cholesterol and total cholesterol remain inconclusive and require additional higher quality studies with high dose of interventions to provide conclusive evidence.	High	0 - October 2012
Sung-Chan et al. 2013	To examine the methodological rigour and treatment effectiveness of family-based interventions according to intervention types and theoretical orientations.	2 - 19 years old	Home and family, nutrition, PA	Family-based interventions rooted in behaviour theory achieved better results than those theoretically connected to family systems theory in terms of treatment effectiveness.	Moderate	1975 - June 2012

First author, Year	Aim/ Description	Population	Setting/ Intervention Strategy	Main findings	Quality rating	Years included
van der Kruk et al. 2013	To describe the intensity of parental involvement and behaviour change aimed at parents in long-term European childhood weight control interventions.	Parents	Parents	Intensity of parental involvement and behaviour change techniques are important issues in the effectiveness of long-term childhood weight control interventions.	Moderate	1996 - April 2011
Wang et al. 2013	The evidence is moderate about the effectiveness of school-based interventions for childhood obesity prevention. PA interventions in a school-based setting with a family component or diet and PA interventions in a school-based setting with home and community components have the most evidence for effectiveness.	2 - 18 year olds	Schools, Home, Community	Overall, there is moderate to high strength of evidence that diet and/or PA interventions that are implemented in schools help prevent weight gain or reduce the prevalence of overweight and obesity. However, the evidence on the effectiveness of interventions primarily implemented in other settings is largely low or insufficient. We need more research to test interventions conducted in settings other than schools, especially to test the impact of policy and environmental changes.	High	0 - August 11, 2012
Waters et al. 2013	To update the previous Cochrane review of childhood obesity prevention research and determine the effectiveness of evaluated interventions intended to prevent obesity in children, assessed by change in BMI. Secondary aims were to examine the characteristics of the programs and strategies to answer the questions "What works for whom, why and for what cost?"	0 - 18 year olds	Schools, Home and Family, Community	Programmes made a positive difference, but there was much variation between the study findings which we could not explain. It is important that more studies in very young children and adolescents are conducted to find out more about obesity prevention in these age groups, and also that we assess how long the intervention effects last. Also, we need to develop ways of ensuring that research findings benefit all children by embedding the successful programme activities into everyday practices in homes, schools, child care settings, the health system and the wider community.	High	0 - March 2010
Williams et al. 2013	To evaluate the effects of policies related to diet and PA in schools, either alone, or as part of an intervention programme on the weight status of children.	4 - 11 year olds	Primary Schools, PA, nutrition	When implemented alone, school diet and PA related policies appear insufficient to prevent or treat overweight or obesity in children, however, they do appear to have an effect when developed and implemented as part of a more extensive intervention programme.	Moderate	0 - June 2011
Xu et al. 2013	To examine the relationships between active transport to work or school and cardiovascular health, body weight, or other health outcomes.	Population	Active Transport	Active transport to work or school was significantly associated with improved cardiovascular health and lower body weight. However, the strength of the evidence varied from weak (mental health and cancer), moderate (body weight), to strong (cardiovascular health).	Moderate	0 - September 2012
Branscum et al. 2012	To review primary prevention interventions targeting childhood obesity implemented in the after school environment	5 - 18 year olds	Schools, diet, PA	After-school interventions resulted in modest changes in behaviours and behavioural antecedents, and results were mixed and generally unfavourable with regards to indicators of obesity.	Low	2006 - 2011

First author, Year	Aim/ Description	Population	Setting/ Intervention Strategy	Main findings	Quality rating	Years included
Hendrie et al. 2012	To (i) examine the effectiveness of combined-setting (school or community centres and the home) obesity prevention interventions to change children's weight-related dietary, activity, and sedentary behaviour's and risk of obesity and (ii) determine whether there is an association between the effectiveness of these combined-setting interventions and the food and activity behaviours targeted and the behaviour change techniques used.	1 - 18 year olds	Schools, community, home and family, PA, nutrition	Seven studies reviewed here provide support for the effectiveness of combined-setting interventions in changing children's nutrition, activity or sedentary behaviours, or risk of obesity. Family involvement in combined-setting interventions is recommended to increase the likelihood of effectiveness.	High	1998 - 2010
Khambalia et al. 2012	To examine the quality of evidence and compare the findings from existing systematic reviews and meta- analyses of school-based programs in the prevention and control of childhood obesity.	5 - 18 year olds	Schools	Intervention components in the school setting associated with a significant reduction of weight in children included long-term interventions with combined diet and PA and a family component. Several reviews also found gender differences in response to interventions. Of the eight reviews, five were deemed of high quality and yet limited evidence was found on which to base recommendations. As no single intervention will fit all schools and populations, further high-quality research needs to focus on identifying specific program characteristics predictive of success.	Moderate	1990 - October 2010
Krishnaswami et al. 2012	To assess whether incorporating community engagement principles in school-based interventions influences weight-related outcomes.	5 - 18 year olds	Schools	Results suggest that meaningful partnership of diverse school communities within obesity prevention interventions can improve health outcomes.	Moderate	2000 - 2011
Lavelle et al. 2012	Systematic review/Meta-analysis of school-based interventions aimed at reducing the BMI of children < 18 years	Children and young people < 18 years	Schools	There is growing evidence that school-based interventions that contain a PA component may be effective in helping to reduce BMI in children. 43 studies provided 60 measurements of effect; the pooled effect was a 0.17 (95% CI: 0.08, 0.26, P < 0.001) reduction in BMI. The intervention comprised PA only in 11 (26%) studies, education only in three (7%), and combinations of these and improved nutrition in the remaining 29 (67%). On stratified analysis, PA used in isolation (-0.13, 95% CI: -0.22, -0.04, P = 0.001) or combined with improved nutrition (-0.17, 95% CI: -0.29, -0.06, P < 0.001) was associated with significant improvements in BMI. Interventions targeted at overweight/obese children reduced their BMI by 0.35 (95% CI: 0.12, 0.58, P = 0.003). Those delivered to all children reduced it by 0.16 (95% CI: 0.06, 0.25, P = 0.002).	Moderate	1991 – 2011 (February)
Leung et al. 2012	To assess the effectiveness of interventions that focus on reducing sedentary behaviour (SB) among school-age youth and to identify elements associated with interventions' potential for translation into practice settings.	6 - 19 year olds	Schools, screens, PA, nutrition	Overall, interventions that focused on decreasing SB were associated with reduction in time spent on SB and/or improvements in anthropometric measurements related to childhood obesity. Several of the studies did consider elements related to the intervention's potential for translation into practice settings.	High	1980 - April 2011

