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Evidence Check

Community-based approaches to adolescent obesity

An **Evidence Check** rapid review brokered by the Sax Institute for the NSW Office of Preventive Health. August 2017.

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Contents

Abbreviations and definitions

BMI	Body mass index (kg/m^2): weight (kg) × (height (m) × height (m))
BMI z	Body mass index z-scores; measures of relative weight adjusted for a child's age and gender.
CAFAP	Curtin University's Activity, Food and Attitudes Program
CBT	Cognitive behaviour therapy
GP	General Practitioner
HRQoL	Health-related quality of life
LMP	Lifestyle modified program
MEND	Mind, Exercise, Nutrition, Do it!
NHMRC	National Health Medical Research Council
NSW	New South Wales
NZ	New Zealand
Obese	Stated as per International Obesity Task Force (IOTF) cut-point, or BMI ≥95th percentile
Overweight	Stated as per International Obesity Task Force (IOTF) cut-point, or BMI ≥85th – 95th percentile
PA	Physical activity
RCT	Randomised controlled trial
SES	Socio-economic status
UK	United Kingdom
US	United States
Wt	Weight

Executive summary

Background

Currently, more than a quarter of Australian adolescents aged 13–17 years old are overweight or obese. This is a significant concern as adolescent obesity is a risk factor for various diseases in adulthood, and adolescents who are obese tend to become obese adults. During adolescence, greater autonomy over food choice and influences from peers can contribute to overweight risk behaviours, including unhealthy diets, insufficient activity and excessive sedentary time. To address this, the New South Wales (NSW) Premier has set a target to reduce the prevalence of overweight and obese children by 5% in the next decade. Evidence around obesity prevention approaches for adolescents aged 13–17 years old is required to inform decisions about future interventions. Of interest are community-based approaches which have been shown to be effective to prevent adolescent obesity or promising approaches which could be piloted. This rapid review aims to identify and summarise current evidence on effective community-based approaches to prevention of adolescent obesity.

Summary of methods

The review team conducted a comprehensive systematic search of eight electronic databases (Medline (Ovid), Embase (Ovid), PsycINFO (Ovid), CINAHL (EBSCOhost), Cochrane Central Register of Controlled Trials, Cochrane Database of Systematic Reviews, Informit and Scopus) to identify peer-reviewed literature on community-based adolescent obesity prevention approaches from a developed country published between January 2011 and March 2, 2017. The review team independently reviewed the final search results in duplicate against the following primary selection criteria (detailed inclusion and exclusion criteria are presented in Appendix Two):

- Published from 2011 and beyond
- Participants ranged in age (mean or median) from 13–17 years old
- Participants included overweight or obese adolescents (i.e. secondary prevention)
- The intervention/program was community-based, defined as delivered in settings such as the home, outpatient clinics, community health services, councils and non-government organisations
- The study reported intervention outcome data relating to anthropometrics and diet/healthy eating or activity behaviours (primary outcomes) or sedentary behaviour, self-esteem or quality of life (secondary outcomes).

The review team extracted data, including study characteristics, National Health and Medical Research Council (NHMRC) evidence rating, methodological quality, intervention content and program outcomes from included studies. The review team then scored the methodological quality of studies using the Effective Public Health Practice Project Quality Assessment Tool for Quantitative Studies. This tool assesses the quality (weak, moderate or strong) of six components: selection bias; study design; confounders; blinding; data collection methods; and withdrawals and dropouts. An overall quality rating (weak, moderate or strong) was determined. We defined effective studies as those with a moderate or strong quality rating, reporting a decrease or stability in BMI z or BMI over time either or both at the end of the intervention and at any stage of follow-up. We evaluated included articles according to the NHMRC Evidence Hierarchy and the evidence summarised according to the NHMRC grading system for recommendations.

In addition, the review team conducted a thorough search of grey literature for other programs that had not been disseminated in the peer-reviewed literature. These included searching government reports, specialised grey literature resources, research organisations, conference and meeting proceedings, theses repositories, and clinical trial registries. The review team contacted one organisation for further information on current programs for which there were no reports or results in the public domain.

Key findings

The review team's comprehensive systematic review of the literature identified 33 papers reporting on 23 programs that met the criteria for inclusion in this review. Of these, eight were rated as strong quality, nine were of moderate quality and six were of weak quality.

Q1: What community-based secondary prevention or weight management programs are effective for 13–17 year olds?

The review team identified a total of 13 community-based programs from Australia, the United States and several European countries as effective secondary prevention or weight management programs for the adolescent group of interest. Outcomes were reported across 19 publications of sufficient quality (moderate or strong rating). Program effect size ranged from a decrease of 2–11% in BMI z, or 1–7% in BMI, from baseline to program end or follow up. Common elements of successful community-based programs were identified according to program length (3-month duration), content (multicomponent, most with a lifestyle component and several with a psychological component), format (group-based, with or without a one-to-one contact) and support (parental-involvement). The NHRMC overall body of evidence was rated as B (Good); the evidence base was rated as good, consistency as good, clinical impact as satisfactory and generalisability as good.

A comprehensive search of the grey literature identified one emerging program that is consistent with the review criteria; the MEND (Mind, Exercise, Nutrition, Do it!) Teens program in the UK for overweight 13–16 year olds. The MEND weight management and lifestyle program, originally developed for 7–13 year olds in the UK, has been adapted by the NSW Ministry of Health and delivered as 'Go4Fun' since 2009.

Gaps in the evidence

Identified programs were conducted in researcher-led programs and thus there is limited evidence that these programs are effective outside of a research environment. Most studies had small sample sizes, few were culturally relevant for specific populations such as Aboriginal or Torres Strait Islanders or disadvantaged populations and there was no evidence of an up-scaled community program targeting adolescent obesity. Additionally, the evidence of the long-term program effectiveness was moderate and no studies investigated the cost-effectiveness of the community-based program.

Applicability to NSW

Q2: Of the programs and interventions reported in question 1, in the review team's expert opinion, which are most likely to be applicable to the NSW setting, considering the requirements of the Office of Preventive Health?

Of the programs identified, two candidate programs were conducted in Australia; one in NSW (the Loozit® trial) and one in Western Australia (the Curtin University's Activity, Food and Attitudes Program (CAFAP). These require the least translation to English language and/or update of program content, implementation model and evaluation for an Australian context. Of the two Australian programs, the Loozit® trial, which

researchers and practitioners at the Westmead Children's Hospital and the Sydney West Local Health District conducted in NSW, was identified as the stronger, more effective study, as CAFAP was rated as weak quality.

The Office of Preventive Health should consider the Loozit® program, particularly due to language translation cost savings and efficiencies in community delivery which could be afforded by pairing it with the current Go4Fun community-based program. As previously mentioned however, this program has not been evaluated outside of a research setting and hence translation to an up-scaled community program would still require independent evaluation of its effectiveness for long-term investment.

Conclusion

From the programs identified in this review, we recommend that an effective community-based adolescent obesity program in NSW bear the characteristics listed below.

- Length: ≥3 months in duration
- Content: Multicomponent lifestyle intervention ± psychological component such as cognitive behaviour therapy (CBT)
- Format: Group-based program, ± one-to-one contact before, between and/or after sessions for individual behaviour change/goal setting support
- Participants: Include overweight and obese children, and involve parents in sessions with their adolescent children, or parent-only sessions with the aim to support adolescent behaviour change in the family and home environments
- Evaluation: Long-term follow-up ≥12 months' post-program to determine sustainability of lifestyle changes and long-term benefit.

Background

Introduction

Obesity is a significant public health problem that affects low, middle and high income countries across all facets of society.[1-3] It has been described as the major health challenge of the 21st century[4] and, despite concerted interventions, no country has seen a decline in the prevalence of obesity over the last three decades.[3] Australia is no exception, with the majority of Australian adults — and more than a quarter of children and adolescents — being overweight or obese.[5] Public health efforts have focused on the prevention of obesity in adults and young children[6], and more recently attention has been directed at young adolescents, with 31.8% of boys and 25.4% of girls aged 13–17 years old considered to be overweight or obese.[7] According to the NSW Schools Physical Activity and Nutrition Survey, the prevalence of overweight and obese individuals among young people may be stabilising[8], but it remains at concerning levels.[9]

Physical and psychological consequences of weight gain

Adolescent obesity affects not only the physiological and psychological health of young people but also their future health as obesity tends to persist into adulthood[10, 11], with more than 70% of obese adolescents remaining so into adulthood.[12] Furthermore, adolescent obesity which continues into adulthood is associated with a higher risk of premature death and disability in later life due to non-communicable diseases such as diabetes and cardiovascular conditions.[10, 13] Associated risk factors include metabolic syndrome, hypertension and dyslipidaemia.[13] Type 2 diabetes — which was considered a disease of those middle-aged — is now presenting in children and adolescents, and is more difficult to treat and associated with serious health consequences.[14, 15]

Overweight and obese adolescents are also at a greater risk of social isolation and the development of psychological distress than those in the healthy weight range.[16, 17] As a result of stigma, bias and discrimination, overweight and obese adolescents experience more teasing, bullying and pervasive victimisation.[17] This can lead to poor peer relationships, maladaptive eating, low self-esteem and poor school experiences.[16-18] All of these may have long lasting effects, continuing into adulthood.[13, 17]

Adolescent obesity affects those most disadvantaged and increases inequities in health[19, 20], with those living in areas of low social advantage and Aboriginal and Torres Strait Islander children most affected. An unpublished report using Australian Health Survey data from 2011/2012[5], found that children from the lowest socio-economic status (SES) areas were more likely to be overweight or obese (33%) compared to those in the highest SES areas (19%).

Determinants of adolescent weight gain

Obesogenic but modifiable behaviours include unhealthy diet and insufficient physical activity. Less than 5% of Australian adolescents meet national fruit and vegetable recommendations[7] and in NSW adolescents commonly skip breakfast (27% of males and 42% of females), consume on average 250 mL of sugar-sweetened beverages each day (60% males, 40% females) and exhibit other dietary behaviours implicated in increased risk of obesity.[8] According to the most recent Australian Health Survey, 41% of adolescents aged 14–18 years old consumed 41% of their total energy intake as discretionary foods.[21] These foods are typically energy dense and nutrient poor, and are not considered as part of a recommended diet — except occasionally by the physically active.[21]

Physical activity has a vital role in adolescent health, and contributes to short and long-term physical, social and psychological development.[22-24] Improved academic performance, improved social and mental health, and decreased anxiety and depression have been associated with physical activity in adolescents.[25, 26] However, epidemiological studies have identified an increasing prevalence of inactivity in those aged 11–15 years old, with nine out of ten young people not meeting national physical activity guidelines.[24] In Australia, adolescents aged 15–17 years old average one hour of physical activity per day and three hours of screen-based leisure activities per day[27], well outside the Australian national physical activity and sedentary behaviour guidelines.[28] With age, physical activity levels decrease and sedentary screen-based activity increase.[27]

Public health response

Greater autonomy over food choice, decreased physical activity and increased sedentary behaviour are risk factors which transpire in adolescence. It is a period of transition where modifiable risk factors such as physical activity, sedentary behaviour and diet can affect adolescents' current, and future health and wellbeing. There is a strong imperative to prevent adolescent overweight and obesity before it becomes established and contributes to significant levels of non-communicable diseases. Therefore, prevention and early intervention to address overweight and obesity in adolescence is a key priority.

Current Australian recommendations to address the prevalence of obesity in young people focus on obesity prevention[29-31], and are supported with national guidelines on physical activity and the reduction of sedentary behaviour[28], and healthier eating.[32] This concurs with recommendations globally[33, 34] and in other similar countries.[35]

The prevention of childhood overweight and obesity has recently been identified as a Premier's Priority in NSW, with a target to reduce its prevalence by 5% over the next 10 years.[9, 36] The transition into young adolescence between the ages of 13 and 17 years old presents many challenges but also opportunities for addressing obesogenic behaviours.

The NSW Office of Preventive Health/Centre for Population Health commissioned the Evidence Check to provide a rapid review of the current evidence on effective community-based approaches to adolescent obesity prevention. This will be used to inform the development of appropriate and comprehensive strategies.

Evidence Check: Evidence for effective community-based approaches to adolescent obesity prevention

The Evidence Check aimed to identify, describe and evaluate the existing evidence for effective community-based approaches to adolescent obesity prevention. Specifically, the target age group was 13–17 years old, and studies from Australia, Europe, the United Kingdom and the United States were of most relevance. The Evidence Check aimed to answer two key questions:

1. What community-based secondary prevention or weight management programs are effective for 13–17 year olds?
2. Of the programs and interventions reported in question 1, which are most likely to be applicable to the NSW setting, considering the requirements of the Office of Preventive Health?

Methods

Peer reviewed literature

The review team used a systematic review approach which focused on three concepts of relevance: 1), adolescent obesity; 2), interventions, programs, or therapies; and 3), secondary prevention outcomes such as weight loss, improved self-esteem or behaviours including levels of physical activity and quality of food intake. The authors and commissioning agency agreed on a protocol for the systematic literature review.

Search strategy

The review team searched the following databases for literature published from January 2011 to March 2, 2017: Medline (Ovid), Embase (Ovid), PsycINFO (Ovid), CINAHL (EBSCOhost), Cochrane Central Register of Controlled Trials, Cochrane Database of Systematic Reviews, Informit, and Scopus. The review team designed and executed the search strategy in Medline (Appendix One) and then a research librarian accurately translated it for all the other databases. The search incorporated a wide range of database-specific subject headings (where available) and author title/abstract terms (text words) to minimise the risk of missing relevant literature. Searches were limited to literature published in English. To optimise generalisability to Australia, the review team excluded from the search countries considered to be 'developing', according to a list of provided by the Agency and those published by the International Statistical Institute[37] (detailed in Appendix Six). To ensure retrieval saturation, the reference lists of studies chosen as relevant to this rapid review, and pertinent systematic reviews, were checked. Although conference abstracts identified through database searches were excluded at the screening stage, these abstracts were cross-checked for full article versions of reported studies.

After duplicates were removed, retrieved citations were uploaded into the Covidence web-based software for systematic reviews.[38]

Study screening

Two review team members screened all studies retrieved from the peer reviewed literature search on title/abstract for relevance. Following title and abstract screening, full text studies were screened in duplicate for inclusion. At both stages of screening, the review team assessed studies for inclusion or exclusion according to the following selection criteria:

Types of participants

This review focused on adolescents aged 13–17 years old who were overweight or obese. Aboriginal and Torres Strait Islander participants, those from culturally and linguistically diverse backgrounds or ethnicities and individuals with low educated parents were also identified.

Types of interventions

Interventions were required to be based in the community (e.g. delivered in the home, outpatient clinic, community health service, councils) and target overweight or obese adolescents (i.e. secondary prevention). Any medium of intervention delivery was included (e.g. face-to-face, online, phone, mobile applications or mixed methods).

Types of outcome measures

The primary outcomes were weight, BMI or BMI z scores, diet/healthy eating behaviours or activity-related behaviours. Secondary outcomes were sedentary-related behaviours, self-esteem and quality of life. Other outcomes such as knowledge, attitudes and metabolic outcomes were highlighted if reported on, however, these were not the focus of the review and are hence noted for reference only.

Exclusion criteria

Studies were excluded if they were: not applicable to an otherwise healthy adolescent population aside from overweight/obesity (e.g. health conditions such as cystic fibrosis or behavioural/learning difficulties); not applicable to a high-income country setting; offered no full text article accessible in English; or, were published prior to 2011.

Detailed inclusion and exclusion criteria used in the selection of studies for inclusion in this rapid review are presented in Appendix Two. Discrepancies between reviewers were resolved by discussion to meet consensus or a majority vote with other investigators.

Data extraction

The review team extracted data on program and participant characteristics, and outcomes of interest (weight, diet, activity, sedentary behaviour, self-esteem, quality of life) and they are reported in tables in the body of this report (Table 4 and Table 5) and appendices (Appendix Four and Appendix Five). Data are typically reported in text as mean ± standard deviation or mean (95% CI: LL, UL) as reported in the publication. We defined effective studies as those with a moderate or strong quality rating, reporting a decrease or stability in BMI z or BMI over time, either at the end of the intervention, at any stage of follow-up, or both.

Assessment of included studies

1. Quality appraisal

The review team assessed study quality using the Effective Public Health Practice Project Quality Assessment Tool for Quantitative Studies.[39] The team identified this tool from 213 quality assessment tools as useful for systematic reviews that evaluate randomised and non-randomised intervention studies.[40] It assesses overall study quality from six individual component ratings:

- Selection bias
- Study design
- Confounders
- Blinding
- Data collection methods (validity/reliability), and
- Withdrawals and dropouts.

Component and overall quality ratings were scored as weak, moderate, or strong and are presented in Appendix Three.

Discrepancies in component ratings were resolved through discussions between reviewers to reach consensus.

2. NHMRC Evidence Hierarchy

The review team also evaluated the included articles according to the National Health and Medical Research Council (NHMRC) Evidence Hierarchy and the evidence was summarised according to the NHMRC grading system for recommendations.

First, the review team rated the quality of evidence according to the NHMRC evidence ratings for intervention studies outlined in Table 1.

*Table 1: Levels of evidence used to classify the included studies in this Evidence Check**

Level	Description
I	A systematic review of Level II studies
II	A randomised controlled trial
III-1	A pseudo-randomised controlled trial (i.e. alternate allocation or some other method)
III-2	A comparative study with concurrent controls (i.e. non-randomised experimental trials, cohort studies, case-control studies, interrupted time series studies with a control group)
III-3	A comparative study without concurrent controls (i.e. historical control study, two or more single arm studies, interrupted time series studies without a parallel control group)
IV	Case series with either post-test or pre-test/post-test outcomes

*As per: https://www.nhmrc.gov.au/_files_nhmrc/file/guidelines/stage_2_consultation_levels_and_grades.pdf?