First author, Year	Aim/ Description	Population	Setting/ Intervention Strategy	Main findings	Quality rating	Years included
Metcalf et al. 2012	To determine whether, and to what extent, PA interventions affect the overall activity levels of children.	0 - 16 year olds	PA	This review provides strong evidence that PA interventions have had only a small effect (approximately 4 minutes more walking or running per day) on children's overall activity levels.	Moderate	1990 - March 2012
Niemeier et al. 2012	To review child and adolescent weight-related health intervention characteristics, with a particular focus on levels of parental participation, and examine differences in intervention effectiveness.	2 - 19 year olds	Schools, parents, PA, nutrition	This study suggests that weight-related health interventions that require parent participation more effectively reduce body mass indexes of child and adolescent participants. In addition, longer interventions that include parent participation appear to have greater success.	Low	2004 - December 2010
Nixon et al. 2012	To identify the most effective behavioural models and behaviour change strategies, underpinning preschool and school-based interventions aimed at preventing childhood obesity.	4 - 6 year olds	Early childhood, home and family, parents	Interventions that combined high levels of parental involvement and interactive school-based learning; targeted PA and dietary change; and included long-term follow-up, appeared most effective. It is suggested that interventions should also be focused on developing children's (and parents') perceived competence at making dietary and physical changes.	Moderate	1995 - April 2010
Summerbell et al. 2012	To summarise and translate the findings from four recent reviews of educational strategies and psychological approaches explaining young children's acquisition and formation of energy-balance related behaviours and management of these behaviours.	4-6 years	School, preschool, PA, sedentary behaviour, nutrition	Childhood obesity is not an issue for the education sector alone; it needs to be tackled at a multi sectoral level, recognizing the particularly important role of local governments, nongovernment organizations and the media.	Not rated (Not SR – is a translation oriented paper based on 4 existing reviews)	Not stated.
Van Lippevelde et al. 2012	To determine the impact of parental involvement in school-based obesity prevention interventions in children and adolescents.	6 - 18 year olds	Schools, Home and family, parents, PA, nutrition, screens	There is a need for more studies comparing school-based interventions with and without a parental component, and dose, strategies and content of parental components of school-based interventions should be better reported in articles.	Moderate	1990 - 2010

First author, Year	Aim/ Description	Population	Setting/ Intervention Strategy	Main findings	Quality rating	Years included
Verstraeten et al. 2012	To review the evidence on the effectiveness of school-based interventions targeting dietary behaviour and/or PA for the primary prevention of obesity in children and adolescents aged 6–18 y in low- and middle-income countries.	6 - 18 year olds	Schools	School-based interventions have the potential to improve dietary and PA behaviour and to prevent unhealthy body weights in low- and middle-income countries. To reach their full potential, interventions should conduct process evaluations to document program implementation. The effect and the pathways through which interventions have this effect need to be better documented through rigorous evaluation studies.	High	1990 - July 2011
Atkin et al. 2011	To systematically review of interventions to promote PA in young people conducted in the hours immediately after school.	5-18 year olds	Schools, PA	There is some evidence to suggest that single-behaviour interventions may be most successful during after-school hours. Further work is required to develop interventions delivered during this time and determine whether changes in behaviour can be maintained over extended periods of follow-up.	Low	1990 - March 2010
Berge et al. 2011	To conduct a meta-analysis of family-based interventions targeting childhood obesity in the last decade in order to inform the research in the next decade.	5-18 year olds	Family, parents, nutrition (SSBs), PA	There is preliminary evidence that suggesting that family-based interventions targeting childhood obesity are successful in producing weight loss in the short and long-term. Including families in weight loss treatment of obese children warrants further implementation and study.	Moderate	December 2009 – April 2010
Chillon et al. 2011	To review intervention studies related to AST to assess quality and effectiveness	6-18 years old	Schools, PA, active travel	Almost all of the interventions reported a small effect size on active travel. However, methods used to assess change and effect sizes varied limiting ability draw conclusions. The review highlights the importance of community involvement for success (schools, parents and community). Interventions with the highest effectiveness shared a strong school involvement, and parents receiving specific materials and being encouraged to walk. Interventions which focused on AST may be more effective than broader focused initiatives.	Moderate	0-January 2010
De Bourdeaudhuij et al. 2011	To systematically review the evidence of school-based interventions targeting dietary and PA behaviour in primary (6-12 years old) and secondary school (12-18 years old) children in Europe	6-18 year olds	Schools, Europe, nutrition and PA	The results suggest that combining educational and environmental components that focus on both sides of the energy balance give better and more relevant effects. Furthermore, computer-tailored personalized education in the classroom showed better results than a generic classroom curriculum. Environmental interventions might include organized physical activities during breaks, or before and after school; improved availability of PA opportunities in and around the school environment; increased physical education lesson time.	Moderate	1990 – December 2007