Second, the review team summarised the level of evidence according to the five key components recommended by the NHMRC listed below.

1. **The evidence base:** level of evidence (as described in Table 1 above), quantity of evidence and quality of studies (risk of bias, as described below)
2. **Consistency:** The extent to which the studies produce consistent results across the range of included studies
3. **Clinical impact:** the potential clinical benefits, the duration of intervention and the relevance of the evidence to the target population for the review
4. **Generalisability:** How well the body of evidence matches the target population for this review
5. **Applicability:** How relevant the included studies are to the Australian health care context and, in particular, the NSW context.

The quality of the evidence rated was on a scale of A (Excellent) to D (Poor) for each of the five components, based on the NHMRC criteria outlined in Table 2.

Table 2: NHMRC body of evidence matrix employed to summarise the evidence base for community-based approaches to adolescent obesity prevention

	A	B	C	D
	Excellent	**Good**	**Satisfactory**	**Poor**
Evidence base	Several level I or II studies with low risk of bias	One or two level II studies with low risk of bias or a systematic review or multiple level III studies with low risk of bias	Level III studies with low risk of bias or level I or II studies with moderate risk of bias	Level IV studies, or level I or III studies with high risk of bias
Consistency	All studies consistent	Most studies consistent and inconsistency may be explained	Some inconsistency reflecting genuine uncertainty around clinical question	Evidence is inconsistent
Clinical Impact	Very large	Substantial	Moderate	Slight or restricted
Generalisability	Population/s studies in body of evidence are the same as the target population in question	Population/s studied in the body of evidence are similar to the target population in question	Population/s studied in body of evidence differ to target population in question but it is clinically sensible to apply this evidence to the target population	Population/s studied in body of evidence differ to target population and hard to judge whether it is sensible to generalize to target population
Applicability	Directly applicable to Australian context	Applicable to Australian context with a few caveats	Probably applicable to Australian context with some caveats	Not applicable to Australian context

*As per: https://www.nhmrc.gov.au/_files_nhmrc/file/guidelines/stage_2_consultation_levels_and_grades.pdf?

Grey literature

The review team sought grey literature reports of adolescent obesity interventions from government and organisational websites and National Library catalogues from Australia, New Zealand (NZ), Canada, UK and the US. The review team also searched conference websites, theses repositories and clinical trial registries for reports produced since January 2011. A full list of grey literature sources searched is provided in Table 3.

In addition, the review team executed three simplified versions of the database search strategy in Google using the advanced search feature. For each variant, the details of the first 100 retrieved webpages were copied into a Word document for subsequent checking (i.e. total n = 300). Of the 474 sources identified, the majority were excluded based on screening of the title and short summary using the exclusion/inclusion criteria detailed in Table 8. As a result, the review team identified a further 34 programs for further investigation. The review team also identified a further twenty government or organisational reports and

inspected them for any relevant programs, with references also checked. Of the 34 programs, 6 had studies published and are therefore included in the peer reviewed literature, 15 targeted children with an average age that was below our inclusion criteria, 3 were completed prior to 2011, 5 were multi-component national initiatives aimed at the general adolescent population, 3 were school-based, 1 was not available in English and another did not have any information available.

Of the reports, those relevant to this rapid review were from: the American Academy of Nutrition and Dietetics, COAG Health Council, New Zealand Ministry of Health, Nemours Foundation, European Commission, World Health Organisation, Canadian Federal, Provincial, and Territorial Ministers.

The review team contacted one organisation for further information on current programs for which there were no reports or results in the public domain.

Table 3: Sources searched for grey literature on adolescent obesity interventions

Type of resource	Example
Australian State and Federal Government agency reports	Department of Health, NSW Health, VicHealth, Queensland Health, Australian Institute of Health & Welfare, Australian Institute of Family Studies
International Government agency reports	Department of Health (UK), National Institute for Health and Clinical Excellence (NICE), National Institutes of Health (US), Centers for Disease Control (CDC), Health Canada, New Zealand Ministry of Health, World Health Organization
Specialised grey literature resources	OpenDOAR, OpenGrey, National Technical Reports Library, OAIster, Australian Indigenous HealthInfoNet, Australian Policy Online, Clearinghouse for Sport
Research organisations	NHMRC, National Collaborative on Childhood Obesity Research (NCCOR), Australasian Child and Adolescent Obesity Research Network (ACAORN), Healthy Kids (NSW), EPPI-Centre, Campbell Collaboration, ALSPAC research study.
Clinical trial registries	Clinicaltrials.gov, Australian New Zealand Clinical Trials Register (ANZCTR)
Conference and meeting proceedings	World Congress on Obesity, Childhood Obesity Conference, International Congress on Obesity, European Congress on Obesity
Theses	TROVE, NZResearch.org, British Library's Electronic Thesis Online Service, Theses Canada, WorldCat

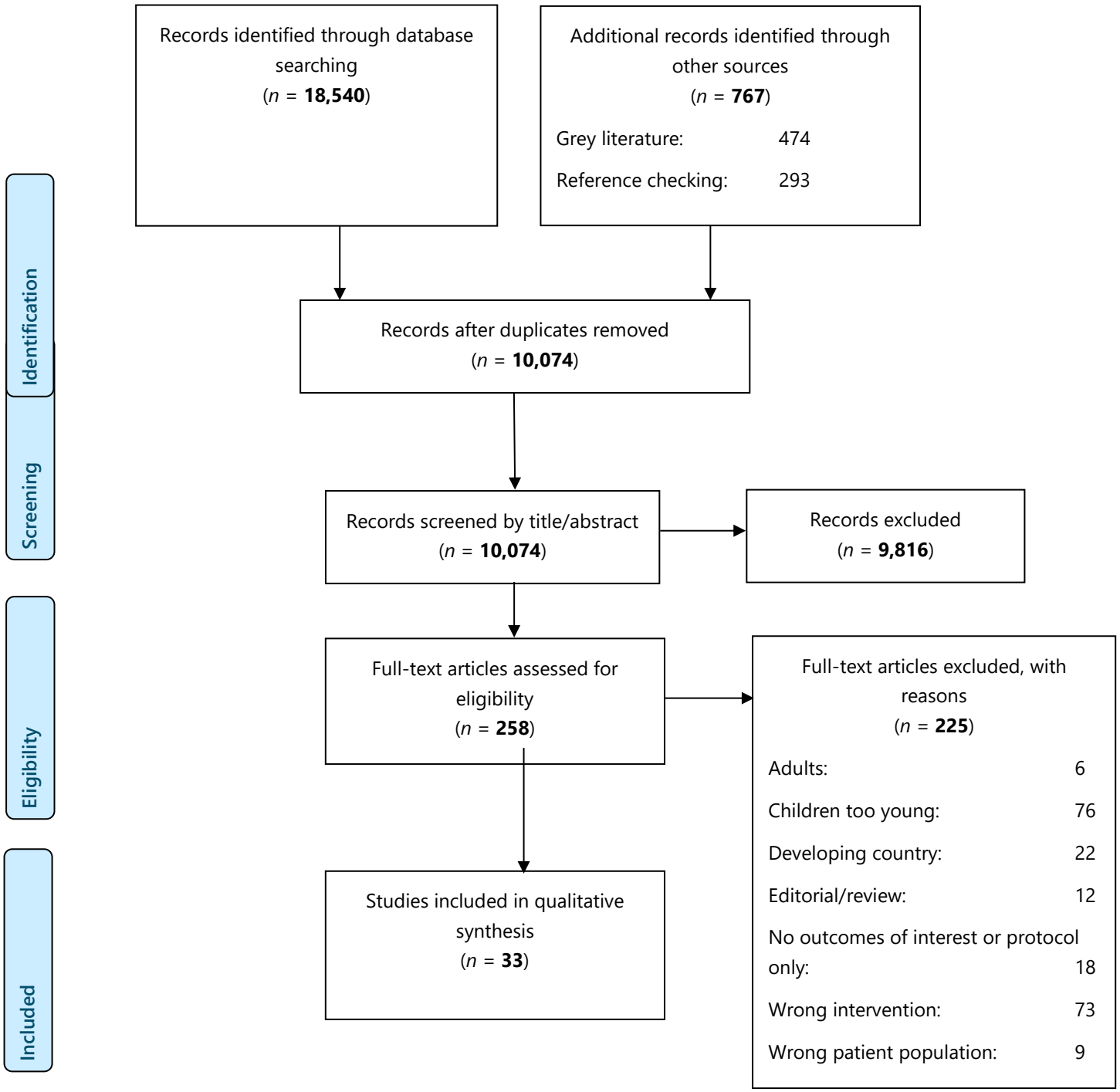

Figure 1: Flow chart of study selection

Findings

Overview of findings of the comprehensive search strategy

Of the studies identified, 33 met the inclusion criteria for this rapid review (Figure 1). These studies report on 23 unique programs, of which 8 were rated as strong quality[41-50], 9 rated as moderate quality[51-61] and 6 rated as weak quality (Appendix Three).[62-71]

Study characteristics of all included studies are detailed in Table 4. Of these, the mean age of adolescent participants ranged from 13–16 years old, sample sizes ranged from 16–208 participants and study length ranged from 6 weeks to 12 months. Studies were conducted in the UK (*n*=1), the US (*n*=16), Europe (*n*=7) and Australia (*n*=2). The majority of studies (73%; *n*=19) targeted both overweight and obese children, with just 7 (27%) targeting obese adolescents exclusively.

Q1: What community-based secondary prevention or weight management programs are effective for 13–17 year olds?

We identified 13 community-based programs which were effective at managing weight (measured by BMI z or BMI) (Table 5). Outcomes were reported across 19 publications of sufficient quality, with the programs rated as moderate (*n*=7)[51-59] to strong (*n*=6).[41-48] Program details and the effect size of the intervention on BMI or BMI z score change are summarised in Table 5. Briefly, the effect sizes ranged as below:

- BMI z at end of the intervention: *n* = 8 (from 2% to 9% decrease)[51]
- BMI z at follow-up: *n*=5 (from 2% to 11% decrease)[51]
- BMI at end of the intervention: *n*=7 (from 1% to 7% decrease)[72]
- BMI at follow-up: *n*=1 (from 3% to 5% decrease,[58] depending on treatment arm).

Of the studies in this review, common elements of effective community-based programs are listed below.

- **Content**: Programs were generally multicomponent lifestyle interventions, with just under half (*n*=5)[41, 42, 44, 51-56, 58] also incorporating CBT or another psychological component to achieve behaviour changes.
- **Format**: In addition to group sessions, approximately half of the programs (*n*=7)[41, 42, 44, 45, 51, 52, 54, 55, 58, 59, 72] had some one-to-one contact designed to tailor program content for individuals, and assist with individual goal setting and keeping on track.
- **Length:** Programs varied in length from 6 weeks to 12 months with eight short-term (<6 months)[43, 44, 46-48, 51, 52, 58, 59, 73], two medium term (6–11 months)[41, 42, 57] and three long-term (≥12 months).[45, 53-55]
- **Target:** Approximately two-thirds of the programs (*n*=8)[43, 46-48, 51, 52, 54, 55, 58, 59, 73] targeted both overweight and obese adolescents rather than exclusively obese adolescents.
- **Parent involvement**: All but one program involved parents (*n*=12)[59], however parent involvement occurred at varying levels. Some programs had parent-only sessions and some involved parents in joint sessions with their children.
- **Location**: Effective programs were held in Australia (*n*=1)[54-56], the US (*n* = 6)[41-43, 45, 48, 51, 52, 57, 74] and Europe (*n*=6).[59, 73]

Only two of the 13 effective studies[59, 73] used a technology only intervention, with no or minimal face-to-face contact; and, just under half (*n*=6) also reported favourable outcomes including physical activity or sedentary behaviour (*n*=3)[54-56, 59, 73], health-related quality of life, or HRQoL (*n*=3)[44, 46, 47, 57], and healthy eating (*n*=1).[54-56] These programs and others that were deemed less successful or rated as weak quality are

described in detail by country of origin in the following section. Those that are both effective and most translatable to the NSW context are further discussed in section 'Applicability to NSW'.

Table 4: Summary characteristics of all included studies, ordered by study location (Australia, Europe, UK and US)

Study	Mean age at BL (year)	*n*	Target weight status[1]	Intervention				Location
				Type	Technology	Comparator	Length (months)	
Nguyen et al. 2012, 2013; Shrewsbury et al. 2011[54-56]	14	151	Overweight +obese	Healthy lifestyle behaviour change	✓ One arm received additional ph coaching, & text or email messages	Booster session only	12 (intense) + 12 booster	Australia
Straker et al. 2014; Smith et al. 2015; Howie et al. 2015; Howie et al. 2016[67-70]	14	69	Obese	Nutrition + PA	✓ Tapered SMS and telephone call support	Waitlist control	2 (intense) + 20 booster	Australia
Bartelink et al. 2014, 2017[64, 65]	14	96	Overweight +obese	Nutrition + Exercise + Psychology		No treatment	3	Europe (Netherlands)
Charmay-Weber et al. 2016[53]	14	74	Obese	Nutrition + Exercise + Psychoeducation		1:1 care	12	Europe (Switzerland)
Delgado-Rico et al. 2012[72]	14	42	Overweight +obese	Nutrition + Exercise + Psychoeducation		No comparator	3	Europe (Spain)
Hofsteenge et al. 2013, 2014[46, 47]	15	95	Overweight +obese	Nutrition + PA + ST + psychosocial		Current regular care (dietitian referral)	3 (intense) + 6 booster	Europe (Netherlands)
Riiser et al. 2014[59]	14	120	Overweight +obese	PA + motivational interviewing	✓ Internet intervention	Usual care	3	Europe (Norway)
Ruotsalainen et al. 2015[73]	15	46	Overweight +obese	Healthy lifestyle	✓ Facebook-delivered	Usual care	3	Europe (Finland)
Vos et al. 2012[44]	13	81	Obese	Nutrition + PA advice, CBT		Initial advice (Nutrition + PA)	3	Europe (Netherlands)

Study	Mean age at BL (year)	*n*	Target weight status[1]	Intervention				Location
				Type	Technology	Comparator	Length (months)	
Avery et al. 2012[71]	NR 11 – 15	128	Overweight +obese	Nutrition		No comparator	NR	UK
Berkowitz et al. 2013[45]	15	169	Obese	Lifestyle		Self-guided lifestyle program	12	US
Daly et al. 2016[62]	NR 14 – 17	37	Overweight +obese	Mindfulness + meditation		Nutrition and exercise information	1.5	US
Davis et al. 2011[60]	16	38	Overweight +obese	Exercise ± motivational interviewing		No treatment (delayed intervention)	4	US
Davis et al. 2012[63]	16	61	Overweight +obese	Nutrition + Exercise + motivational interviewing		Monthly newsletter with information	8	US
DeBar et al. 2011[66]	14	208	Overweight +obese	Lifestyle		Usual care	6	US
Foster et al. 2014[57]	NR ≥13	40	Overweight +obese	Lifestyle	✓ Telephone call support	No comparator	6	US
Jelalian et al. 2011[58]	14	93	Overweight +obese	Lifestyle + peer-based adventure therapy		Lifestyle + supervised exercise	4	US
Lloyd-Richardson et al. 2012[51]		118						
Sato et al. 2011[52]		86						
Jelalian et al. 2015[48]	15	49	Overweight +obese	Lifestyle + enhanced parenting		Lifestyle only	4	US
Jensen et al. 2016[43]	14	16	Overweight +obese	Behaviour change	✓ Smartphone-assisted	No comparator	6	US
Kulik et al. 2015[49]	15	41	Overweight +obese	Peer support		No peer support	4	US

Study	Mean age at BL (year)	*n*	Target weight status[1]	Intervention				Location
				Type	Technology	Comparator	Length (months)	
Kulik et al. 2016[50]	16	65	Overweight +obese	Peer support		No peer support	6	US
Pretlow et al. 2015[61]	16	43	Obese	Addiction treatment model	✓ Smartphone App	No comparator	5	US
Sallinen et al. 2013[41]	15	83	Obese	Lifestyle		No comparator	6	US
Woolford et al. 2011[42]	15	67						

BL, baseline; m, month; n, number of participants; ph, phone; UK, United Kingdom; US, United States; wt, weight; y, year; [1] *≥85th – 95th percentile, overweight and ≥95th percentile obese; 4 weeks = 1 month*

Table 5: Characteristics and effect size of effective community-based adolescent weight management interventions

Study	Country	Sex	Mean age at BL (y)	Target wt status	Effect size End-I	Effect size FU	Effective on other outcomes	Intervention				Structure		Parents involved	Includes tech.
								Length / FU (m)	Estimated no. of sessions	Focus*	Target	Group	1:1		
Outcome: BMI z score															
Lloyd-Richardson et al. 2012[51]	US	♂ + ♀	14	Overweight + obese	↓ 9%	↓ 11% (12m) ↓ 11% (24m)	BMI z: Y – time N – group × time	4 / 12 / 24	**52 total** Adolescents: 36 (twice weekly 16w then 4 biweekly maintenance) Parents: 16	Lifestyle + Psych	Family	Yes	Yes	Yes	—
Chamay-Weber et al. 2016[53]	Europe (Switzerland)	♂ + ♀	14	Obese	↓ 9%	NA	NA	12	**26 total** Adolescents; 18 Parents: 8	Lifestyle + Psych	Family	Yes	—	Yes	—
Jensen et al. 2016[43]	US	♂ + ♀	14	Overweight + obese	↓ 6%	↓ 4% (6m) ↓ 4% (12m)	Wt: Y	4 / 6 / 12	**24 total** Adolescents: 12 Parents: 12 smartphone monitoring and daily text messaging	Lifestyle	Family	Yes	—	Yes	Yes – smartphone self-monitoring, daily text messaging
Vos et al. 2012[44]	Europe (Netherlands)	♂ + ♀	13	Obese	↓ 5%	↓ 10%	HRQoL: N (End-I), Y (FU)	3 / 12	**13 total** Adolescents: 7 Parents: 5 Adolescents + parents: 1	Lifestyle + Psych	Family	Yes	Yes	Yes	—

Nguyen et al. 2012; Nguyen et al. 2013[54, 55]	Australia	♂ + ♀	14	Overweight + obese	I: ↓ 3% I + ATC: ↓ 4%	I: ↓ 10% I + ATC: ↓ 9%	arms combined: HE: Y (end, FU) SB: Y (end, FU) P: Y (end, FU)	12 / 24	**14 total** Adolescents; 7 (+ 5 booster after 12m) Parents: 7 *I + ATC: + 13 TC + 32 SMS/email messages*	Lifestyle + Psych	Individual	Yes	Yes (I + ATC only)	Yes	Yes (I + ATC only)
Shrewsbury et al. 2011[56]	Australia	♂ + ♀	14	Overweight + obese	↓ 2%	NA	HE: Y SB: Y PA: N	2	**14 total** Adolescents; 7 Parents: 7	Lifestyle + Psych	Individual	Yes	—	Yes	—
Berkowitz et al. 2013[45]	US	♂ + ♀	15	Obese	↓ 5% (6m) ↓ 5% (12m)	NA	NA	12	**34 total** Adolescents: 17 Parents: 17	Lifestyle	Individual	Yes	Yes	Yes	—
Foster et al. 2014[57]	US	♂ + ♀	NS for ≥13y only	Obese	↓ 2%	↓ 6%	HRQoL: Y (FU)	6 / 18	**36 total** Adolescents: 12x face-to-face, 12x home, 12x telephone sessions Parents: 5x face-to-face, self-conducted 12x home sessions	Lifestyle		Yes		Yes	Yes - telephone sessions
Hofsteenge et al. 2013; Hofsteenge et al. 2014[46, 47]	Europe (Netherlands)	♂ + ♀	15	Overweight + obese	NA	↓ 4% (6m) ↓ 2% (18m)	HRQoL: Y	3 / 6 / 18	**9 total** Adolescents; 7 (+4 boosters after 3m) Parents: 2	Lifestyle	Individual	Yes	—	Yes	—

Study	Country	Sex	Mean age at BL (y)	Target wt status	Effect size End-I	Effect size FU	Effective on other outcomes	Intervention				Structure		Parents involved	Includes tech.
								Length / FU (m)	Estimated no. of sessions	Focus*	Target	Group	1:1		
Outcome: BMI															
Delgado-Rico et al. 2012[72]	Europe (Spain)	♂ + ♀	14	Overweight + obese	↓ 7%	NA	NA	3	**12 total** Adolescents: 6 Adolescents + parents: 6	Lifestyle	Individual	Yes	Yes	Yes	—
Jelalian et al. 2011;[58] Sato et al. 2011[52],(as per[51])	US	♂ + ♀	14	Overweight + obese	I + PEAT: ↓ 6% I + EXER: ↓ 5%	I + PEAT: ↓ 5% I + EXER: ↓ 3%	NA	4	**52 total** Adolescents: 36 (2x weekly 16w then 4 biweekly maintenance) Parents: 16	Lifestyle + Psych	Individual	Yes	Yes	Yes	—
Sallinen et al. 2013; Woolford et al. 2011[41, 42]	US	♂ + ♀	15	Obese	↓ 2% (3m) ↓ 6% (6m)	—	NA	6	**48 total** 24 rotating group/individual sessions (adolescents + parents, nutrition sessions; separate, psych sessions) + 24 exercise sessions	Lifestyle + Psych	Family	Yes	Yes	Yes	—
Ruotsalainen et al. 2015[73]	Europe (Finland)	♂ + ♀	15	Overweight + obese	I: ↓2% I + AM: ↓4%	—	SB: Y PA: Y	3	Adolescents: weekly public + private Fb discussions Parents: weekly public + private Fb discussions	Lifestyle	Individual	Yes		Yes	Yes

Jelalian et al. 2015[48]	US	♂ + ♀	15	Overweight + obese (excl. SO)	↓ 1%	NA	NA	4	**32 total** Adolescents: 16 Parents: 16	Lifestyle	Individual	Yes	—	Yes	—
Riiser et al. 2014[59]	Europe (Norway)	♂ + ♀	14	Overweight + obese	↓ 1%	NA	Wt: Y HRQoL: Y PA: Y	3	Adolescents: online weekly counselling (*n*=12) + daily registration encouraged	Physical activity	Individual	Yes	Yes	—	Yes

Abbreviations: 1:1, one-to-one; AM, activity monitor; ATC, additional therapeutic contact; BL, baseline; BMI, body mass index; EXER, exercise; Fb, Facebook; FU, follow up; HRQoL, health-related quality of life; I, intervention; m, month; NA, not assessed; NR, not reported; P, psychology (including cognitive behavioural therapy); PA, physical activity; PEAT, peer enhanced adventure therapy; SO, severely obese; TC, telephone coaching; Wt, weight; y, years

*Ordered by descending effect size; NB studies of weak quality are not included; *Lifestyle refers to inclusion of a diet and activity or sedentary behaviour component*

Synthesis of study findings

For in depth synthesis, the review team grouped studies according to whether they were conducted in Australia, in comparable English-speaking Western nations (US and UK) or in non-English speaking countries (Europe). The review team further categorised interventions as short-term (<6 months in duration), medium-term (6–11 months) or long-term (≥12 months).

Programs from Australia

The Evidence Check identified two community programs for overweight or obese adolescents from Australia: 1), the Loozit program from NSW, which resulted in three articles reporting relevant outcomes[54-56]; and 2), Curtin University's Activity, Food and Attitudes Program (CAFAP) from Western Australia, which resulted in four articles reporting relevant outcomes.[67-70] The interventions in both studies comprised an intensive phase of eight weeks followed by a maintenance phase. Loozit's intense phase consisted of seven weekly face-to-face group sessions, each 75 minutes long, while CAFAP participants met twice a week for two hours each time. Parents and adolescents attended separate sessions in both programs; however, there was a joint component to these sessions in the CAFAP trial. Both interventions covered a range of topics including healthy eating, physical activity, sedentary behaviour and various aspects of psychology such as CBT (Loozit) or self-determination and goal setting (CAFAP). The maintenance phase in both programs was characterised by less frequent contact, which was provided by phone calls and text messages until 12 months (CAFAP) and three monthly booster sessions (Loozit). While the intensive phase of Loozit was provided to all participants, the maintenance phase consisted of two arms where participants were randomised to booster sessions alone or booster sessions plus some additional contact via mobile phone and email until two years after commencement.

Loozit reported small but statistically significant reductions in mean (95% CI) BMI z at two months [-0.05 (-0.06, -0.03)][56], 12 months [-0.09 (-0.12, 0.06)][55] and two years (-0.13 (-0.2, -0.06)].[54] The CAFAP showed similar reductions in mean BMI z across 12 months (pre-intervention, 2.11 ± 0.01; 3 months, 2.09 ± 0.02; 6 months, 2.07 ± 0.02; 12 months, 2.04 ± 0.04, $P < 0.050$).[67]

Both programs reported positive changes in dietary intake with CAFAP reporting a significant increase in serves of fruit (from 0.6 serves at baseline to 1.1 at 8 and 12 weeks and 0.9 and 1 serve at 26 and 52 weeks, respectively).[69, 70] Vegetable intake only increased significantly at 26 weeks (from baseline of 1.3 serves to 1.7 serves, $P < 0.05$) but dropped back to 1.4 serves at 52 weeks.[69, 70] Intake of non-core foods reduced from baseline (4.6 serves) to 3.2, 3.4, 3.3 at 8, 12 and 26 weeks, respectively but rose again to 4.3 serves at 52 weeks.[69, 70] At two months, the Loozit trial reported a significant increase in the proportion of people who maintained or increased serves of vegetable to at least four serves a day (proportion who decreased: maintained: increased intake was 15:41:44, $P = 0.04$) and at least two serves of fruit daily (18:54:28), $P < 0.007$.[56] The authors also reported improvements in food behaviours including consumption of breakfast, lunch and dinner, eating in front of the TV and eating dinner with the family.[56]

CAFAP found small increases in the intensity of physical activity over the intervention, whereas Loozit showed no difference in physical activity but a significantly lower amount of time spent in sedentary behaviour at 8 weeks which was sustained until 12 months. Loozit also reported positive changes in HRQoL at both 8 weeks[56] and 12 months.[55] The Loozit trial found no advantage of offering additional contact through mobile phone messages (SMS) and emails on any of the outcomes of interest.

Quality appraisal ratings of weak for the CAFAP trial[67-70] and moderate for the Loozit trial[54-56] were determined due in part to potential selection bias, as participants were self-referred in CAFAP — and therefore unlikely to be representative of the target group — and a high drop-out rate in both studies. For the Loozit program, the quality was rated as moderate and largely limited by study design as, despite being

an RCT, the analysis of interest answering the research question for this rapid review was of pre-post study design.

In summary, both of these Australian programs delivered a multi-component group approach with parental involvement and a booster phase which improved some health-related behaviours and translated to small but significant decreases in BMI z in the short term, which were reportedly sustained longer term (effect size -0.07 to -0.13). The Loozit trial was deemed effective because of its effect size and moderate quality rating. The CAFAP program was not deemed effective as it was rated as weak quality and therefore excluded from appraisal of effectiveness.

Programs from the United States and the United Kingdom

The review team identified 16 studies, reporting on 14 programs conducted in the US (*n* = 13) and the UK (*n* = 1), as eligible for this rapid review. Interventions are categorised as short-term (<6 months in duration), medium-term (6–11 months) or long-term (≥12 months), with studies conducted in minority groups reported separately.

Short-term interventions (<6 months)

There were six studies reporting on four programs of less than 6 months duration; one rated as strong quality[49] and three rated as moderate.[48, 51, 52, 58, 60, 61] Four of the six studies, reporting on two programs, were deemed effective (Table 5).[48, 51, 52, 58]

Jelalian et al. Sato et al. and Lloyd-Richardson et al. all rated as moderate quality, report on an RCT (*n* = 118 at baseline) of a 16-week behavioural weight control intervention. The group program involved CBT (behavioural topics such as goal setting, self-monitoring, stimulus control, motivation and relapse prevention) combined with either aerobic exercise (weekly supervised sessions) or peer-based adventure therapy (designed to increase teamwork, social skills and self-esteem). Adolescents in both groups were prescribed a balanced energy-deficit diet and gradual increases in physical activity. Change in BMI was reported at study end, i.e. 4[52], 12[58] and 24-months follow up.[51] Despite a decrease in weight outcomes over time in all subjects (BMI ↓~5%/BMI z ↓~9%[52,51] at 4 months, BMI ↓ 4%/BMI z ↓~11%[58,51] at 12 months; BMI z ↓~11% 24 months [51]), there were no differences between groups at 4, 12 or 24-months. In other words, there was no advantage of offering peer-based adventure therapy over exercise training as part of a behavioural weight control intervention, however receiving a behavioural weight control intervention (using either strategy) does lead to significant changes in BMI or BMI z score. No other outcomes of interest for this review were reported on by these studies. Retention across the program was good, with 85% completing the end-of-intervention assessment at 4 months, 79% completing the 12 month follow up assessment and 75% completing the 24 month follow up assessment.[51, 58] These retention rates are higher than reported in other studies, possibly as a result of the financial compensation (amount not specified) for completing follow-up assessments.[51, 58]

A further two short-term studies from the US report on a 16-week standard cognitive behavioural weight loss program with an enhanced component: either peer support through social networking[49] or parenting.[48] The program content for both RCTs were modelled on a previous weight control study[74] which included diet, exercise, behaviour modification and cognitive restructuring components (such as self-monitoring, goal setting and stimulus control). At the end of the 4-month intervention, Jelalian et al. (rated as moderate quality) found that the standard behavioural treatment (SBT) without enhanced parenting achieved greater decreases in BMI than the added enhanced parenting group, which included additional parent-adolescent communication training about weight-related behaviours.[48] Further, session attendance was greater in the SBT without enhanced parenting group (81% vs 67% in SBT/SBT + EP). Little loss-to follow up was observed (SBT/SBT, *n* = 2; SBT/SBT + EP, *n* = 4).[48] In contrast, at the end of the 4-month intervention, Kulik et al. (rated

as strong quality) found that both groups lost weight but there was no significant difference between groups.[49] That is, no greater weight loss was experienced in the enhanced peer support group — which undertook small group activities on peer support skills and received peer support online via Facebook between sessions — than the standard group who received nutrition and physical activity education, behaviour skills and cognitive therapy. In this study, 89% of participants completed 4 or more sessions (out of 8) with no significant difference in mean attendance between the enhanced and standard group.

The final study by Pretlow, rated as moderate quality, was a 20-week (5-month) intervention consisting of four face-to-face group sessions plus weekly 15 minute phone calls and an addiction treatment approach using a smartphone app.[61] Pretlow's addiction treatment approach showed a reduction in the degree of obesity measured by change in %over BMI. Obesity in males reduced from 95.9% to 82.6% and in females from 70.9% to 67.1%, $P < 0.01$.[61]

In summary, one of these four short-term group programs originating from the US, reported across three studies[51, 52, 58], was deemed effective (Table 5). The multi-component approach incorporating CBT, physical activity and a balanced deficit diet resulted in decreases in BMI or BMI z in the short term (↓ 5 – 9%), which were reportedly sustained longer term (↓ 3 – 11%), and which were the greatest effects seen from all the studies evaluated in this review. Thus, this program could be recommended as a model for adoption in Australia.

Medium-term interventions (6–11 months)

In total, seven studies reported on six programs of 6–11 months duration; four rated as strong[41-43, 50] and three rated as weak.[57, 66, 71] Participants ranged from 14[66] to 16[50] years of age (mean), and were overweight and obese[50, 57, 66] or obese only.[41, 42] Sample size ranged from 40[57] to 208[66] participants. All interventions targeted participants' lifestyle and most were single arm pre-post studies.[41, 42, 57, 66, 71]

Two studies by Woolford et al. and Sallinen et al. were rated as strong quality[41, 42] and reported weight outcomes from the MPOWER (The Michigan Pediatric Outpatient Weight Evaluation and Reduction) program. The 24-week multidisciplinary intervention comprised of 2 hours per week contact; 1 hour of supervised exercise with an exercise physiologist and 1 hour group or individual sessions with a paediatrician, psychologist, dietitian or social worker. The MPOWER program targets obese adolescents only and involves parents. Both studies reported a decrease in BMI at 3[41] and 6 months[42], however statistical significance of the differences were not stated. No other outcomes of interest were reported for this study. The study by Kulik et al, also rated as strong quality, compared a behavioural weight loss intervention (behavioural therapy; BT) for overweight and obese adolescent girls with a behavioural weight loss intervention enhanced with an online internet component (behavioural therapy + intervention; BT + I)[50]. The behavioural weight loss intervention comprised of nine 60-minute group sessions with a focus on diet, exercise and behaviour modification with the BT + I group receiving between-session internet group chats once per week. Both groups experienced statistically significant decreases in weight at 6-month and 12-month follow ups, however there was no statistically significant difference between groups. Collapsed data showed decreases in weight from baseline to 6 and 12 months for all participants, however significance was not reported. No other outcomes of interest were reported for this study.

An additional study by Jensen et al.[43] was rated as strong quality and employed phone messages during the maintenance phase of their intervention and a smart phone app for self-monitoring for 12 weeks after the 12-week group program. However, these small, significant reductions in BMI z from baseline (1.85 ± 0.11) to 12 weeks (1.74 ± 0.13) were not sustained at either 24 weeks (1.78 ± 0.13) or at 12 months (1.78 ± 0.12).

The review team rated three studies as weak quality.[57, 66, 71] They included face-to-face group sessions for adolescents as well as parent involvement. The RCT by DeBar et al. involved 16 group sessions for adolescents (females only) and 12 group sessions for parents over 24 weeks.[66] The single arm pre-post

study reported by Foster et al. involved 12 group sessions for adolescents, 12 home sessions conducted by the parents and 12 telephone calls from the program facilitator over 24 weeks.[57] Intervention content for both studies covered behavioural and cognitive tools for coping, including goal setting and stimulus control, as well as self-monitoring of lifestyle behaviours (e.g. dietary intake, physical activity and screen time). DeBar et al. included discussion of additional topics important to adolescent girls such as promoting body image and minimising emotional eating.[66] BMI z decreased by 2%[57] and 6%[66] after the 6-month intervention, which improved to 6%)[57] or was maintained at 12 months.[66] Foster et al. also reported a significant intervention effect on HRQoL at the 18-month follow up time point (from baseline and from intervention end – 6 months), with a retention rate of 70%.[57] At intervention end, DeBar et al. reported no intervention effect on physical activity (mins/day) or dietary outcomes (total calories per day, percent calories as fat). However, there were significant intervention effects on body satisfaction, sugar-sweetened beverage intake, family meals and fast-food consumption (data not reported) at the 12 month follow-up, but no effect on metabolic outcomes, appearance attitudes or HRQoL.[66] The retention rate in DeBar et al. was better (94%) than that in Foster et al. (84%) at 6 months. The average session attendance in DeBar et al. was 10/16 sessions and participants were generally satisfied with the program (average rating = 4.4 out of 5, where 5 was excellent). The final study by Avery et al.[71] reports the outcomes from 8 months of the Family Affair program in the UK. This study was rated as weak quality yet reported a significant change in BMI z (baseline, 2.49 ± 0.72; 8 months, 2.27 ± 0.74) following a family-based group program targeting adoption of healthier lifestyle habits by the whole family.