First author, Year	Aim/ Description	Population	Setting/ Intervention Strategy	Main findings	Quality rating	Years included
Fraser et al. 2011	This review aimed to systematically synthesize worldwide evidence from published observational and experimental studies examining the impact of the built environment on cycling behaviour.	Children & adults	Community built environments, cycling paths, routes and active travel to school	The environmental factors identified as being positively associated with cycling included presence of dedicated cycle routes or paths, separation of cycling from other traffic, high population density, short trip distance, proximity of a cycle path or green space and for children projects promoting 'safe routes to school'. Negative environmental factors were perceived and objective traffic danger, long trip distance, steep inclines and distance from cycle paths.	Moderate	0-June 2009
Gerards et al. 2011	The aim of the current literature review was to provide an overview of interventions addressing general parenting in order to prevent or treat childhood obesity.	Parent-focussed	Family, parents, PA, nutrition, lifestyle programs	Few interventions have been developed that address general parenting in the prevention of childhood obesity. There was small to moderate effects on at least one weight-related outcome to suggest interventions provide evidence that promote authoritative parenting is an effective strategy for the prevention and management of childhood obesity.	Moderate	0-2010 (Feb)
Gracia-Marco et al. 2011	To review child and adolescent obesity prevention programmes to determine whether they have included the Social Marketing Benchmark Criteria (BC).	Children and adolescents	Social marketing, PA, nutrition, lifestyle, social support	Almost all the interventions reviewed resulted in improvements in body composition. Review of the effectiveness of the social marketing aspects of interventions showed the higher BC did not equate to higher effectiveness. At present studies aimed at prevention obesity in children and adolescents have not included social marketing aspects in their interventions in a comprehensive manner.	Moderate	1990 - 2009 (February)
Hiller et al. 2011	To describe some of the strengths and weaknesses of community-based complex interventions which aim to prevent obesity in children and adolescents	Children and adolescents	Community, combined nutrition, sedentary behaviours, PA	Specific complex interventions are highlighted. There are challenges and opportunities associated with designing and evaluating community-based complex interventions and initiatives. These include sign issues, (strength and weaknesses of different types of evidence), measurement of outcome (effectiveness), development of interventions (underpinning theories, planning frameworks, piloting), partnership working and community engagement, and health inequalities.	Not rated (not SR)	2008 -2011
Kelly et al. 2011	To conduct the first systematic review of the effects of weight loss camps and residential programs for obese children.	Obese children and adolescents 8-18-year-olds	Immersion environment – i.e. residential summer camp, in-patient or school setting, where (i) the participant remained in the controlled environment day and night; and (ii) intervention lasted at least 10 continuous days.	22 studies met inclusion criteria. Similar components across programs included controlled diet, activities, nutrition education, and therapy and/or education regarding behaviour change. Participants lost substantial amounts of weight in all 22 studies, as measured by reductions in per cent-overweight during intervention. Inclusion of a cognitive-behavioural therapy (CBT) component seemed especially promising; follow-up evaluations (11 programs) showed decreased per cent-overweight at follow-up by an average of 30% for CBT immersion programs vs. 9% for those without CBT.	Moderate	1958 - 2008

First author, Year	Aim/ Description	Population	Setting/ Intervention Strategy	Main findings	Quality rating	Years included
Kriemler et al. 2011	To review recent reviews and new studies aimed to increase PA or fitness in youth.	6-18 year olds	School, PA	The school-based application of multi-component intervention strategies was the most consistent, promising strategy, while controversy existed regarding the effectiveness of family involvement (particularly adolescents), focus on healthy populations at increased risk or duration and intensity of the intervention.	High	2007-2010
Leavy et al. 2011	To systematically review the literature on PA mass media campaigns, 2003–2010.	Not identified	Social marketing mass media, PA	The review found that beyond awareness raising, changes in other outcomes were reported in varying ways. While there is improvement in evaluation, the limited evidence of campaign effects remains.	Moderate	2003–2010
Lubans et al. 2011	To systematically examine the potential health benefits associated with ATS among children and adolescents.	5 - 18 years old	Schools, active travel	There is some evidence to suggest that active travel to school is associated with a healthier body composition and level of cardiorespiratory fitness among youth. Strategies to increase active travel to school are warranted and should be included in whole-of-school approaches to the promotion of PA.	Moderate	1980 - December 2009
Nelson et al. 2011	To examine whether sports participation prevents obesity.	6–18 year- olds (primary and secondary aged children and young people)	Settings for Sports participation Research comparing sport participants with non-participants on weight status, physical activity and diet.	In 19 studies authors found no clear pattern of association between body weight and sport participation. In 17 studies sport participants were more physically active non-participants. Seven studies examined the relationship between sport participation and diet and found that sport participation is associated with more fruit, vegetable and milk consumption, but also more fast food and sugar sweetened beverage consumption and greater overall calorie intake. It is unclear whether sports programs, as currently offered, protect youth from becoming overweight or obese.	Moderate	0-February 2011
Sargent et al. 2011	To identify controlled interventions that treated childhood overweight or obesity in either a primary care setting or with the involvement of a primary healthcare professional and examine components of those interventions associated with effective outcomes in order to inform future intervention trials in primary care settings.	0-18 years old	Primary care, nutrition, PA, sedentary behaviour	There is evidence for: training for health professionals before intervention delivery; behaviour change options (including healthy diet, activity and sedentary behaviour); effecting behaviour change via a combination of counselling, education, written resources, support and motivation; and tailoring intensity according to whether behavioural, anthropometric or metabolic changes are the priority.	High	1990 –2007
Silveira et al. 2011	Systematic review to evaluate the effectiveness of school-based nutrition education in reducing or preventing overweight and obesity in children and adolescents.	School-aged children ~ 5-18-year olds	Schools	24 articles met inclusion criteria. There is evidence of positive effects on anthropometry and of increase in fruit and vegetable consumption. Characteristics of the interventions that demonstrated effectiveness are: duration > 1 year, introduction into the regular activities of the school, parental involvement, introduction of nutrition education into the regular curriculum, and provision of fruits and vegetables by school food services.	Moderate	0-2010 (May)

First author, Year	Aim/ Description	Population	Setting/ Intervention Strategy	Main findings	Quality rating	Years included
Skouteris et al. 2011	Conceptual and methodological review of the literature on the parental variables targeted in interventions designed to modify risk factors for obesity by promoting healthy eating and/or PA and/or reducing sedentary behaviours in families of children aged 2–6 years	2-6 year-olds and family context	Family, parents, nutrition, sedentary behaviours, PA	There were significant methodological limitations of existing studies and the scientific study of this area is in its infancy. However, the results suggest that the modification of parental variables known to be associated with obesity-promoting behaviours in pre-school children may show promise as an obesity prevention strategy; further research is needed.	Moderate	1999-April 2009
Wong et al. 2011	To examine and summarize the relationships between objectively measured built environment features and active school travel in children and adolescents and to critically discuss GIS methodologies used in this context.	5 - 18 years olds	Active Travel	The inconsistent use of spatial concepts limits the ability to draw conclusions about the relationship between objectively measured environmental attributes and active school travel.	Moderate	0 - May 2010
Van Cauwenberghe et al. 2010	To summarise the existing European published and 'grey' literature on the effectiveness of school-based interventions to promote a healthy diet in children and adolescents	6-18 year olds	School, Europe, nutrition	Limited evidence of effect was found for educational interventions on behaviour, and for environmental interventions on fruit and vegetable intakes. Interventions that specifically targeted children from lower socio-economic status groups showed limited evidence of effect on behaviour. In adolescents, moderate evidence of effect was found for educational interventions on behaviour and limited evidence of effect for multi-component programmes on behaviour in school-aged children in European Union countries on self-reported dietary behaviour. Evidence for effectiveness on anthropometrical obesity-related measures is lacking.	Moderate	1990 – December 2007
Faulkner et al. 2009	To investigate if children who actively commute to school are more physically active than children who travel by motorized transport and if children who actively commute to school (also) have a healthier bodyweight than passive commuting children	5-17 years	School, community, active travel, PA	These studies demonstrate that active school commuters tend to be more physically active overall than passive commuters. However, evidence for the impact of AST in promoting healthy body weights for children and youth is not compelling.	Moderate	1945 - 2008
Lee et al. 2008	To systematically review identify all published literature relating to the association between active commuting to school and children's PA or weight.	5-18 years old	School, active travel, PA	Most studies assessing PA outcomes found a positive association between active commuting and overall PA levels. However, almost all studies were cross-sectional in design and did not indicate whether active commuting leads to increased PA or whether active children are simply more likely to walk. Therefore, interventional studies are needed to help determine causation.	Low	0-December 2007

## Appendix 5: Search strategy in detail

### *Outline of the search strategy according to the PICO framework*

#### **Population (P1)**

Children aged 0-18 years

#### **Settings**

- (Se1) Childcare
- (Se2) Schools
- (Se3) Primary health care
- (Se4) Home/family
- (Se5) Community

#### **Intervention**

Lifestyle counselling, health education, health promotion, primary prevention, early intervention, diet or physical activity intervention, family therapy, parenting intervention

#### **Target strategies**

- (St1) Active travel
- (St2) School canteens
- (St3) Mass communication
- (St4) Parental education & involvement
- (St5) Screen viewing

#### **Comparison**

Control group (e.g. RCT), non-equivalent control group (e.g. quasi-experimental design), baseline level (e.g. before and after studies)