In summary, of these seven medium-length studies, four, reporting on three programs, were deemed effective (Table 5).[41-43, 57] The multi-component approach with obese adolescents and their parents resulted in short term decreases in BMI (↓ 2 – 6%%), which were reportedly enhanced longer term in one study (↓ 6%). [57]

Long-term interventions (≥12 months)

One long-term program by Berkowitz et al. rated as strong quality, targeted obese adolescents (mean age 15 years old) and provided two models of lifestyle modification program (LMP) for use in primary care: 1) group LMP or 2), self-guided LMP.[45] The 12 month comprehensive family-based LMP curriculum was delivered following detailed treatment manuals provided to adolescent and parent dyads and included behavioural and cognitive tools (e.g. goal setting, stimulus control, self-monitoring of behaviours) similar to that in the other US studies reported above. Both groups received one-to-one counselling with a health coach six times in a clinic. Those in the self-guided LMP were instructed to read and complete lessons in a treatment manual and review them on a weekly basis at home while the group LMP received an additional 17 group sessions at which they reviewed their progress, had interactive discussions around diet and physical activity, and received peer support. At 6 and 12 months, there were no statistically significant differences between groups in changes in anthropometric outcomes (weight, BMI, BMI z score or waist circumference). Both groups experienced a reduction in BMI z from baseline to 6 months (group LMP -0.11 ± 0.02; self-guided LMP -0.09 ± 0.02) and baseline to 12 months (group LMP -0.12 ± 0.03; self-guided LMP -0.12 ± 0.03). No other outcomes of interest were reported for this study.

In summary, the single long-term program originating from the US demonstrated a 5% reduction in BMI z at both 6 and 12 month outcome assessments in a program of 12 months' duration.[45] Evidently, there is limited evidence from the US and UK on the long-term effect of community-based interventions to improve adolescent obesity.

Studies with minority groups

Additionally, in the US there were three eligible studies identified that were designed and delivered exclusively in ethnic minority groups. One study by Daly et al. *2016*[62] evaluated the efficacy of a 6-week Mindful Eating Intervention that involved weekly 90-minute group classes inclusive of mindfulness meditation, combined instruction, discussion and eating skills practice in obese adolescent Latino females. Compared to a control group who were provided with nutrition and exercise educational handouts only, the intervention group demonstrated a statistically significant decrease in BMI of 1.1 kg/m^2 over the 6 weeks compared to an increase in BMI in the control group of 0.72 kg/m^2, $P < 0.001$. While only the intervention group were followed up at 10 weeks, there was an indication that the significant decrease in BMI achieved as a result of the mindful eating intervention could be maintained with BMI from baseline to 10 weeks decreasing by 1.4 kg/m^2 ($P = 0.019$).

These findings are unlike those of Davis et al. *2012*[63] who reported no significant improvements in outcomes amongst overweight minority (Latino and African American) adolescents who, following an intensive four month nutrition and/or strength training intervention[75, 76], were randomised to receive a maintenance program consisting of monthly 90-minute classes focused on nutrition, or nutrition and strength training, in addition to four motivational interviews over the telephone ($n = 33$) or a monthly newsletter consisting of healthy eating and/or physical activity tips ($n = 28$).

In an earlier study by the Davis et al. *2011*[60], the research group investigated the effect of twice weekly for 16-weeks circuit training (CT) only ($n = 14$) or in combination with motivational interviewing (MI) ($n = 12$) on reducing adiposity and type 2 diabetes risk factors compared to a no treatment control ($n = 12$) in minority Latino adolescent girls. There were no significant group effects for changes in BMI, BMI z or percentiles. Other outcomes of interest included waist circumference (WC), subcutaneous abdominal adipose tissue (SAT) and visceral adipose tissue (VAT) as measured by dual-energy X-ray absorptiometry (DEXA). Compared to controls, those in the CT group had significant decreases in WC (3%), SAT (10%) and VAT (10%), however, there were no significant changes in the CT + MI treatment group.

Neither the study by Daly et al. *2016*[62] or Davis et al. *2012*[63] reported on any other key outcomes of interest for this review. While the study by Davis et al.[63] met the inclusion criteria for this review, it is important to highlight that it is a maintenance intervention involving participants from a previous study[75, 76] which does not meet the inclusion criteria for this review, on the basis of intensity (>2 sessions per week).

Quality ratings of weak were determined for two of these studies[62, 63] and moderate for one.[60] Key limitations are noted to be the likely possibility of selection bias due to non-random sampling, issues with validity of the outcomes measured (BMI and weight change rather than BMI z) and the relatively small sample sizes. Retention of participants in community programs and cost is also an important issue for consideration. For both studies by Daly et al. *2016*[62] and Davis et al. *2012*[63], incentives were provided to encourage participants to maintain engagement in these programs. Providing participants with a variety of cooking utensils and gadgets appears to have been successful for those attending the maintenance program with 80% of participants attending all eight classes.[63] In contrast promising US$20 to those completing the mindful eating intervention, led to only 6 out of 14 participants attending a single session. None of the three studies reported on the cost to deliver the community program.

In summary, there appear to be no studies published since 2011 reporting on effective community programs designed and delivered exclusively in ethnic minority groups that we could confidently recommend as models for adoption or further refinement in Australia at this time.

Face-to-face programs from Europe

The review team identified nine papers, reporting on seven studies conducted in Europe, as eligible for this Evidence Check. Most were RCTs or non-randomised experimental studies rated as moderate[72, 73] or strong quality.[44, 46, 47, 59]

Short-term interventions (<6 months)

There were eight papers that reported on six short-term interventions from Europe in overweight and obese[46, 47, 59, 64, 65, 72, 73], or obese only[44], adolescents. There were two papers by Bartelink et al. [64, 65] that reported different outcomes from the same 3-month program.[64, 65] All three interventions involved advice or skills training in nutrition and physical activity and had some psychoeducation component (for example, CBT). Studies by Bartelink et al.[64, 65] and Vos et al.[44] were RCTs each held in the Netherlands, while Delgado-Rico et al.[72] reported on a single arm pre-post study from Spain. Bartelink reported on changes in BMI to follow-up of 12 months (outcomes not reported immediately post-intervention) where there was a significant mean decrease in BMI z-score of -0.39 ± 0.62 in the intervention group, which was significantly different to changes in the no treatment control (P = 0.002). The study by Delgado-Rico[72] largely reported on biochemistry outcomes, and cognitive performance in overweight and obese adolescents, before and after a 12 week intervention (i.e. no follow-up period). In this smaller cohort of 42 adolescents, BMI was reported to significantly decrease from 29.4 ± 4.5 kg/m^2 pre-program to 27.3 ± 4.4 kg/m^2 post-program (P < 0.01). Vos et al.[44] reported changes in BMI z and HRQoL of obese adolescents before and after an intensive 3-month treatment that involved fortnightly group sessions. BMI z significantly decreased from baseline (4.2 ± 0.7) to post-treatment (4.0 ± 0.9) and 12 months after baseline remained significantly lower than baseline (3.8 ± 1.1). Parents and adolescents reported changes in adolescent HRQoL at each of the three time points. There was no significant change in mean (95% CI) adolescent-reported HRQoL from baseline (80.2 (78.4 – 87.2)) to post-program (84.1 (80.8 – 87.5)) but there was a significant improvement in HRQoL at follow-up (86.8 (83.3 – 90.3)) 12 months after baseline, 9 months after treatment ended. Two of these papers were appraised as weak quality[64, 65], one was scored as moderate[72] and one was scored as strong quality.[44]

Two short-term studies by Riiser et al.[59] and Ruotsalainen et al[73], which we rated as strong and moderate quality respectively, used technology alone to deliver the intervention. Ruotsalainen et al. conducted a 12-week, 3-arm trial comparing a Facebook intervention with one that used Facebook and self-monitoring, and a control group which received usual care. There were no significant differences between groups in change in BMI or physical activity; however, the one that used Facebook with self-monitoring had lower sedentary time on weekdays compared to the control group, 56% vs 65% of time, P = 0.021. There were no changes in BMI or physical activity over time. Similarly, Riiser et al. offered one face-to-face session followed by access to an online program focused on physical activity and motivational interviewing, and compared this to usual care. There were no changes in BMI in the intervention group over time; however, the control group increased BMI significantly, hence the intervention could be protective against weight gain (mean (95% CI) BMI z difference between groups: -0.39 (-0.74, -0.03), P = 0.03). The intervention group had a small increase in cardio-respiratory fitness (mean (95% CI) difference: 0.14; (0.01, 0.28), P = 0.04) and some improvement in HRQoL (mean 5.22 (0.90, 9.53), P = 0.02).

Hofsteenge et al. appraised as strong quality[46, 47], reported outcomes from the Netherlands Go4it study.[46, 47] Go4it was a multidisciplinary healthy lifestyle program that held fortnightly group sessions for a period of three months followed by four booster sessions to a total period of 12 months. The comparison control group received current regular care comprising of referral to a dietitian. Hofsteenge reported changes in primary outcomes of interest, BMI z[46] and HRQoL[47], as well as other outcomes including biochemistry and fat and muscle mass.[46] When compared to the control group, there was no significant effect of the Go4it intervention on BMI z six months after baseline (mean difference -0.10 (-0.23, – 0.04)), however there was a

significant benefit of the intervention at 18 month follow up (mean difference -0.16 (-0.30, 0.02)). Mean HRQoL gradually improved in the Go4it group over time from 75.1 ± 12.2 at baseline to 78.5 ± 11.2 at 6 months and to 81.7 ± 12.0 at 18 months. However, at each follow-up time point, there was no significant difference between HRQoL in the intervention group and the control group; mean difference of -0.1 (-3.5, 3.3) at three months and 3.8 (-0.2, 7.7) at 18 months.

In summary, five out of six short-term programs in Europe were deemed effective (Table 5), with decreases in BMI or BMI z score in the short and long-term, ranging from a decrease in BMI of 1% post-intervention[59] to a decrease in BMI z score of 10% at 12-month follow up.[44] Four of these five programs involved parents; four targeted the individual only and one program targeted the whole family. All five programs were of three months' duration.

Medium-term interventions (6 – 11 months)

There were no medium-term interventions (6 – 11 months) from Europe in the published literature which met the criteria for this Evidence Check.

Long-term interventions (≥12 months)

The review team identified one program from Europe as a long-term intervention meeting the selection criteria for a community program in this Evidence Check. This study, by Charmay-Weber et al. rated as moderate quality[53], reported outcomes from a 12-month Swiss non-randomised experimental study that compared changes in BMI z over time following nutrition, exercise and psychoeducation group sessions to a lower intensity, one-to-one model comparable to standard care[53]. Group sessions for adolescents were initially more intensive with one session a week for five months, then four sessions over a seven-month maintenance period. Parents also had sessions separately or with adolescents, which were initially once or twice per month and then once in the maintenance period. Changes in BMI z were reported separately for adolescents aged 12 – 14 years old and 14 – 18 years old, as well as together for all participants (aged 12 – 18 years old).

BMI z decreased over time in both groups, with mean change of -0.20 ± 0.5 reported for the one-to-one group and mean change of 0.24 ± 0.5 reported for group therapy participants. There was no significant difference in treatment allocation on BMI z change over time, which is surprising given the variation in mean contact from 4.5 ± 2.5 hours for the one-to-one group, compared to significantly greater mean contact for the group therapy cohort of 26.1 ± 4.1 hours. Across both groups, the authors reported greater mean decreases in BMI z for adolescent boys than girls (boys, -0.30 ± 0.57 vs girls -0.13 ± 0.34, $P = 0.008$) especially in the group therapy participants (boys, -0.49 ± 0.7 vs girls, -0.09 ± 0.3, $P < 0.01$). Additionally, Charmay-Weber et al. reported that participants who had a higher BMI z score at baseline and a longer period of follow-up had greater changes in BMI z.

In summary, there is limited evidence from Europe on the long-term effect of community-based interventions to improve adolescent obesity. The single long-term program originating from Europe demonstrated a 9% reduction in BMI z at 12 months; the equal largest effect seen from all the studies evaluated in this review. Thus, this Contrepoids® program could be recommended as a model for adoption in Australia.

Quality of the evidence for community-based adolescent obesity prevention approaches

Component ratings and scoring of the overall quality of the evidence according to the NHMRC body of evidence matrix are highlighted in Table 6 and described in detail below.

Evidence base

The grade of evidence assessed for the reviewed studies is listed below.

- Level II studies (n=15)
  - RCT (strong): *n* = 6
  - RCT (moderate): *n* = 6
  - RCT (weak): *n* = 3
- Level III studies (n=9)
  - Non-randomised experimental (strong): n = 2
  - Non-randomised experimental (moderate): n = 1
  - Non-randomised experimental (weak): n = 6
- Level IV studies (n=9)
  - Case series (pre-post) (strong): n = 2
  - Case series (pre-post) (moderate): n = 6
  - Case series (pre-post) (weak): n = 1.

Reviewed studies were predominantly moderate to strong quality RCTs. The overall evidence base, quantity of evidence and quality of studies was rated as **good.**

Consistency

The studies the research team reviewed were generally consistent in demonstrating an effect on weight status (BMI or BMI z) for overweight and obese adolescents. These outcomes were calculated from height and weight measured using reliable and valid methods (rather than self-reported) and were determined from accepted BMI z reference scores. Programs identified from this review were less consistent in their reporting of other health behaviours, diet and activity outcomes, and HRQoL. Consistency of the evidence, defined by the extent to which the studies produce consistent results across the range of included studies, was rated as **good;** most studies produced consistent results and inconsistency may be explained.

Clinical impact

There is no universally accepted definition of clinically significant weight loss in children and adolescents. Commonly used cut-points are reductions of ≥ 0.25 or ≥ 0.50 BMI z units, which are associated with improvements in key metabolic risk factors including triglycerides, cholesterol LDL, HDL and blood pressure.[77] The community-based programs in this review did not achieve this level of clinical significance of weight loss in the adolescent participants. Hence, we considered programs which reported any maintenance or decrease of BMI z or BMI at either program end or at follow-up to be effective. The studies we reviewed for this Evidence Check of effective community-based approaches for adolescent obesity prevention were judged to have moderate clinical impact. We rated the potential clinical benefits, the duration of intervention and the relevance of the evidence to the target population for the review as **satisfactory**.

Generalisability

The body of evidence retrieved in this review is generalisable to the Australian Caucasian population at large, including in NSW. However, there were no studies which reported on specific target populations, such as Aboriginal and Torres Strait Islander people in the two Australian programs. Several studies which focussed on minority groups were based in the US and were culturally adapted to target Latino adolescents. There was also little, if any, indication of the rurality or urbanicity of the cohorts in the reviewed studies, with such often needing to be interpreted from the institution of the study. Several studies were delivered to

adolescent girls only, or involved programs where the majority of participants were female. As such, the acceptability and effectiveness of these programs for adolescent boys is unknown. In addition, the reviewed studies did not report characteristics of their populations in sufficient detail to allow generalisability to NSW to be considered; and, outcomes were not reported by such characteristics which would permit effectiveness in target or at risk populations to be reliably assessed. In total, the generalisability of the reviewed studies was rated as **good**; the populations studied in the body of evidence are similar to the target population.

Applicability

Studies from developing countries were excluded in the present review in order to focus on programs that would be most applicable to Australian people and the NSW health care context. Overall, the reviewed programs may be relevant to Australians but there is no conclusive evidence from which this can be reasonably inferred. Two programs from Australia and one from NSW are likely to be the most applicable for the NSW context. Other programs may have been delivered in a language other than English or culturally adapted for the population of interest, and these may be less applicable. Consumer engagement and consultation with other community and health care stakeholders is required to reliably assess program applicability. Hence, the evidence retrieved in this review is probably applicable to Australian context with some caveats and, therefore, applicability was rated as **satisfactory**.

Table 6: NHMRC body of evidence matrix employed to summarise the evidence base for community-based approaches to adolescent obesity prevention, with rating decisions highlighted in grey

Component	A	B	C	D
	Excellent	**Good**	**Satisfactory**	**Poor**
Evidence base	Several level I or II studies with low risk of bias	One or two level II studies with low risk of bias or a systematic review or multiple level III studies with low risk of bias	Level III studies with low risk of bias or level I or II studies with moderate risk of bias	Level IV studies, or level I or III studies with high risk of bias
Consistency	All studies consistent	Most studies consistent and inconsistency may be explained	Some inconsistency reflecting genuine uncertainty around clinical question	Evidence is inconsistent
Clinical Impact	Very large	Substantial	Moderate	Slight or restricted
Generalisability	Population/s studies in body of evidence are the same as the target population in question	Population/s studied in the body of evidence are similar to the target population in question	Population/s studied in body of evidence differ to target population in question but it is clinically sensible to apply this evidence to the target population	Population/s studied in body of evidence differ to target population and hard to judge whether it is sensible to generalize to target population
Applicability	Directly applicable to Australian context	Applicable to Australian context with a few caveats	Probably applicable to Australian context with some caveats	Not applicable to Australian context

Findings from grey literature

A comprehensive search of grey literature identified one emerging program that fits the inclusion criteria for this review: the MEND Teens program in the UK, based on the 10-week Mind, Exercise, Nutrition, Do it!

(MEND) program developed in 2000. The first MEND weight management and lifestyle program focused on younger children aged 7 – 13 years old and has since been evaluated extensively, replicated and up-scaled for community delivery. [78] It has been adapted by the NSW Ministry of Health and since 2009 has been offered free to above healthy weight children aged 7 – 13 and their parents or carers, as Go4Fun. [79] Mytime Active acquired MEND which has been adopted for use in NZ, Australia, Canada and the US. MEND Teens is directed at 13 – 16 year olds who are above a healthy weight. All of the MEND programs address diet, physical activity and parenting strategies, and are delivered by trained facilitators from local communities. Evaluation for MEND Teens is currently underway, however outcomes are yet to be reported.

More specifically, MEND Teens is a healthy lifestyle program designed by a clinical psychologist, a registered dietitian and a physical activity expert for young people aged 13 – 16 years old. The program is implemented by a local team in the community, with each program modified to meet the needs of the local context. The core program features a series of 10 two-hour sessions, delivered over a period of 10 weeks. Each session comprises a one-hour workshop followed by one hour of varied physical activity. The workshops facilitate discussion and learning across a range of topics from diets and fads to increasing everyday physical activity levels. Alongside the weekly workshops and physical activity sessions, there are several other interventions built into the program designed to engage, motivate and inspire the young people taking part. There are also two optional sessions which cover healthy cooking on a budget and body image. Parents do not attend the program but a number of other strategies engage the parents and ensure that the support and information participants receive is extended into the home. This program is currently being piloted for the third and final time, and has been informed by a long history of successfully implemented and evaluated programs with younger children. It is continuously being improved in response to participants' feedback and ongoing evaluation, before being finalised for wider dissemination. It is emerging as a very promising intervention for young adolescents.

Gaps in the evidence

Varying level of support and prescription in researcher-led programs

We identified programs across a continuum from those wholly group-based to those which included varying levels of one-to-one contact or an element of tailoring or personalisation, such as individual goal setting to assist with keeping on track and meeting program objectives. We also identified programs which were far more prescriptive or had more program contact time. Some programs appeared to be more akin to a community program than others but we considered all programs to be candidate community-based approaches due to their intervention characteristics. The level of control over the program was difficult to determine from the methods reported and the programs were inferred to be mostly researcher-led (rather than community-led), however this was never explicitly stated. Overall, there is limited evidence from the reviewed studies that these programs are effective outside a research environment when not researcher-led.

Up-scaling of adolescent obesity programs to large-scale or state-wide public health initiatives

Despite an exhaustive search of the literature with targeted search terms, we identified a paucity of studies reporting on processes or outcomes from the translation or delivery of community-based approaches for adolescent obesity prevention on a larger scale (for example, state-wide). We identified only five studies which had a sample size of over 100, with the largest study having 208 participants. This finding is in contrast to secondary obesity prevention programs for families of younger children (i.e. primary school-aged children, ~5 – 13 years old) for which there are several case studies from Australia — in both New South Wales[79, 80] and Queensland[81, 82] — and the UK.[83] While such examples are out of the scope for this rapid review, lessons learned may be applicable to and informative of secondary prevention programs for adolescents which involve parents or have a family focus.

Limited evidence in priority populations in NSW

Study populations were largely heterogeneous, held across Australia, Europe and the US. While some programs were tailored or culturally relevant for specific populations such as Latinos, neither of the two Australian programs reported the proportion of Aboriginal or Torres Strait Islander participants, nor program outcomes for this population. Some programs reviewed across the regions reported indicators of SES, however these were inconsistent and may not be particularly meaningful or transferrable to the Australian population; for example, Supplemental Nutrition Assistance Program recipients (formerly food stamps) or Medicaid in the US context.

Moderate evidence on long-term favourable outcomes

There was a moderate level of evidence of long-term effectiveness of these programs. Six out of the eight effective programs, which reported improvements in BMI z, measured outcomes at 12, 18 or 24-month follow-up. High quality evidence up to and beyond two-year follow-up is required to understand long-term sustainability of intervention effects, and to better understand changes across the life course[84], particularly in adolescents who soon become adults.

Program cost, resources and cost-effectiveness

In this rapid review, we sought to extract information on costs and resources required to deliver programs identified, however there was only one study of the 33 reviewed that included any information on program resourcing or cost. This Swiss study by Charmay-Weber et al.[53] compared the cost of delivering an intensive group therapy to a comparison group who received one-to-one paediatrician contact. The authors calculated treatment costs based on the Swiss TARMED[1] procedure codes and converted costs from CHF (Swiss Franc) to USD. Of note, they reported a conversion rate of $1 USD = 0.965 CHF, which remains comparable to the current exchange rate (1 USD = 0.99 CHF). They costed 45 minute consultations with a paediatrician as $USD228 and structured multidisciplinary group therapy costs as $USD4352 which, although underestimated, is the amount reimbursed by Swiss health insurance companies. Costs of group sessions were added to costs of medical consultations before, during and after the group therapy. Overall, they reported the group therapy cost as $USD6941 ± 836 compared to $USD1279 ± 875 for one-to-one contact, on average ~$USD5662 or 5.4 times more expensive. The authors reported that participants who received group therapy had significantly more hours of contact (26.1 ± 4.1 hours) compared to one-to-one contact (4.5 ±2.5 hours), however did not report a significant benefit of the group program over one-to-one care, and concluded that the less intensive one-to-one care was as effective as the costly group treatment.

We recommend that this isolated finding be treated with caution as there are currently no other comparisons which can be made from this literature. Additionally, it is not clear whether the authors apportioned the cost of the group program across the number of individuals in the groups. This could not be estimated as actual group sizes were not reported, however the authors stated in their methodology notes that there was a maximum of 15 families in each age-specific group (12 – 14 years old or 15 – 18 years old). The authors also reported cost figures in the publication's abstract which differed to those in its body. Finally, this study was of overall moderate quality as it suffered from selection bias (weak rating).

There was no reporting of program cost-effectiveness in the studies reviewed.

[1] Standardised fee schedule that covers all clinical outpatient procedures in Switzerland

Applicability to NSW

Applicability of the findings to the NSW context

We identified a large number of studies (*n* = 33) that were conducted in the target group of interest (13 – 17 year olds overweight or obese adolescents from a developed country) and which are likely to be somewhat applicable to the NSW context. Of the effective studies identified in Table 5 the most effective in reducing BMI z (which accounts for age and height of individuals) were conducted in the US[43, 45, 51, 57], Europe (Switzerland[53] and the Netherlands[44, 46, 47]) and NSW (The Loozit Program).[54-56] These programs are consistent in content (multicomponent lifestyle interventions, mostly with a psychological component), format (group-based, with or without one-to-one contact) and support (parental-involvement). Despite the populations of the Europe-based studies being comparable to those in Australia, these studies were delivered in countries where English is not the primary language (i.e. the Netherlands and Switzerland) and therefore, should one of these programs be adapted for the NSW context in Australia, there may be additional costs in the language translation of the program, its evaluation materials and procedures for use. The most effective program (both in the short and long-term) of all evaluated for this Evidence Check originated from the US and could therefore be recommended as a model for adoption in Australia [51]. However, given the Loozit Program was delivered in NSW, it is the study most likely to be applicable to the NSW setting. This program achieved important reductions in BMI z of between 3 – 4% at 12 months (post-program) which improved to 9 – 10% at 24 month follow up. Nonetheless, as the proportion of Aboriginal or Torres Strait Islanders that participated in these programs — or the effectiveness of the intervention in these sub-populations — was not reported, their applicability to them is unknown.

Further considerations to inform applicability of identified programs for the requirements of the Office of Preventive Health

Specific populations

In general, no studies reported on programs or interventions that have been used with effect for Aboriginal adolescents. Additional grey literature searching of Australian Indigenous HealthInfoNet revealed no promising programs for adolescent obesity prevention in this population. As Indigenous peoples are most susceptible to obesity, along with those from low SES backgrounds, final program selection needs to consider accessibility, literacy and cultural appropriateness for these populations, and budget for program adaptation as appropriate. Further, few studies reported details regarding culturally and linguistically diverse (CALD) communities or adolescents in low SES communities.

Online programs

While online programs undoubtedly have potential to achieve the greatest reach of participants, due to the fact participation is not necessarily bound by physical location, we identified a lack of evidence of effective online programs for the secondary prevention of adolescent obesity in Australia. As adolescents are innately familiar and confident with social media and online technologies, they are an ideal target population for such innovative approaches to behavioural interventions. Online programs can be self-paced or have group components which aim to build community and empower peer-learning, however, when compared to face-to-face programs, they generally suffer from higher levels of attrition. Limited engagement may compromise the cost-effectiveness of such a program, particularly as online programs can be costly to develop due to additional costs, which include outsourcing of specialised technological expertise for online platform or app development and ongoing improvement. A previous systematic review on the effectiveness of methods and strategies aimed at facilitating adolescent and/or young adult exposure to internet-delivered interventions[85] may be of interest should this avenue be pursued. Additionally, reliable and high-

speed internet, or hardware such as tablets, computers and smartphones, may not be universally available or attainable for all participants, particularly those at greater social and economic disadvantage.

Scalability

This review yielded no recent evidence of effective community-based obesity approaches for adolescents that have been up-scaled (for example, delivered across a state). Scalability case studies are emerging within the translation research and public health literature and there are previous examples from community-based obesity prevention programs for younger children (<13 years old).[79-83] At present, these case studies for programs in a younger population are the best evidence to inform community program challenges from implementation at scale, including participant recruitment, engagement and retention, as well as upskilling and training the workforce to deliver these programs as part of (or in addition to) their current practice. Evidence on program cost-effectiveness and long-term effectiveness of up-scaled programs in this age group was unavailable and greatly needed. The programs we reviewed had varying levels of supervision, prescription, tailoring and intensity, and so may not necessarily be scalable without modification and subsequent evaluation to ensure effectiveness remains. Scalability needs to be considered with regard to realistic community delivery and resourcing, and be balanced with participant need and expectation. Where programs involve parents as well as adolescents, the needs of both must be considered, which adds another level of complexity.

Conclusion

This Evidence Check identified recent evidence for effective community-based approaches for adolescent obesity prevention in Australia. However, when compared to community-based obesity prevention efforts in primary school-aged children, adolescents appear to be a comparatively under-served population and this may be due to complexities in this age group. Of note, other health risk behaviours cluster during adolescence (e.g. cigarette smoking, alcohol consumption including binge-drinking, drug use, unprotected sex and antisocial behaviour)[86] and strategies to mitigate these undesirable behaviours[87] appear to be more abundant in this population than obesity management.

Recommendations

Intervention characteristics

From the programs identified in this Evidence Check, we recommend that an effective community-based adolescent obesity program in NSW bear the characteristics listed below.

- Length: ≥3 months in duration
- Content: Multicomponent lifestyle intervention ± psychological component such as CBT
- Format: Group-based program, with one-to-one contact before, between and/or after sessions for individual behaviour change/goal setting support
- Participants: Include overweight and obese children, and involve parents in sessions with their adolescent children, or in parent-only sessions with the aim to support adolescent behaviour change in the family and home environments
- Evaluation: Long-term follow-up ≥12 months post-program to determine sustainability of lifestyle changes and long-term benefit.

Gaps in the literature

Additionally, gaps in the literature could be addressed by incorporating cost-effectiveness analyses and dissemination of outcomes as a comprehensive case study on up-scaling an effective community-based adolescent obesity program for state-wide delivery.

Overall recommendations

We have listed the following recommendations to inform the Agency's selection of a community-based adolescent obesity prevention program for NSW below.

- Community versus researcher-led: The feasibility of the program for delivery in the NSW community-setting should be considered. Many programs were inferred to be based in a research setting, or researcher-led, and this may not be the preference for a program in NSW. Hence, the practicality of the program in the community-setting should be considered and negotiated with communities as required
- Level of support: The level of support which is prepared to be offered, or can be afforded needs to be considered, as some programs involved higher levels of one-to-one support, prescription, and/or supervision (e.g. supervision of exercise sessions by a personal trainer or exercise physiologist)
- Applicability: Programs should be presented to eligible participants (consumers or users) and other stakeholders to determine appropriateness of the program and its materials (e.g. cultural acceptability and participant literacy)

- Generalisability: Where further information on program participants would inform consideration or selection of a program, authors of the studies should be contacted for further information not published (e.g. postcode, ARIA, Indigeneity) as this may be available on request but was beyond the scope of the present review
- Scale of delivery: The scale at which the program is to be delivered needs to be considered, as with up-scaling often comes a lessening of the effect of the intervention, and so this should be anticipated from the outset.

A pilot study or implementation review of the selected program in its early stage is further suggested to inform and improve program delivery at scale.

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Appendix One

Table 7: Search strategy – Ovid MEDLINE(R) 1946 to 2 March 2017

Includes: Ovid MEDLINE(R) Epub Ahead of Print, In-Process & Other Non-Indexed Citations, and Ovid MEDLINE(R) Daily

#	Searches	Results
1	*overweight/ or *obesity/ or *obesity, morbid/ or *pediatric obesity/ or *Adiposity/	128,302
2	Adolescent/	1,789,795
3	1 and 2	24,413
4	((obes* or overweight* or over-weight* or excessive weight or adiposity) adj4 (Adolescen* or teen* or pubescen* or prepubescen* or juvenile* or secondary school* or middle school* or high school* or youth*)).tw,kw.	10,017
5	or/3-4	28,067
6	National Health Programs/ or Self-Evaluation Programs/ or Government Programs/ or Voluntary Programs/ or Adolescent health services/ or Community health services/ or preventive health services/ or pilot projects/ or program evaluation/ or capacity building/ or program development/ or health planning/ or social planning/	261,773
7	Education/ or "patient education as topic"/ or "physical education and training"/ or Health Promotion/ or Health Education/ or "early intervention (education)"/ or education.fs.	447,303
8	Family therapy/ or counseling/ or motivational interviewing/ or cognitive therapy/ or psychotherapy, group/ or directive counseling/ or self help groups/ or behavior therapy/ or exercise therapy/	133,545
9	Social support/ or community networks/ or community participation/	80,482
10	weight reduction programs/ or nutrition therapy/ or diet therapy.fs,sh.	56,396
11	cell phones/ or smartphone/	7,576
12	((Mobile or tablet? or smartphone? or smart-phone?) adj2 (app? or application? or device? or technolog*)).tw,kw.	6,830
13	((cell* or mobile*) adj2 (phone? or telephone?)).tw,kw.	8,009
14	(smartphone or smart-phone$ or Android? or iPad? or iPod? or iTunes or GooglePlay or appstore* or app store* or iOS).tw,kw.	7,046
15	(tablet* adj2 (computer* or device*)).tw,kw.	822
16	((handheld or hand-held) adj2 (computer? or device?)).tw,kw.	1,929
17	(app or apps or wearable*).tw,kw.	22,919
18	(mhealth* or m-health* or mobile health or m-wellbeing or mwellbeing or mwell-being).tw,kw.	2,716
19	"Randomized controlled trials as topic"/ or "evaluation studies as topic"/ or feasibility studies/ or intervention studies/ or randomized controlled trial.pt.	720,781
20	(program* or initiativ* or strateg* or intervention* or campaign* or project* or implement* or translat* or service* or communit* or health promotion* or education* or feasibility or pilot or upscal* or "scale up" or "scaled up" or "at scale" or counsel* or training or random*).tw,kw.	430,5896
21	or/6-20	4,914,469
22	secondary prevention/ or Disease management/ or treatment outcome/ or pc.fs.	1,888,098
23	(prevent* or manage* or treat*).tw,kw.	5,860,928
24	Diet/ or Diet, reducing/ or diet, fat restricted/ or energy intake/ or caloric restriction/ or eating/ or food/ or fruit/ or vegetables/ or carbonated beverages/ or dietary sucrose/ or dietary carbohydrates/ or dietary fiber/ or breakfast/ or meals/ or menu planning/ or fast foods/ or snacks/ or cooking/	313,788
25	(Diet* or eat* or food* or meal* or snack* or junkfood* or fruit* or vegetable* or nutrition* or soft drink* or carbonated drink* or soda* or cook* or ((energy or caloric) adj2 (intake or expenditure or restrict*))).tw,kw.	1,064,780
26	Weight Loss/ or Body weight/ or Body Weight Changes/ or Body mass index/ or Body size/ or Waist circumference/ or Skinfold thickness/ or Anthropometry/ or Adiposity/ or Body fat composition/ or body composition/ or Abdominal fat/ or body constitution/ or waist-hip ratio/	355,901