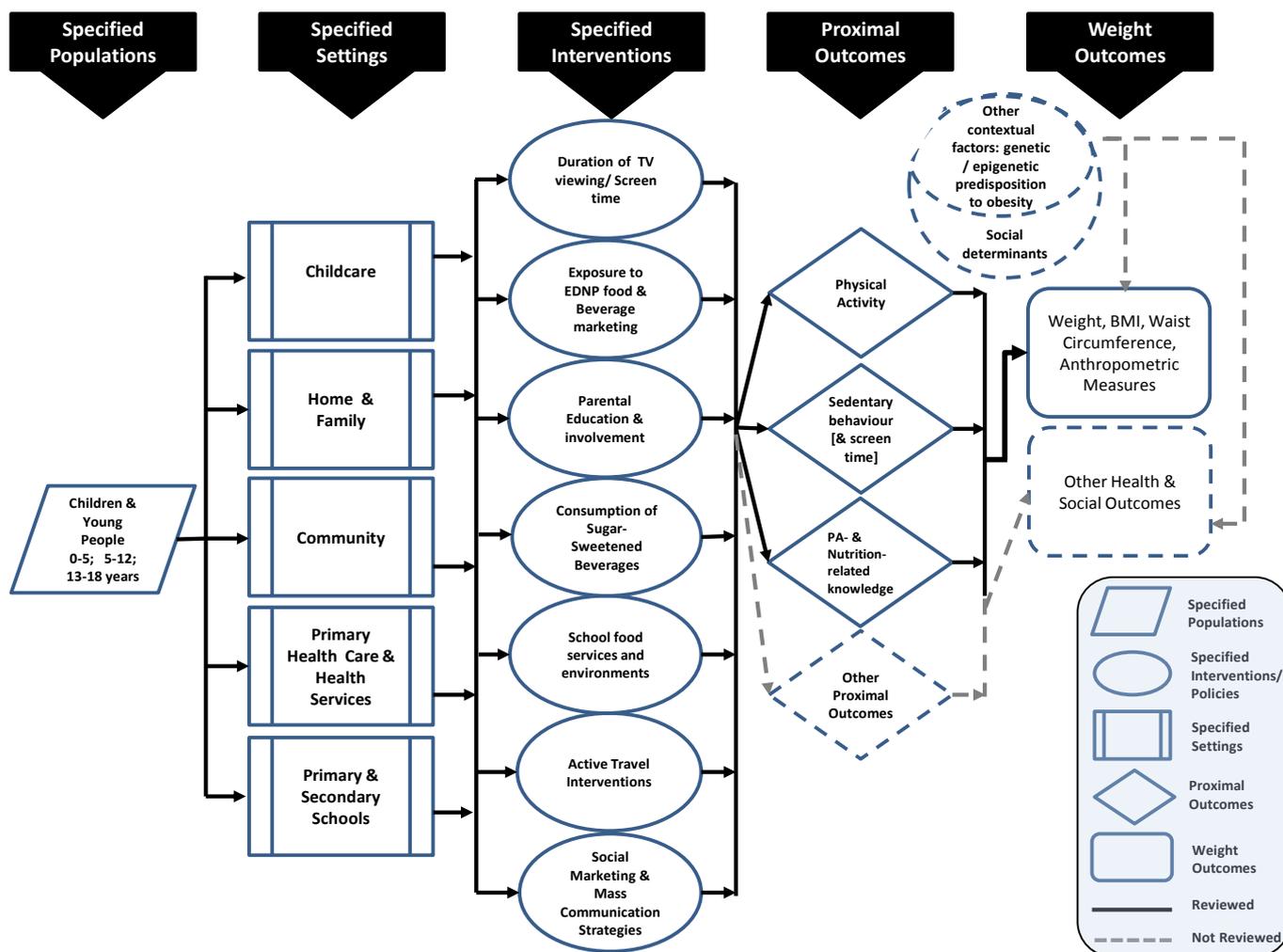
#### **Outcomes**

Objectively or subjectively measured physical activity and eating behaviours. PA-related outcomes can include intensity levels, duration of PA, frequency of PA or sedentary behaviour (e.g. screen time), or related knowledge in these. Eating behaviours can include types of food eaten (e.g. vegetables, fruits, EDNP foods), diet quality (food indices), breakfast programs, meals eaten out, fast food, take-away food, portion size, **or nutrition-related knowledge**. Objectively or subjectively measured weight outcomes. These include weight, BMI, waist circumference, and anthropometric measures

**Logic Framework for this Evidence Review**

The use of logic frameworks and models has become an increasingly common feature of systematic reviews<sup>236-238</sup>. Logic frameworks can help reviewers to 'think' conceptually at various points during the review, and can be a useful tool in defining study inclusion and exclusion criteria, guiding the search strategy, identifying relevant outcomes, identifying mediating and moderating factors, and communicating review findings<sup>236</sup>. The logic framework for this rapid evidence review is shown in Figure 5 below. It is emphasised that the logic framework is designed to capture the agreed terms of reference specified; it does not purport to capture in detail the many influences on obesity such as has been in the Foresight Report's "obesity system map"<sup>7</sup>.