27	(Body mass index or BMI or BMI z or (weight adj2 (loss* or lost or reduc* or maintain* or chang* or status or stabili*))).tw,kw.	268,879
28	((Body adj2 (size or fat or composition or constitution)) or waist circumference* or skinfold thickness* or anthropometr* or adipos* or abdominal fat or waist-hip ratio).tw,kw.	191,046
29	food preferences/ or feeding behavior/ or food habits/ or nutritional status/ or nutritive value/ or appetite/ or appetite regulation/ or hunger/ or satiation/	132,237
30	(preference* or habit* or appetite or hunger or satiety or satiation).tw,kw.	285,683
31	Behavior/ or Health behavior/ or adolescent behavior/ or child behavior/ or choice behavior/ or risk reduction behavior/ or social behavior/ or maternal behavior/ or paternal behavior/ or parenting/	198,781
32	(behavior* or behaviour* or parent*).tw,kw.	1,289,060
33	Exercise/ or sports/ or walking/ or running/ or bicycling/ or recreation/ or leisure activities/ or physical fitness/ or physical exertion/ or motor activity/ or muscle strength/ or exercise tolerance/ or physical endurance/	319,070
34	(Exercis* or sport* or club* or walk* or run* or cycl* or bicycl* or bike* or recreation* or leisure activities or fitness or exertion or strength or endurance or physically active or daily activit* or physical activit* or activity level* or physically fit or sedentary or inactiv* or sit or sitting or sedentary).tw,kw.	2,037,351
35	Life Style/ or Healthy Lifestyle/ or Healthy Diet/ or Life Change Events/ or Sedentary Lifestyle/	75,781
36	(lifestyle* or life style*).tw,kw.	83,661
37	or/22-36	10,004,178
38	5 and 21 and 37	12,329
39	Developing countries/ or caribbean region/ or west indies/ or cuba/ or dominica/ or dominican republic/ or grenada/ or haiti/ or jamaica/ or saint lucia/ or "saint vincent and the grenadines"/ or americas/ or central america/ or belize/ or costa rica/ or el salvador/ or guatemala/ or honduras/ or nicaragua/ or panama/ or "gulf of mexico"/ or latin america/ or mexico/ or south america/ or argentina/ or bolivia/ or brazil/ or colombia/ or ecuador/ or guyana/ or paraguay/ or peru/ or suriname/ or venezuela/ or asia/ or asia, central/ or kazakhstan/ or kyrgyzstan/ or tajikistan/ or turkmenistan/ or uzbekistan/ or asia, northern/ or russia/ or siberia/ or asia, southeastern/ or cambodia/ or east timor/ or indonesia/ or laos/ or malaysia/ or myanmar/ or philippines/ or thailand/ or vietnam/ or asia, western/ or bangladesh/ or bhutan/ or india/ or afghanistan/ or iraq/ or jordan/ or lebanon/ or syria/ or turkey/ or yemen/ or nepal/ or pakistan/ or sri lanka/ or china/ or "democratic people's republic of korea"/ or mongolia/ or europe, eastern/ or albania/ or bosnia-herzegovina/ or bulgaria/ or kosovo/ or "macedonia (republic)"/ or moldova/ or montenegro/ or "republic of belarus"/ or romania/ or serbia/ or ukraine/ or fiji/ or papua new guinea/ or vanuatu/ or micronesia/ or guam/ or palau/ or samoa/ or american samoa/ or tonga/ or africa/ or africa, northern/ or algeria/ or egypt/ or libya/ or morocco/ or tunisia/ or "africa south of the sahara"/ or africa, central/ or cameroon/ or central african republic/ or chad/ or congo/ or "democratic republic of the congo"/ or equatorial guinea/ or gabon/ or africa, eastern/ or burundi/ or djibouti/ or eritrea/ or ethiopia/ or kenya/ or rwanda/ or somalia/ or sudan/ or tanzania/ or uganda/ or africa, southern/ or angola/ or botswana/ or lesotho/ or malawi/ or mozambique/ or namibia/ or south africa/ or swaziland/ or zambia/ or zimbabwe/ or africa, western/ or benin/ or burkina faso/ or cape verde/ or cote d'ivoire/ or gambia/ or ghana/ or guinea/ or guinea-bissau/ or liberia/ or mali/ or mauritania/ or niger/ or nigeria/ or senegal/ or sierra leone/ or togo/	867,170
40	38 not 39	11,194
41	(surg* or gastrectom* or bariatric* or gastric or syndrome* or disorder* or disab* or patient* or primary care or general practi* or primary health* or prevalence).ti.	2,952,546
42	40 not 41	9,165
43	limit 42 to (english language and yr="2011 -Current")	4,487

Notes:
/ or sh = search on Medical Subject Headings (MeSH)
tw = search on title and abstract fields
kw = search on author keywords
fs = search on free-floating subheadings
ti = search on title field
** allows for unlimited end variants on a word stem*
? allows for the substitution of zero or one character
adj allows a specified number of intervening spaces to occur between two words
Programs held in developing countries were excluded (Appendix Six)

Appendix Two

Table 8: Inclusion and exclusion criteria for study selection

	Inclusion criteria	Exclusion criteria
Population	• Adolescent *children aged 13 – 17y* • *Median age 13 – 17y* • Mean age 13 – 17y • Population includes children 13 – 17y and outcomes reported separately children 13 – 17y • Overweight or obese children • Population includes overweight or obese. Outcomes reported separately for overweight or obese children • Mean or median BMI reflects overweight or obesity	• Does not include children aged 13 – 17y • Does not include overweight and obese children • Pregnant adolescents • Children with disabilities, health conditions (e.g. cystic fibrosis) or behavioural/learning difficulties • Children with eating disorders/disordered eating (e.g. binge eating, bulimia) or other mental health disorders
Intervention	• community-based intervention/program • group sessions/program • group programs with 1:1 sessions • reports outcomes for adolescent children • all mediums considered, including the following but not limited to face-to-face; telephone; online; mobile technology (apps, SMS); peer-led interventions; multi-component • include programs delivered in home; school (as venue, not delivered as part of the curriculum or within school hours); provided the target population has outcomes reported separately (i.e. Overweight/obese AND age group); outpatient clinic; community health service; other community setting (church, sports club, NGO, councils) • include programs which are secondary prevention, or both primary and secondary prevention • programs with no more than two face-to-face contacts per week • include intervention studies (e.g. RCT, pre-post, non-randomised experimental); full scale, small scale, and pilot implementation or translation studies • participants are "free-living" in the community during the program/intervention • held in any developed country	• clinical studies (including drugs, single nutrients) • prescribed, pre-programmed, restricted or regimented diet or exercise changes or sessions (e.g. high protein, low GI, cycling for 1h 3× per week) • programs which involve clinical treatments (e.g. provided by primary care practitioners incl. GPs) • short-term experimental exercise studies e.g. those comparing immediate effects of different workouts • programs which involve food provision and meal replacements (e.g. Light n' easy) • one-on-one/ individualised/ tailored/ personalised counselling/ support or motivational interviewing or supervised exercise or personal training sessions only (e.g. by GP, dietitian, psychologist with no group component) **We assume is one-to-one if there is not statement that this counselling/support/MI/supervision/PT is of a group • school-centred including changes to school environments/policies (e.g. foods available in the canteen, water fountain installation): programs delivered by schools during school hours or within the education system/curriculum i.e. lesson plans (although included programs may be delivered within a school setting i.e. school as a venue after or before hours) • exclude programs which include healthy weight children ONLY (i.e. those which are primary prevention ONLY) • primary prevention programs only • targets eating disorders/disordered eating (e.g. binge eating, bulimia) or other mental health disorders • involves bariatric surgery • not "free-living", e.g. immersion treatments, residential programs, school/summer/winter camps, inpatient clinics • policy changes (e.g. guidelines, strategies, plans) • environmental changes or interventions – e.g. new parks, water fountain installations • held in a developing country (over page)

Outcomes	• primary outcomes include weight, BMI or BMI z score [population level obesity prevalence, weight category for up-scaled programs], diet/healthy eating behaviours or activity-related behaviours such as physical activity • secondary outcomes include sedentary behaviour/screen time, self-esteem, quality of life	• outcomes not reported • does not report primary outcomes of interest • does not report primary outcomes of interest for overweight/obese children age 13 – 17y • family outcomes only • parent outcomes only
Time	• any duration of intervention	• cross-sectional/epidemiology studies only
Other	• article/abstract in English	• non-English articles/abstracts • abstract only (follow-up with grey literature searches) • review article (check citations/grey lit search as needed)

Appendix Three

Table 9: Study quality of final studies, assessed by Effective Public Health Practice Project Quality Assessment Tool for Quantitative studies

Reference	Component Ratings						Global Rating
	Selection Bias	Study Design	Confounders	Blinding	Data Collection Method	Withdrawals & Dropouts	
Hofsteenge et al. 2013[47]; Hofsteenge et al. 2014[46]	Moderate	Strong	Strong	Moderate	Strong	Strong	Strong
Vos et al. 2012[44]	Moderate	Strong	Strong	Moderate	Strong	Strong	Strong
Kulik et al. 2015[49]	Moderate	Strong	Strong	Moderate	Strong	Strong	Strong
Riiser, et al. 2014 [59]	Moderate	Strong	Strong	Moderate	Strong	Strong	Strong
Berkowitz et al. 2013[45]	Moderate	Strong	Strong	Moderate	Strong	Moderate	Strong
Kulik et al. 2016[50]	Moderate	Moderate	N/A	Moderate	Strong	Moderate	Strong
Sallinen et al. 2013[41]; Woolford et al. 2011[42]	Moderate	Moderate	N/A	Moderate	Strong	N/A	Strong
Jensen et al. 2016[43]	Moderate	Moderate	N/A	Moderate	Strong	Moderate	Strong
Jelalian et al. 2015[48]	Weak	Strong	Strong	Moderate	Strong	Strong	Moderate
Ruotsalainen et al. 2015[73]	Weak	Strong	Strong	Moderate	Strong	Strong	Moderate
Davis et al. 2011[60]	Weak	Strong	Strong	Moderate	Strong	Strong	Moderate
Lloyd-Richardson et al. 2012[51]; Jelalian et al. 2011[58]; Sato et al. 2011[52]	Weak	Strong	Strong	Moderate	Strong	Moderate	Moderate
Charmay-Weber et al. 2016[53]	Weak	Moderate	Strong	Moderate	Strong	N/A	Moderate

Loozit trial - Shrewsbury et al. 2011; Nguyen et al. 2012; Nguyen et al. 2013[54-56]	Moderate	Moderate	N/A	Moderate	Strong	Weak	Moderate
Delgado-Rico et al. 2012[72]	Moderate	Moderate	N/A	Moderate	Strong	Weak	Moderate
Pretlow et al. 2015[61]	Weak	Moderate	N/A	Moderate	Moderate	Moderate	Moderate
Foster et al. 2014[57]	Weak	Moderate	Strong	Moderate	Strong	Strong	Moderate
Daly et al. 2016[62]	Weak	Strong	Strong	Moderate	Strong	Weak	Weak
Davis et al. 2012[63]	Weak	Strong	Strong	Moderate	Strong	Weak	Weak
Bartelink et al. 2014[64] Bartelink et al. 2017[65]	Weak	Strong	Strong	Weak	Strong	Moderate	Weak
DeBar et al. 2012[66]	Weak	Strong	Weak	Moderate	Strong	Strong	Weak
Straker et al. 2014; Smith et al. 2015; Howie et al. 2015; Howie et al. 2016[67-70]	Weak	Moderate	Weak	Moderate	Strong	Weak	Weak
Avery et al. 2012[71]	Weak	Moderate	Strong	Moderate	Strong	Weak	Weak

NB sorted by descending global quality score

N/A, not applicable; Strong = no weak ratings; Moderate = 1 weak rating; Weak = ≥2 weak ratings

Appendix Four

Table 10: Study characteristics

Author, year	Study type (NHMRC Level of evidence)	Study quality rating	Program	Region, Location, Setting	Intervention details			Population (Reach)					
					Delivery mode	Content	Duration, Follow up	Sample size	Age group / mean age	Sex	Wt status	SES	Ethnicity/ CALD
Avery et al. 2012[71]	Case series (pre- post) IV	Weak	Family Affair	UK	Family based Group	Nutr (other NR)	ongoing	128	11-15yo	47f 10m	BMI >91st centile	-	
Bartelink et al. 2014[64]; Bartelink et al. 2017[65]	Non-randomised experimental, III-2	Weak	RealFit	Netherlands, Maastricht Urban	Face-to-Face Group (adol + parents)	Nutr + PA + Psych + PP	13wks (13wk **(T_1)**+) 5m FU **(T_2)**, (13wk +)12m FU **(T_3)**	R: 118 (n=86 I, n=32 C) P: 96 (I – n=67, C – n=29)	IC: 13-18yo Mean: I - 14.1y±1.53, C - 13.6y±0.94	%M: I - 37.3, C- 44.8	IC: Ow + obese Obese: I - 56.7% I, C -27.6% BMI z: I - 2.38±0.42, C -1.98 ±0.47	<u>Parent Educ:</u> Low - I 40%, C 65.5% High - I 40%, C 20.6% 'other' -I 20%, C 13.8%	Dutch: I - 98.5%, C - 96.6%
Berkowitz et al. 2013[45]	RCT, II	Strong	NS	US	Family based Group-LMP ***or***	LMP consisted of SM (Nutr +	12m	169	IC: 12-16yo	77%F	IC: obesity, BMI ≥28kg/m^2	<u>Parent educ:</u> High school, 33%, some college 58%,	47% AA, 47% Caucasian,

				Philadelphia & Danville, Pennsylvania Urban (n=92) & rural *n=77)	Self-guided LMP LMP= 1:1 counselling x 6 sessions (adol + parent) with health coach Group LMP: extra 17-group sessions	PA) + StM+ CR + SS			Mean: 14.6±1.4 yo		Mean: 36.7±5.2 kg/m^2 Mean BMI z: 2.3±0.3	college or more 9.5%	5% multi-ethnic
Charmay-Weber et al. 2016[53]	Non-randomised experimental, III-2	Moderate	Contrepoids®	Switzerland, University Hospitals of Geneva	Face-to-Face groups 18× 90 min sessions (s) in 12m for adolescents (A) and parents (P) 5 m intensive A: 1 s/wk P: 1-2 s/m 7 m maintenance A: 4 s P: 1 s + 90 min/w PA during school y	Nutr + PA + PE	12 m program IC: ≥ 5m follow-up FU varies 20.8 ± 9.4 m	*n* = 74	IC: 11 – 18yo all: 13.1 ± 1.7yo I: 13.9 ± 1.7yo	Girls I: n = 46 (62%)	IC: BMI >97th %ile BMI z I: 2.7 ± 0.6 Obese I: 67 (90.5%)	NS	NS

					Comparison to 1:1 F2F groups, out of scope age and program (outcomes NR)								
Daly et al. 2016[62]	RCT, II	Weak	NS	Arizona, US Urban School	I: Face-to-face, weekly 90min sessions C: Face-to-face, one visit to receive educational material	I: Mindful Eating Intervention – mindfulness meditation, and combined instruction, discussion and eating skills practice C: Nutrition and exercise information handouts	6 weeks program duration 6 weeks FU (I & C) 10 weeks FU (I only)	*n*=37 (I n=14; C n=23)	IC: 14-17yo	IC: girls 100%F	IC: BMI >90th%ile Mean BMI (all): 35.7±7.6 kg/m^2 Mean BMI (I): 37.7±7.6 kg/m^2 Mean BMI ©: 34.3±6.2 kg/m^2	NR	IC: Latino ethnicity 100% Latino
Davis et al. 2011[60]	RCT, II	Moderate	NS	California, US University Research setting	I: Face-to-face group sessions in supervised exercise laboratory (circuit training – CT) ± individual group	*PA (CT) ± MI* I - CT: 2/wk for 60 – 90 min (30 – 45 min cardio, 30 – 45 min strength training)	16 weeks' program duration no FU	*n* = 38 I (CT + MI): *n* = 12 I (CT only): *n* = 14 C: *n* = 12	IC: grade 9 – 12, age 14 – 18yo Mean age: All: 15.8 ± 1.1y	IC: girls 100%F	IC: BMI ≥ 85th %ile BMI z: I (CT + MI): 2.1 ± 0.4	NR	IC: Latino ethnicity 100% Latino

					motivational interviewing (MI) sessions C: no intervention	I - CT + MI: as above + 4× individual and 4× group MI sessions C: no intervention			I (CT + MI): 15.7 ± 1. 2y I (CT only): 15.7 ± 1. 1y C: 15.8 ± 1. 0 y		I (CT only): 2.0 ± 0.3 C: 2.2 ± 0.2		
Davis et al. 2012[63]	RCT, II	Weak	NS	California, US NS Community	I: Face-face, 90min monthly group 'maintenance' sessions C: Newsletter	I: Nutrition only (N) or Nutrition + Strength Training (N + ST), plus 4 MI phone calls. Separate sessions for parents (same curriculum as child) C: Monthly newsletter (HE or HE + PA tips - matching the initial 4m intervention)	8 month 'maintenance' programme ($\underline{\mathbf{T_{4m}\ to\ T_{12m}}}$)	*n* =61 (*n* = 53 completers) I: *n* = 33 C: *n* = 28	IC: grades 9-12 Mean age: All: 15.4±1.1 y I: 15.6 ± 1.1y C: 15.8 ± 0.9y	I: 48%F C: 66%F	IC: BMI≥85th %ile BMI z I: 2.2 ± 0.5 C: 2.2 ± 0.5	NR	IC: Latino & African-American

DeBar et al. 2012[66]	RCT, II Single arm pre-post p 653 of DeBar 2012 Pediatrics 129 e611 but RCT for 129 (3)	Weak	NS	US Pacific North West	Group sessions + yoga + exergaming +	Nutr + PA + Psych + PCP support	6m 6m, 12m	208 I: n=105 C: n=103 **12 months** I: *n= 90* *C; n = 83*	IC: 12-17yo Mean: 14.1±1.4 y	100%F	IC: BMI z ≥90th percentile (EC: severe obesity, BMI > 40) Mean BMI percentile: 97.09±2.27	Family income >$75000: I 40.0, C 36.5	%white: I 71.4, C 72.8
Delgado-Rico et al. 2012[72]	Case series (pre- post) IV	Moderate	BRAINOBE study subsample	Spain, Grenada, Clinical Research setting	Face-to-face Group sessions with 10-12 participants (from 60 – 150m) Sessions in 6 of 12 w included parents 1 session/w	Nutr + PA + Psych Includes prescribed and monitored PA and diet	12 w, pre-post treatment only – no FU	*n* = 42	IC: 12 – 17yo Mean: 14.19 ± 1.38y Range 12 – 17y	33.3% M (*n* = 14) 66.7% F (*n* = 28)	IC: overweight or obese BMI Mean: 29.15 ± 4.50 kg/m^2 Range: 22.06 ± 38.21 kg/m^2	Income (/y): 5% € 0 – 11533; 32.5% € 11533 – 18200; 45.0% € 18200 – 26548; 10.0% € 26548 – 41292; 7.5% € 41292 - 3144000	NR

Foster et al. 2013[57]	Case series (pre- post) IV	Moderate	JOIN for ME	US Rhode Island, Providence City YMCA	Face-to-Face group sessions + home sessions + telephone	Nutr + SM + GS + SC + ST + PA + SH + RM *(Foster et al 2012)*	6m 3m, 6m, 18m **(1y FU)**	40	≥13yo	NS for ≥13y only	IC: Obese +_ extremely obese 91.6% obese, 46.5% extremely obese	-	Caucasian 65.8%
Hofsteenge et al. 2013[47] Hofsteenge et al. 2014[46]	RCT, II	Strong	Go4it	Netherlands, Amsterdam, Outpatient clinic	Face-to-face adolescent peer group sessions of 8 – 12 adolescents separate parallel sessions (2) for parents	Nutr + PA + ST + PS multidisciplinary, involved dietitian, psychologist and paediatric-endocrinologist C: current regular care i.e. dietitian referral	3 mo fortnightly sessions, then booster sessions at 6 w, 14 w, 26 w and 36 w after 3 mo intervention FU at 6 m + 18 m	Randomised n = 122 (I: n = 71, C: n = 51) [47] Data for n = 95 I: n = 57, C: n = 38	IC: 11 – 18yo mean: I: 14.6 ± 1.6y C: 14.5 ± 1.7y	n girls/boys I: 29/28 C: 24/14	IC: ow + obese BMI z: I: 2.9 ± 0.4 C: 2.9 ± 0.5 [46] n ow/obese I: 5/66 C: 7/44	n education low /high I: 44/12 C: 28/9	western/non-western [47] I: 29/28 C: 14/24 [46] I: 36/35 C: 18/33
Jelalian et al. 2011[58]	RCT, II	Moderate	-	US Rhode Island, Providence	Face-to-face Group	BWC (CBT)+ PEAT ***or***	16wks (4m) 12m	93 (12mo) (n=89 complete data for analysis)	IC: 13-16yo Mean: 14.20±0.93y	69%F	IC: 30-90% overBMI Mean BMI: 31.45±3.53 kg/m^2	-	79% Caucasian, 12% AA, 6%

				City		BWC (CBT) + PA							Hispanic, 3% other
Lloyd-Richardson et al. 2012[51]						(BWC consisted of Nutr + PA + BM; GS, SM, SC, Mtv, RP)	16wks (4m) 12m, 24m	118 (B, 0m) 100 (4mo) 93 (12mo) 89 (24mo)	IC: 13-16y Mean (baseline): 14.33±1.02y	68%F	IC: 30-90% overBMI Mean BMI: 31.41±3.33 kg/m^2	-	White AA Hispanic
Sato et al. 2011[52]							16wks (4m)	86 (B)	IC: 13-16yo Mean: 14.29±0.18y	71%F	IC: 30-90% over BMI Mean BMI: 31.22±3.21 kg/m^2 Mean BMI z: 1.59±1.55	<u>Parent Educ</u> 36% high school, 44% 4-years college, 20% graduate degree	<u>Ethnicity</u> 7% Latino, 93% non-Latino <u>Race</u> 76% Caucasian, 15% AA, 9% other
Jelalian et al. 2015[48]	RCT, II	Moderate	-	US Rhode Island, Providence City	Face-to-face Group	BWC (CBT) ***or*** BWC (CBT)+ EP *(BWC consisted of Nutr + PA + BM + CR + GS*	16wks (4m)	49	IC: 13-17yo Mean: 15.10±1.33y	76%F	IC: BMI≥95th percentile and absolute BMI ≤40kg/m^2	<u>Parent educ:</u> 'some college or more', BWC 77%, BWC + EP 87%	67% non-Hispanic White 12% Hispanic/Latino

						+ SM + SC + Mtv)					Mean BMI: 32.16±3.64 kg/m^2 %ow: 61.59±17.59		
Jensen et al. 2016[43]	Case series (pre- post) IV	Strong	NR, Smartphone-assisted behavioural weight control intervention for adolescents	US NR NR	Face to face group Weekly ×75 min for 12 weeks plus smartphone: self-monitoring & text msg (daily) Followed by 12 weeks of ph only intervention Separate, concurrent sessions for adolescents and parents Parent/adolescent dyads received 15 min individual family	Behaviour change including: self-monitoring portion control, problem solving, stimulus control, emotional eating, and physical activity. Motivational interviewing was used to assess motivation and to problem solve how to overcome barriers to	12 weeks' prog + 12 weeks' txt msg & self-monitoring 12mo (after first session)	16	IC: 13-18yo Mean: 14.29±1.12y	25% M	IC: >85th%ile BMI Mean (SD) BMI%ile 95.78 (3.51)	Mean monthly parent income $6151.45	56% white 25% Hispanic/Latino 19% other

					intervention every 4 weeks after sessions Then 12 weeks of smartphone only: self-monitoring & text msg (daily)	treatment in individual family sessions							
Kulik et al. 2015[49]	RCT, II	Strong	NS	US, University research setting	Face-to-face group sessions (1.5h ea)	Nutr + PA + Beh + Cog E: enhanced, smaller groups activities to practice peer support skills, Peer support between sessions via Facebook: chats (10-15 min with group leader or peer), and check-in with 3 peers S: standard (program	16 w program, weekly for 1 m, then fortnightly for 1 m, then monthly for 2 m measures during and post-program at 4 w + 16 w	Randomised n = 41 (E: n = 23 S: n = 18) Outcome data for E: n = 19 S: n = 17	IC: 13 – 17yo mean all: 15.2 ± 1.5y E: 15.3 ± 1.5y S: 15.1 ± 1.5y	IC: girls (100%)	IC: 30 – 130% overweight BMI (kg/m^2) mean all: 34.6 ± 5.2 E: 33.8 ± 4.5 S: 35.6 ± 6.0 %overweight all: 71.0 ± 24.5	NS	all: 58.5% Caucasian; 19.5% AA; 7.3% Hispanic; 4.9% Native American/ Alaskan; 9.8% Other/multiracial Caucasian: E: 52.2% S: 66.7%

						only, no peer support)					E: 66.4 ± 20.3 S: 76.8 ± 28.7		
Kulik et al. 2016[50]	Non-randomised experimental, III-2	Strong	NS Behavioural Weight Loss Training (BWLT) ± Peer Support (I)	US, University research setting	Face-to-face groups 9× sessions (60 min) One arm with Internet chats	BWLT (all) Nutr + PA + Beh L BWT + I also had Internet chat group	6 m program FU post-program at 6 m + 12 m	*n* = 65	IC: 14 – 17yo mean 15.6 ± 1.0y	IC: girls (100%)	IC: %overweight 30 – 80% BMI (kg/m^2) median 32.4 %overweight all: 59.1 ± 14.6	NS	75% Caucasian 7.8% AA 1.6% Asian 14.1% Hispanic 1.5% multiracial
Shrewsbury et al. 2011; Nguyen et al. 2012; Nguyen et al. 2013[54,55,56]	Case series (pre- post) IV	Moderate	Loozit®	Australia Urban HC + hospital	Face to face group sessions (5 – 9 participants), held weekly (7 ×75 min) separate group sessions for	**Phase 1:** 2 mo HL + CBT (HL, HE, PA, SB, Stress management, SE) All sessions	2m 12m 24m	151	IC: 13 – 16yo Median (IQR): 13.9 (13.4, 14.8)	48% M	IC: BMI z 1 – 2.5 Mean (SD) 2.02 (0.33)	Mean (SD) SEIFA IRSAD 1054 (84) University degree: Mothers 38% Fathers 31%	PLOTE n=32/151 Region of birth (M:F): Australia: 59:49

					parents and adolescents adolescent sessions include 20 min of resistance activities and fun active games	included 20 min RT + fun games **Phase 2:** 2-24 mo maintenance phase I: Booster session every 3 mo + additional contact via ph/email C: booster alone							South-east Asia: 8:10 North Africa and Middle East 7:10 Southern-Central Asia: 7:5 North-West Europe: 5:7 Oceania: 4:7 Other: 10:12
Pretlow et al. 2015[61]	Case series (pre- post) IV	Moderate	NR	US Urban	4 x face to face group meetings (2 – 4 h each) + daily check-ins (text/email)+ weekly individual phone calls (15 mins)	Addiction approach via iPhone app focussed on sequential withdrawal of problem foods, snacking and excessive	20 weeks,	43	IC: NR Mean: 16.0 ± 0.43y Range: 10-21y	37% M	Mean (SD) BMI %ile: 0.98 ± 0.00 %over BMI: 77.4 ± 4.6	Measure unclear: 44% Low SES 56% middle/high SES	83.7% Caucasian 9.3% black 4.7% Latino 2.3% Asian

						food amounts at meals. Daily weighing (self)							
Riiser et al. 2014[59]	Non-randomised experimental study, III-2	Strong	The Young & Active Controlled Trial	Norway NR Internet	I: 1 face to face session then internet intervention, C: usual care	PA diary and counselling MI SDT Weekly individualised feedback and counselling from a health professional. Option to exchange short messages with counsellor	12 wks 1 yr (NR)	120 I: 84 C: 36	IC: 13-18yo Median (min-max) I: 13.7y (12.9 - 15.1) C: 13.8y (12.8 – 15.0)	I: 40% M C: 36% M	IC: adjusted BMI ≥25 I: 68% ow, 32% ob C: 64% ow, 36% ob	NR	**Born in Norway** I: 86% C: 81%
Ruotsalainen et al. 2015[73]	RCT, II (analysed as case series)	Moderate	NR Facebook-delivered lifestyle counselling and PA self-	Finland Northern Finland school district Internet	I1: Facebook I2: Facebook + self monitoring of PA C: usual care	I1: HL counselling I2: HL counselling + activity monitor	12 wks	46 I: 16 I2: 15 C: 15	IC: 13-16yo Mean: all: 14.7 ± 0.8y	30% M I1: 31% I2: 33% C: 27%	IC: ow or ob Mean (SD) BMI all: 28.1 (5.7)	Parent education College. Vocational: 62% mothers	**NR**

			monitoring		12 week intervention period Separate closed Facebook groups for parents and adolescents	C: usual care control HL counselling via Facebook included informational support, social support, behavioural management skills, and menu and tailored exercise program suggestions			I1: 14.8 ± 0.8y I2: 14.8 ± 0.8y C: 14.7 ± 0.8y		I1: 27.5 ± 4.2 I2: 29.7 ± 8.1 C: 27.0 ± 3.8	58% fathers Bachelor level university degree: 22% mothers 20% fathers	
Straker et al. 2014; Smith et al. 2015; Howie et al. 2015; Howie et al. 2015[67-70]	Non-randomised experimental study, III-2	Weak	CAFAP	Perth, Australia Urban (2 sites) & Rural (1 site) Community	I: Face-to-face, 2/wk 120min multi-disciplinary group sessions for 8wks (children + parents), then tapered 12m telephone and text message support	I: Nutrition and Physical Activity	8 weeks program duration (Baseline, T_{0w} T_{8w}) 3-, 6- and 12-months FU (T_{12w}, T_{26w}, T_{52w})	*n*=69	IC: 11-16y Mean age: 14.1 ± 1.6y	71%F	IC: overweight or obese; BMI-for-age and sex >85th %ile (CDC BMI-for-age growth charts)	High proportion low SES	NR

Vos et al. 2012[44]	RCT, II	Strong	NS	Netherlands	screening phase (3 m); 1:1 meetings with dietitian (×2), physiotherapist (×2), psychologist (×2) and social worker (×1) intensive treatment (3 m) 7× group sessions fortnightly (1.5 h ea, groups of 10) Booster sessions to 2 y ref protocol paper Vos 2011		3 m screen 3 m intensive treatment T1, post-treatment (after 3 m intensive treatment) T2, FU at 12 m after BL	n = 81 randomised BL: I: *n* = 41 C: *n* = 40 T1 I: *n* = 36 C: *n* = 33 T2 I: *n* = 32 C: *n* = 35	mean BL: I: 13.3 ± 2.0 C: 13.1 ± 1.9	I: 18/22 (M/F) C: 19/20 (M/F)	BMI z I: 4.2 ± 0.7 C: 4.3 ± 0.6	NR	NR
Sallinen et al. 2013[41];	Case series (pre- post) IV	Strong	MPOWER	Michigan, US	Face-to-face groups 2 h/w: 1 h exercise supervised by	Nutr + PA + Beh	24 w	*n* = 83	IC: 12 – 18y mean: 14.5y	72%F	IC: ≥95th %ile BMI mean: 43.4 kg/m^2	65.1% carriers of private health insurance	59% white

					exercise physiologist, 1 h group or individual session with paediatrician, psychologist, dietitian, social worker						range: 27.4 – 78.3		
Woolford et al. 2011[42]								*n = 67*	IC: 12 – 18yo mean: 14.5y	71%F	BMI mean: 40 kg/m^2 range: 29 – 70	50% Medicaid enrollees Income (USD/y): 53% <$25k; 9% $25-50k; 13% $50 – 75k; 25% $75 – 100k	51% Caucasian; 30% AA; 19% other (Asian, North American Indian, Middle Eastern)

Abbreviations: A, adolescents; AA, African American; B, baseline; Beh, Behaviour; BM, behaviour modification; BMI, Body Mass Index; BWC, behavioural weight control (standard behavioural treatment); BWLT, behavioural weight loss training; C, control; CALD, Culturally and Linguistically Diverse; CBT, cognitive behavioural treatment; CCT, controlled clinical trial; CDC: Center for Disease Control; Cog, cognitive; CR, cognitive restructuring; CT, circuit training; E, enhanced treatment; Educ, education; EC, exclusion criteria; EP, enhanced parenting; F, female; FU, follow up; GS, goal setting; Gp, group; HC, Health Centre; IC, Inclusion criteria; I, Intervention; LMP, lifestyle modification program; m, months; M, male; MI, motivational interviewing; Mtv, motivation; N, No; NA, not available; NR, Not Reported; NHMRC, National Health and Medical Research Council; NS, not specified; ow, overweight; P, parents; PE, psycho-education; PEAT, Peer-based Adventure Therapy; Psych, psychology; PA, physical activity; PCP, primary care provider; PLOTE, primary language other than English; PP, parent participation; PS, problem solving; RCT, randomised controlled trial; RM, relapse management; RR, response rate; RP, relapse prevention; RT, resistance training; S, standard treatment; s, sessions; SC, stimulus control; SDT, self determination theory; SEIFA, Socio-economic Indexes for Areas; SE, self-esteem; SB, Sedentary Behaviour; SES, Socio-economic Status; Sg, self-guided; SH, sleep hygiene; SM, self-monitoring; SS, social support; ST, screen time; StM, stress management; T, time; UK, United Kingdom; US, United States; USD, United States dollar; V, vegetables; wks, weeks; Wt, Weight; y, years; Y, Yes; yo, years old; YMCA, Young Men's Christian Association; %ile, percentile; % over BMI, (BMI – BMI at 50th percentile for age and gender)/BMI at 50th percentile·× 10

Appendix Five

Table 11: Summary of study findings

Author, year (ref)	Study type, Program	Outcome: Outcome Ax Method	Outcomes / Main Findings							Intervention Effectiveness	
			Wt	HE	PA	SB	SE	QoL	Other (e.g. knowledge, skills, wellbeing, food pref)	End-I	FU
Avery et al. 2012[71]	Case series (pre- post), Family Affair	Wt & ht: measured	**Mean ΔBMI z** 2.49±0.72 to 2.27±0.74 (base – study end) p<0.001 **Other:** Mean Δwt, Mean ΔBMI	–	–	–	–	–	–	BMI z: Y	–

Bartelink et al. 2014[64]	Non-randomised experimental, RealFit	Wt & ht: dietitian-measured AF: **$V0_{2max}$** sports-instructed measured (Astrand Test) HE: 19-item FFQ PA: 12-item PAQ-A	**ΔB to (T_3)** **<u>BMI z</u>** I -0.39 (±0.62), C 0.13 (±0.39, diff -0.41 (-0.67 to -0.15), p=0.002 **<u>WC</u>** I -3.24 (±9.30), C 3.70 (±6.23), diff (=8.07 (-11.58 to -4.56), p<0.001	**ΔB to (T_3)** **<u>Veg (≥200g/d)</u>** (I =ns, C=ns) **<u>Fruit (≥2 portions/d)</u>** (I =ns, C=ns) **<u>Soft drinks</u>** (I =ns, C=ns) **<u>Other:</u>** BF, snacks	**ΔB to (T_3)** **<u>PA (≥60min/d)</u>** (I =ns, C=**) **<u>Other:</u>** sports club member, enjoying PA	**ΔB to (T_3)** **<u>PI (mins/d on TV or comp)</u>** (I =* (+14.9%), C=ns)	–	–	**ΔB to (T_3)** **<u>AF (VO_{2max})</u>** I 3.61 (±8.30), C -0.63 (±6.97), diff 3.42 (-0.22 to -7.06), p=0.065	–	**1y FU** BMI z: Y WC: Y HE: N PA: N SB: N AF: N
Bartelink et al. 2017[65]	Non-randomised experimental, RealFit	Overall SE: 31-item CBSA (range total score 35-140) Food craving: 21-item G-FCQ-T (range total score 21-126)	–	–	–	–	**ΔB to (T_3)** **<u>SE (CBSA total score)</u>** I -12.21, p<0.001; C –7.04, p=0.009; diff B	–	**ΔB to (T_3)** **<u>G-FCQ-T</u>** I -7.22±17.18, p<0.001; C -1.67±12.77, p=?; diff B=0.99 (-5.21 – 7.20), p=0.751	–	SE: G-FCQ-T: N

							= 4.55; 95% CI: −0.90 to 10.01, p=0.101 **Other:** CBSA subscales - AA, PhysA, GSW				
Berkowitz et al. 2013[45]	RCT, NS	Wt & Ht: measured	**ΔBMI z 0-6m** Gp LMP -0.11±0.02, Sg LMP -0.09±0.02, diff 0.02 (-0.03,0.07) p=ns **ΔBMI z 0-12m** Gp LMP -0.12±0.03, Sg LMP -0.12±0.03, diff 0.00 (-0.08,0.07) p=0.91	–	–	–	–	–	–	BMI z: N WC: N	BMI z: N WC: N