**Figure 5 Obesity Prevention in Children and Young People aged 0-18; Logic Framework for the Rapid Evidence Review**



## SEARCH TERMS

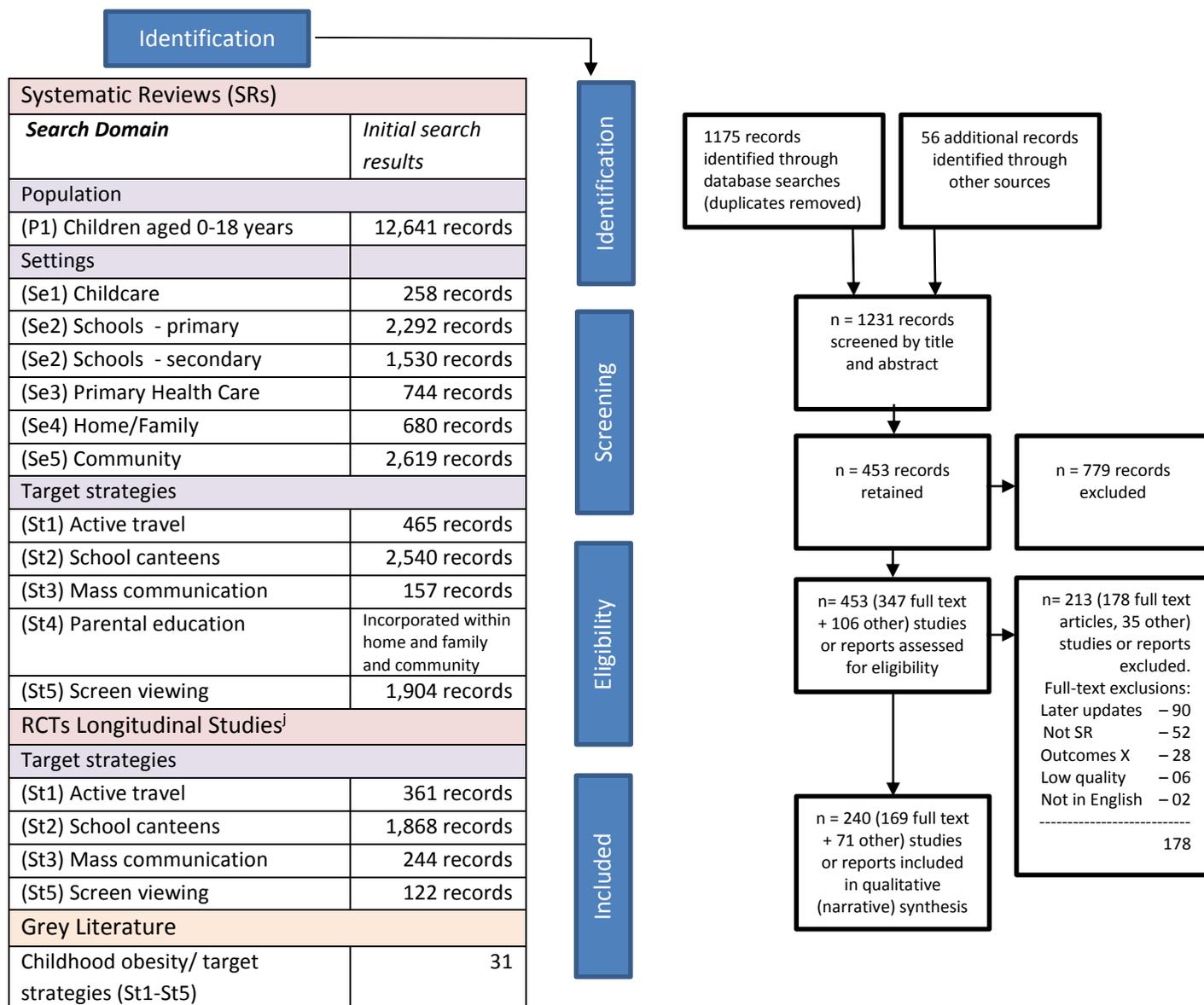
Settings and Populations	
1	(childcare educat* or childcare centre* or kindergarten* or pre?school* or daycare or preschool* or child?support or day?care?centre).tw.
2	(child* or youth or young?people or paed* or primary?school* or school?age* or elementary?school* or primary?student or elementary?student).tw.
3	(school* or secondary* or high?school* or adolescen* or child* or teenage* or student* or learn*).tw.
4	(primary care or primary health or primary health?care or healthcare teams or paed* or physician* or doctor or general practice or population program specialist).tw.
5	(communit* or neighbo?hood or living arrangements or society or social or community program or support or multi\$level or multi\$sector or community\$wide or integrated).tw.
6	(family or family member* or relatives or family research or parent or carer or guardian or single?parent or household).tw.
Outcomes	
1	(physical* activ* or exercise or physical?fitness or activ* or motion or Movement or Skill or Sedentary?lifestyle or sedentary?time or Sedentary?behavio* or screen?time or sitting?time or inactiv* or sport*).tw.
2	(health?behavio* or Cogn* or behavio* or learning or attitud* or stigma).tw.
3	(Eating?behavio* or eat* or diet* or fruit* or vegetable* or sugar?sweetened or drink* or beverage* or soft?drink* or water or food* or nutrition or energy?dens* or sugar or energy?rich or portion?size or fast?food* or nutrient?assessment).tw.
4	(body?weight or weight or overweight or obes* or BMI or Body?Mass?Index or waist?circumference or anthropomet* or body?composition or skinfold* or high?weight or fat*).tw.
And 5	(body?weight or weight or overweight or obes* or BMI or Body?Mass?Index or waist?circumference or anthropomet* or body?composition or skinfold* or high?weight or fat*).ti,ab.
Strategies	
1	(active?travel* or bike or cyclist or bicycle or commut* or transport* or travel* or travel?plan* or group?travel or walking?bus or walk*).tw.
2	(cafeteria* or canteen* or cafe* or school?lunch* or school?meal? or food or feeding?program or food?service* or diet* or meal? or nutrition or purchas* or sold or bought or buy or school*).tw.
3	(mass?media or campaign* or consumer?research or (health adj (communication or information)) or advertis* or marketing or social?media).tw.
4	(screen?viewing or television or tv or video?games or computer or screen?media or mobile?phone or cell?phone or electronic or technolo*).tw.
Study Type	
1	((comprehensive* or integrative or systematic*) adj3 (bibliographic* or review* or literature)) or (meta-analy* or metaanaly* or "research synthesis" or ((information or data) adj3 synthesis) or (data adj2 extract*)),ti,ab. or (cinahl or (cochrane adj3 trial*) or embase or medline or psyclit or (psycinfo not "psycinfo database") or pubmed or scopus or "sociological abstracts").ab. or ("cochrane database" or evidence report technology assessment or evidence report technology assessment summary).jn. or Evidence Report: Technology Assessment*.jn. or ((review adj5 (rationale or evidence)).ti,ab. and review.pt.) or meta-analysis as topic/ or Meta-Analysis.pt.
2	("clinical trial" or "clinical trial, phase i" or "clinical trial, phase ii" or clinical trial, phase iii or clinical trial, phase iv or controlled clinical trial or "multicenter study" or "randomized controlled trial").pt. or double-blind method/ or clinical trials as topic/ or controlled clinical?trials as topic/ or randomized?controlled?trials as topic/ or early termination of clinical trials as topic/ or multicenter studies as topic/ or ((randomi?ed adj7 trial*) or (controlled adj3 trial*) or (clinical adj2 trial*) or ((single or doubl* or tripl* or treb*) and (blind* or mask*))).ti,ab,kw. or ("4 arm" or "four?arm").ti,ab,kw.
3	(cohort studies/ or longitudinal studies/ or follow-up studies/ or prospective studies/ or retrospective studies/ or cohort or longitudinal or prospective or retrospective).ti,ab.

## DATABASES

- Cochrane database of systematic reviews to November 2015
- NHS Economic Evaluation Database to 4<sup>th</sup> Quarter 2015
- Health Technology Assessment to 4<sup>th</sup> Quarter 2015
- Medline to November week 1 2015
- Pre Medline at November 2015
- Scopus to November 2015
- PubMed (supplementary searches – e.g., local government)

## PRISMA FLOW DIAGRAM

Initial searches



<sup>j</sup> Recent (mid-2013 onwards) RCTs and Longitudinal studies not already incorporated in SRs

## Appendix 6: Gaps in knowledge and priorities for research

### *Gaps in knowledge*

Our review has highlighted a number of gaps in knowledge of what works, under what circumstances, and for whom in childhood obesity prevention. We recommend the following areas as priorities for research, many of which accord with the recommendations in the review by Wang et al.<sup>11</sup> as well as the gaps identified in the [interim report](#) released by WHO ECHO (during the consultation phase):

1. Evaluation of innovative interventions that address the varied, complex, and interrelated mix of factors that lead to obesity. A systems approach, as taken in the Healthy Victoria initiative, may inform such interventions and could lead to obesity prevention intervention components being embedded in the work programs of areas outside of health, such as education and urban design.
2. Evaluation of large-scale, real-world, and sustained interventions, including long-term follow-up.
3. Evaluation of interventions conducted outside of primary schools, particularly environmental or policy-based interventions and interventions conducted with adolescents and possibly with pregnant women.
4. Publication of formative and process evaluation results to inform the work of others around the world.
5. Assessing and reporting costs and cost effectiveness of NSW childhood obesity interventions.
6. Investigation of health equity issues, including potential differential effects of interventions on disadvantaged populations and potential unintended consequences, such as inciting stigma of people who are overweight; further, the SPANS survey identified that childhood obesity is higher in some sub-populations, and these could be the focus of specific attention.
7. Investigation of the extent to which the effects of childhood obesity on adult non-communicable disease risk are reversible.

### *Filling the gaps*

Notwithstanding the significant gaps in knowledge, the available evidence suggests that any new programs should:

1. Be multi-component (e.g., include healthy eating and active living; educational, environmental, and policy components).
2. Operate across multiple settings (e.g., school, home, and community).
3. Have substantial resources invested over a significant period of time.

A possible model for an intervention of this type is the Massachusetts Childhood Obesity Research Demonstration (MA-CORD) project<sup>239, 240</sup>. MA-CORD involves a comprehensive, systematic intervention to prevent and reduce childhood obesity among low-income children ages 2-12 years in two selected cities in Massachusetts. This community-level obesity prevention initiative incorporates evidence-based interventions in primary healthcare, the Women, Infants, and Children program, early care and education, schools/afterschool programs, as well as community-wide programs to improve food, beverage, physical activity (PA), and messaging environments. The study uses a combination of pre- and post-time series and quasi-experimental designs to examine the extent to which the interventions result in changes in BMI, individual-level lifestyle behaviours, satisfaction with healthcare services, and quality of life among children, as well as changes in health policies, programs, and environments in the two intervention cities, compared to a comparison city.

The importance of thorough evaluation cannot be understated. Thorough evaluation across all levels (i.e. formative, process, impact, outcome, and economic) is important for accountability and for verification that program goals have been achieved. Further, evaluation is essential to address the significant gaps that currently exist in the evidence base for action. The recent funding of the NHMRC Centre for Research Excellence (CRE) for the Early Prevention of Obesity in Childhood<sup>k</sup>, based at the Charles Perkins Centre, University of Sydney provides important new opportunities for engagement with leading researchers in the evaluation of complex interventions for childhood obesity. CRE's focus includes cost-effectiveness, research translation, and upscaling of interventions.

### *The 7- Up Study*

An important strategy to consider is the implementation of a companion cohort study to the 45 and Up study which, for the purpose of discussion, we have called the *7-Up Study*. Such a study would follow a large cohort of children through childhood and adolescence, tracking a number of different health outcomes over several years and would act as an explanatory study on the incidence of obesity: why and how and at what rate children move from acceptable weight to overweight and obesity. The practical aspects of such a cohort could be used to evaluate NSW interventions and explain weight gain in childhood. Tasks required would include

- Configuring the cohort, including sub-cohorts of children of a fixed starting age, recruited from different geographical and population-density regions (for example, two regions of Sydney, a small city such as Wollongong, a large rural centre, and a remote rural centre such as Broken Hill). Several hundred children (for example, 6 or 7 year olds) would need to be recruited from each site and followed
- Seeking ethics approval and piloting recruitment methods
- The cohort, and the baseline and follow up measurement planning would need to be planned by a Steering Group of relevant expert academics and policymakers, and would be a resource-intensive commitment over several years, but would be highly relevant to childhood obesity policy initiatives
- The final sample size would depend on the changes expected, and whether site-specific data were needed (a cohort is not representative of all NSW Children, but would show variation in baseline factors, using geographic diversity for recruitment as above).

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<sup>k</sup> See <https://www.nhmrc.gov.au/grants-funding/apply-funding/centres-research-excellence-cre>

## Appendix 7: Systems approaches to obesity prevention - bibliography

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## Appendix 8: Proposal and Scope of Work

### NSW Office of Preventive Health

#### FOLLOW-UP EVIDENCE UPDATE ON OBESITY PREVENTION (For children aged 0-18 years)

##### Final Proposal

12 October 2015

#### Introduction

An Evidence Check review is a rapid review of existing evidence tailored to the individual needs of an agency. Evidence Check reviews answer specific policy questions and are presented as a short report in a policy friendly format. Reviewers identify gaps in the evidence but do not undertake new research to fill these gaps.

#### Background and context

Prevention of childhood overweight and obesity is a priority for the NSW government and has recently been identified as a Premier's Priority. A NSW Government target has been set to reduce the prevalence of childhood overweight and obesity by 5% in the next ten years.

Evidence around obesity prevention programs for children 0-18 years is required by the NSW Office of Preventive Health and the Centre for Population Health, NSW Ministry of Health, to inform decisions about future interventions.

Since 2011 the Healthy Children Initiative has delivered obesity prevention programs in children's settings in NSW. Two comprehensive primary preventive health programs have had high reach and adoption; and 90% of centre-based early childhood services and 85% of family day care services have been trained in the Munch and Move program, and 84% of all primary schools have been trained in the Live Life Well@School program. Centre-based services and schools participating in these programs have high program adoption rates, 78% and 72% respectively. In the community, the secondary prevention program, Go4Fun program has reached over 6200 families of children who are above a healthy weight.

#### Purpose and audience for this review

A new rapid review is requested to further update a previous review titled 'EVIDENCE UPDATE ON OBESITY PREVENTION: Across the life-course' (PANORG March 2012). The new rapid review should only focus however on obesity prevention *in children (0-18 years)*.

The purpose of the new review update is to outline what *additional* evidence has become available in the last five years on childhood obesity prevention strategies – with particular focus on those that have demonstrated effectiveness, and/or show particular promise for intervening at a population level and/or children's settings in NSW.

The findings of this new rapid review will guide further development of obesity prevention initiatives within the NSW Office of Preventive Health and the Centre for Population Health, NSW Ministry of Health, and inform ongoing policy dialogues with other NSW Government departments and external agencies.

## Review questions

This 2015 review update will address the following questions:

### Question 1:

What does the new evidence (published since 2011) indicate about the effectiveness of population-level and/or settings-based obesity prevention strategies targeting the following three age groups: 0-5 years (pre-school), 5-12 years (primary school), and 13-18 years (high school)?

### Question 2:

What has been shown to work (or not work) in school-based interventions – and what are the characteristics of the effective strategies? In particular:

- 2.1 What is the evidence on the likely effectiveness in NSW of childhood obesity prevention interventions that promote and/or support active travel to school, especially school initiated travel plans?
- 2.2 What is the evidence on the likely effectiveness in NSW of childhood obesity prevention interventions implemented within the high school setting, especially those addressing foods sold and/or promoted through school canteens?

### Question 3:

What is the evidence on the effectiveness of social marketing and population-level communication strategies aimed at children and young people aged 0-18years? In particular:

- 3.1 What does the evidence demonstrate are desirable the features of social marketing and communication strategies that have been shown to be effective?
- 3.2 What are the characteristics of social marketing and communication strategies that were not effective?

### Question 4:

Based on the findings of this 2015 review update, AND drawing on the earlier findings of the 2012 review, what does the combined body of evidence indicate are likely to be the most promising interventions for the prevention childhood obesity in NSW? In particular:

- 4.1 Which population-level interventions / actions have demonstrated evidence of obesity prevention impacts (i.e. weight related outcome measures)?
- 4.2 Which population-level interventions / actions have evidence of impact on relevant behavioral outcomes (e.g. nutrition, physical activity)?
- 4.3 What are the important outstanding gaps in the combined body of evidence?

### Question 5:

- 5.1 Overall, how similar and/or different are the conclusions to be drawn from the updated 2015 evidence compared to the earlier conclusions drawn from the 2012 review?
- 5.2 If there are any important changes to the conclusions drawn resulting from the updated evidence, what are the main differences and why?

## Scope and depth of the review

This rapid review update should draw on and include existing reviews of evidence (systematic, scoping, rapid reviews) on the effectiveness of interventions aimed at preventing childhood obesity in populations and/or children's settings, plus primary evaluation research of the effectiveness of such population level strategies. Include only literature published in 2011 to the current period, either in the peer-reviewed literature, or in evaluations reports in the grey literature (Government reports, non-government organisations, or other professional agencies). Countries of interest for reviewing grey literature are Australia, New Zealand, Canada and the UK.

In addition, the review of evidence should include other locally relevant draft Government or other agency reports which are currently in-progress and/or not yet published (e.g. based on NSW survey data, evaluation research and/or reviews by other agencies). *NB These as yet unpublished reports will be provided to the review team by the commissioning agency.* The nature of the evidence and conclusions based on these unpublished data should be summarised and discussed as a distinct section of the final report so that it can be excluded as required for external dissemination.

The review should adopt the settings-based approach that was adopted in the original 2012 review – i.e. differentiating between the available evidence for the three identified age groups, and for different implementation settings. However, the primary aim of the 2015 review update should be to report on *evidence of effectiveness* (i.e. evaluations of intervention impacts and outcomes). Therefore studies and reports that only describe intervention strategies, or report on process evaluation measures only (e.g. measures of participation and reach) are not a priority for this review - although process measures should be included for those studies also reporting impacts and outcomes.

All quantitative evaluation study designs should be included in this review (RCTs, other controlled or uncontrolled studies) if it seeks to examine or understand the impact of population-level obesity prevention interventions.

The outcome measures of particular interest in this review are weight related outcomes (weight, BMI, waist circumference), or relevant behavioural outcomes (dietary intake, physical activity). Other reported co-benefits / impacts (expected or unexpected) are also of interest if they are reported to arise from population level interventions aimed at preventing childhood obesity – and particularly within school settings.

### Format of the review

The review should be suitable for use, without modification, by senior policy makers in the NSW Office of Preventive Health and the Centre for Population Health, NSW Ministry of Health, as well as by senior policy makers in the Department of Education, and Department of Premier and Cabinet. The report should also be accessible to public health and health promotion practitioners working in the field. Thus language of the report should be appropriate for educated professionals working in health policy or as service providers, but who do may not have training in research methods. The review should be in the range of 10-20 pages, not including tables and references, and include the following elements:

- Executive plain English summary with key points
- Background and introduction
- Description of method of searching, including databases and search terms used, and of selecting papers for inclusion
- Identify areas where there is strong evidence in relation to the review question/s; areas where there is equivocal or conflicting evidence and areas where there are gaps in the evidence base.
- Expert opinion of the reviewers on any areas of consensus, discussion, debate and controversy.
- Tabulation of all included reviews, papers and reports indicating details of the source, setting, elements of the intervention, evaluation methods (design, sample size, setting, comparison, outcome measures), key findings, and level of evidence as identified by the researcher.
- Researchers' final conclusions
- Reference list.

### Researchers

Potential researchers will be identified by the Sax Institute through the Sax Institute RADAR database, by email to the Sax Institute membership, and by an announcement on the Sax Institute website. Researchers may also be proposed by the commissioning agency or knowledge broker.

Researchers will be identified by the Sax Institute for approval by the commissioning agency. Researchers will be contracted by the Sax Institute. There is a very small possibility that we would be unable to find a suitable researcher who is available to undertake the review in the timeframes and costings provided.

### Publication by the researcher in a journal or other format

The commissioning agency may consent to publication of work based on the review in a journal or other format after perusing a draft of the work to be submitted for publication. The commissioning agency may wish to contribute as co-authors on this publication.

### Timeframe for deliverables

Deliverable	Due date
Researcher selected	14 October 2015
Meeting to discuss literature scan	2 November 2015
Draft report for comment	4 December 2015
Comments on draft report due	11 December 2015
Final report including changes for sign off by Agency	16 December 2015
Final report edited	7 January 2016
Final report published online	8 January 2016

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