			<u>ΔWC 0-6m</u> Gp LMP -3.57±0.77, Sg LMP -2.31±0.78, diff 1.26 (-0.91,3.43) p=ns **<u>ΔWC 0-12m</u>** Gp LMP -2.87±1.01, Sg LMP -3.41±1.05, diff 0.54 (-3.42,2.34) p=0.71 Ns differences between gp LMP and sg LMP in %change BMI, BMI, BMI z score or WC at 12m within urban African-Americans or rural Caucasians								
Chamay-Weber et al. 2016[53]	Non-randomised	Ht + Wt measured BMI z (WHO ref)	**<u>ΔBMI z BL-FU</u>** all: -0.24 ± 0.5 IG:	–	–	–	–	–	–	–	BMI z ≥ 5m Y

	experimental,, NS		(12 – 14 y, n = 42) -0.25 ± 3.9 (14 – 18 y, n = 32) -0.23 ± 0.67								
Daly et al. 2016[62]	RCT, NS	Wt & ht: measured Mindful Awareness: Mindful Attention Awareness Scale	**BMI at T_{0w} to T_{6w}** I: decr. 1.1kg/m^2 (p=0.019) C: incr. 0.72kg/m^2 (p=0.021) Btwn gp change: P<0.001 **BMI T_{0w} to T_{10w}** I: decr. 1.4kg/m^2 (p=0.019)	–	–	–	–	–	Mindfulness Awareness (ns)	Wt: Y	Wt: Y
Davis et al. 2011[60]	RCT, NS	Wt, Ht & WC: measured Total fat mass & total lean mass: DEXA	**Wt, BMI, BMI z at T_{0w} to T_{16w}:** ns group effects **WC at T_{0w} to T_{16w}:** sig across-grp effect (p<0.001) I (CT only): decr. 3%		–	–	–	–	**SAT** I (CT only): decr. 10% C: incr. 8% *Diff, p* = 0.01 **VAT** I (CT only): decr. 10%	Wt, BMI, BMI z: N WC: Y Total fat mass: N	NA

			C: incr. 3% *Diff, p*=0.03 **<u>Total fat mass at T_{0w} to T_{16w}:</u>** ns group effects						C: incr. 6% *Diff, p*= 0.05 HOMA-IR Insulin VO_2 max Leg press Bench press		
Davis et al. 2012[63]	RCT, NS	Wt & ht: measured Diet: 3d diet records Biochem & Fitness: Measured Total fat mass & lean tissue mass: aid displacement plethysmogprahy (BodPod™)	**<u>T_{4m} to T_{12m}: NR</u>**	**<u>T_{4m} to T_{12m}:</u>** <u>ns</u>	–	–	–	–	Leg press Bench press Lipids Insulin Insulin sensitivity Acute insulin response Disposition Index Glucose effectiveness	HE: unclear as don't give % macronutrient distribution for each group	–

DeBar et al. 2012[66]	RCT, NS	Ht & wt: measured HE: 3 x 24hr recalls, survey questions on BF, family meals, fast food, SSB's PA: 24hr recall, mins/d SB: hrs/wk ST (survey) SE: Rosenberg Self-Esteem (RSE) Scale QoL: PedsQL Other/Psych: QEWP-A, PHQ-A, SATAQ-3	**Mean ΔBMI z 0-6m-12m** I: 2.00±0.34 – 1.88±0.41 – 1.85±0.46 C: 2.00±0.33 – 1.94±0.38 - 1.92±0.39 Group x time: 8.77, p=0.012 Cohen's d = -0.18	**Total kcal/d** **0-6m** I: 1601.36±452.73 – 1361.32±412.14 C: 1593.95±502.92 – 1425.00±458.72 Group x time: 0.97, p=0.325 **%calories fat** **0-6m** I: 32.53 – 32.54 C: 32.78 – 33.77 Group x time: 0.59, p=0.441 **SSB (times/wk)** **0-6m-12m**	**Mins/day** **0-6m** I: 55.35±51.81 – 64.77±67.60 C: 49.68±39.47 – 56.39±53.12 Group x time: 0.14, p=0.705 **Other:** total MET/d	**Hours/week** **0-6m-12m** I: 30.54±14.91 – 25.44±12.84 – 26.35±14.04 C: 32.23±15.44 – 28.30±14.34 – 26.31±14.23 Group x time: 2.14, p=0.343	**RSE** **0-6m-12m** I: 2.39±0.26 – 2.40±0.25 - 2.45±0.26 C: 2.41±0.27 – 2.39±0.25 – 2.40±0.24 Group x time: 2.58, p=0.275	**PedsQL** **0-6m-12m** I: 71.12±16.22 – 77.693±13.54 – 77.80±13.79 C: 68.81±16.55 – 73.90±14.64 – 71.67±16.39 Group x time: 1.73, p=0.189	Metabolic: TC, HDL, LDL, TG's, fasting glucose % with disordered eating (QEWP-A) % with mood disorder (PHQ-A) Appearance attitudes (SATAQ-3) Body satisfaction (BS)	PA: N Total kcal/d: N %calories fat: N	Metabolic: N Appearance attitudes: Y QoL: N % with disordered eating: N % with mood disorder: N BS: Y SSB: N Family meals: Y Fast-food: Y

				I: 1.10±1.43 – 0.92±0.89 – 0.97±1.18 C: 1.48±1.68 – 1.09±1.16 – 1.22±1.57 Group x time: 2.76, p=0.252 **Other:** BF, family meals, fast-food							
Delgado-Rico et al. 2012[72]	Case series (pre- post), BRAINOBE study subsample	Wt Ht measured	**BMI** Pre Mean: 29.36 ± 4.50 kg/m^2 Range: 22.06 – 38.21 kg/m^2 Post Mean: 27.31 ± 4.41 kg/m^2 Range: 20.28 – 37.44 kg/m^2 P<0.01	–	–	–	–	–	Biochemistry (insulin, basal glucose, triglycerides, cholesterol) + Impulsivity + Cognitive performance (IOWA gambling task and letter number sequencing	BMI: Y	N/A

									and Stroop test)		
Foster et al. 2014[57]	Case series (pre- post), JOIN for ME	Wt & Ht: measured HRQoL: PedsQL	**<u>ΔBMI z</u>** **0-6m-18m** 2.22±0.07 – 2.18±0.09 – 2.09 ±0.09 **Δ0-18m** -0.13±0.05, p=0.02 **Δ6-18m** -0.09±0.05, p=0.09 **<u>Weight status</u>** **0-6m-18m** Obese: 91.6% - 81.5% - 81.5% Extremely obese: 46.5% - 38.5% - 35.2% **<u>Other:</u>** % over BMI	–	–	–	–	**<u>HRQoL (total)</u>** **0-6m-18m** 73.6±1.89 – 78.8±1.71 – 82.1 ±1.59 **Δ0-18m** 8.5±1.75, p<0.001 **Δ6-18m** 3.2±1.51, p<0.04 **<u>Other:</u>** HRQoL	–	–	BMI z: Y % over BMI: N HRQoL (total): Y HRQoL (PhysHS): Y HRQoL (PSHS): Y

								(PhysHS), HRQoL (PSHS)			
Hofsteenge et al. 2013[47]	RCT, Go4it	Ht + Wt measured BMI z (Dutch reference) HRQoL: PedsQL (adolescent-reported)	**BMI z** between-group diff 6m: -0.10 (-0.23, 0.04) 18m: -0.16 (-0.30, -0.02)	–	–	–	–	**HRQoL (total)** BL I: 75.1 ±12.2 C: 75.7 ± 10.7 FU 6m I: 78.5 ± 11.2 C: 77.9 ± 10.0 Diff: -0.1 (-3.5, 3.3)	Also report BL + 6m + 18m HRQoL dimensions (5), BED dimensions (3), CHQ scales (2)	–	BMI z: 6m N 18m Y HRQoL 6m N 18m N

								FU 18m I: 81.7 ± 12.0 C: 77.2 ± 10.5 Diff: 3.8 (-0.2, 7.7)			
Hofsteenge et al. 2014[46]	RCT, Go4it	Ht + Wt measured BMI z (Dutch ref)	**BMI z** BL I: 2.93 ±0.41 C: 2.93 ± 0.51 FU 6m I: 2.81 ± 0.50 C: 2.95 ± 0.55 Diff: -0.10 (-0.23, 0.04) ns FU 18m	–	–	–	–	–	Also report BL + 6 m + 18 m Wt, Wtz, Ht, Htz, BMI, waist, trunk fat, total fat, muscle mass, fasting glucose, glucose 120 min, fasting insulin, insulin 30 min, insulin 120 min, HOMA-IR, SBP,	–	BMI z: 6m N 18m Y

			I: 2.86 ± 0.7 (n = 36) C: 2.96 ± 0.6 (n = 32) Diff: -0.16 (-0.30, -0.02) *P*< 0.05						DBP, HDL, Triglycerides		
Jelalian et al. 2011[58]	RCT, NS	Wt & ht: measured (trained)	**<u>ΔBMI 0-4m-12m-24m</u>** **ALL (pre-post)** **P<0.001** 31.45±3.53 – 29.66±3.73 – 30.20±4.10 – 0-4m, dec.p<0.01 4-12m, inc.p<0.01 0-12m, dec. p<0.01 **<u>ΔBMI 0-4m-12m</u>** **BWC+EXER** 31.28±3.30 – 29.73±3.52 – 30.36±4.04 **Time: p<0.01**	–	–	–	–	–	Peer rejection Social anxiety Self-perception	BMI: Y – time (0-12m), N-group x time	

			BWC+PEAT 31.61±3.77 – 29.60±3.97 – 30.04±4.19 Time: p<0.01 No group x time effect								
Lloyd-Richardson et al. 2012[51]		Wt & ht: measured (trained) PA participation confidence: 8-item PSEQ Self-efficacy: 20-item WEL Self-perception: 45-item SPPA	**<u>ΔBMI z 0-4m-12m-24m</u>** **ALL (pre-post)** **P<0.001** 2.05±0.30 – 1.86±0.39 - 1.83±0.45 – 1.82±0.48 0-4m, dec p<0.001 0-12m, dec p<0.001 0-24m, dec p<0.001 **BWC+EXER** 2.05±0.27 – 1.86±0.35 -	–	–	–	–	–	Self-concept Self-efficacy	BMI z: Y - time, N – group x time	

			1.85±0.43 – 1.88±0.45 **BWC+PEAT** 2.02±0.34 – 1.86±0.44 – 1.78±0.49 – 1.77±0.52 Group x time p>0.05 **Other:** wt, ht, BMI, %ow								
Sato et al. 2011[52]		Wt & ht: measured (trained) HE: Diet records PA: PA records (mins/d)	**ΔBMI 0-4m** ALL: 31.22±3.21 – 29.62±352, p<0.01 (no group effect)	–	–	–	–	–	–	BMI: N	
Jelalian et al. 2015[48]		Wt & ht: measured	**ΔBMI 0-4m** **BWC** 31.17±3.01 – 29.89±3.41, p=0.01 **BWC + EP**	–	–	–	–	–	Parental modelling Parent-teen communication	BMI: Y – time (both grps), Y – group x time (favouring BWC)	

			33.25±4.01 – 32.82±4.06, p=0.04 **ANCOVA: BWC achieved greater dec than BWC + EP** $Mean_{BWC}$=30.81 vs $Mean_{BWC + EP}$=31.78, F (1,46) =3.65, p=0.06 **Other:** %ow							%ow: Y – group x time (favouring BWC)	
Jensen et al. 2016[43]	Case series (pre- post), NS	Wt, Ht, measured at Time 1: baseline Time 2: 12 wks Time 3: 24 wks Time 4: 1 yr	**Mean (SE) at timepoints BMI Z** T1: 1.85 (0.11) * T2: 1.74 (0.13) * T3: 1.78 (0.13) T4: 1.78 (0.12) *p = 0.04	**NR**	**NR**	**NR**	**NR**	**NR**	Diet & PA monitoring Client satisfaction	Wt: Y	Wt: N
Kulik et al. 2015[49]	RCT, NS	Ht + Wt measured BMI, %overweight	**Wt** 16 w S: -6.47 ± 7.1 E: -6.40 ± 8.31	total energy (median, IQR) BL E: 1199, 605	**MVPA** (min/d) BL	**SLPA** (min/d) BL	–	–	friend -support for exercise - encouragement for HE	–	–

			ns between groups diff: 0.07 (-5.2, 5.3) ns treatment effect **%overweight** BL E: 64.84 ± 20.0 S: 74.67 ± 28.1 16w E: 58.59 ± 21.1 S: 68.10 ± 30.4 Δ%ow E: -6.25 ± 6.6 S: -6.57 ± 5.4 diff: 0.32 (-3.8, 4.4) *P* = 0.88	S: 1111, 552 16 w E: 1151, 586 S: 883, 348 P = 0.78 % energy from total fat BL E: 30.2 ± 5.7 S: 35.7 ± 6.4 16w E: 32.3 ± 6.0 S: 36.2 ± 3.8 diff: -1.38 (-4.7, 2.0) *P* = 0.41	E: 45.4 ± 33.7 S: 39.7 ± 11.6 16w E: 33.7 ± 17.3 S: 41.8 ± 13.8 diff: -10.6 (-21.5, 0.48) *P* = 0.06	E: 788.7 ± 41.7 S: 784.9 ± 13.7 16w E: 806.3 ± 17.3 S: 798.2 ± 13.8 diff: 7.0(-5.3, 19.1) *P* = 0.25			- discouragement for HE		
Kulik et al. 2016[50]	Non-randomised experimental, NS	Ht + Wt measured	**Wt** ΔBL – 6m -7.9 ± 13.4 lbs ΔBL – 12m	–	–	–	–	–	also, report family + friend -support for exercise	(End 6m I) Wt: Y	6m FU Wt: Y

			-6.0 ± 17.4 lbs						- encouragement for HE - discouragement for HE		
Shrewsbury, et al. 2011[56] Nguyen et al. 2012[55] Nguyen et al. 2013[54]	Case series (Pre- post), Loozit	**2mo OC** Wt Ht WC measured PA & SB: CLASS Diet: FFQ 15 items QoL: MHI-5 (lower score better) Self-perception profile 45 item (8 domains and global self-worth (1 low; 4 high)	**Mean (95% CI)** **ΔB –2mo** **ΔBMI z** -0.05 (-0.06, -0.03), P<0.0001 **ΔWC** -2.34 (-3.87, -0.81) P=0.003 **ΔB –12mo** **ΔBMI z** -0.09 (-0.12 to 0.06), P<0.05 **ΔWC** -1.1 (-2.7 to 0.5) ns **ΔB –2yr**	**ΔB –2mo** **Δ behaviour/intake** Reduced (%): No change (%): Increased (%) **Veg** (≥ 4 serves/day) 15:41:44 P =0.040 **Fruit** (≥ 2 serves/day) 18:54:28 P <0.007 Other: extra foods, drinks, dietary behaviour	**ΔB –2mo** **ΔMean (SD) Total hours PA** 1.2 (11.1) P=0.216 **ΔB –12mo** **NR** **ΔB –2yr** **NR** Light intensity PA **ΔB –2mo**	**Screen time (h/wk)** **ΔMean (SD)** **ΔB –2mo** **-2.5 (11) P=0.04** **ΔB –12mo** **ΔMean (95% CI)** -0.8 (-1.0 to -0.7), P=0.045 **ΔB –2yr** **NR** **Total leisure**		**MHI-5** **ΔB –2mo** **ΔMean (SD)** -1.0 (3.5) P=0.002 **ΔB –12mo** **ΔMean (95%CI) MHI-5** 0.97 (-1.71 to	BP Total Chol LDL-C HDL-C TG Gluc Insulin ALT	**2mo** Wt: Y WC: Y HE: Y PA: N SB: Y QoL:Y SE: Y **12mo** Wt: Y WC: N SB: Y QoL: Y SE: Y **2yr**	–

			ΔBMI z -0.13 (-0.20 to -0.06), P<0.05 **ΔWC** 0.2 (-1.7 to 2.1), ns Other: Wt, BMI, WHtR	Selected different food behaviours reported in text at 12m and 2y	**ΔMean (SD)** **0.5 (3.7) P=0.133** **12mo NR** **ΔB –2yr** **ΔMean (95% CI)** **-0.80 (-0.96 to –0.64)** (P NR) **Other:** Selected different physical activity behaviours reported in table at 2m, and in text at 12m and 2y	**activity (h/wk)** **ΔB –2mo** **ΔMean (SD)** **-5.7 (17.3) P=0.004** **ΔB –12mo** **NR** **ΔB –2yr** **ΔMean (95% CI)** **1.2 (1.0 to 1.4)** (P NR) **Other:** Selected different sedentary behaviours reported in table at 2m, and in text		-0.22), P<0.05 **ΔB – 2yr** **NR** Global self-worth **ΔB – 2mo** **ΔMean (SD)** 0.17 (0.48) P<0.0001 **ΔB – 12mo** **ΔMean (95% CI)** 0.21 (0.10 to		Wt: Y WC: N QOL: Y SE: Y	

						at 12m and 2y		0.32) P<0.05 **ΔB – 2yr** 0.20 (0.09 to 0.32) (P NR)			
Pretlow et al. 2015[61]	Case series (pre- post), NS	Wt Ht measured %overBMI Food behaviour SE (5 point Likert scale)	**Mean wt (kg)** Males T1: 113.7 T4: 108.7 Females T1: 92.1 T4: 91.3 **%overBMI:** Males T1: 95.9 T4: 82.6 Females: T1: 70.9	**NR**	**NR**	**NR**	**Mean (SE)** T1: 2.78 (0.19) T4: 3.59 (0.17) P<0.01	**NR**	Food behaviour Addictive behaviour Predictors of weight change	Wt: Y SE: Y	

			T4: 67.1 P<0.01 Decrease: 7.14 (0.051/day for 140 d, P<0.01)								
Riiser, et al. 2014[59]	Non-randomised controlled trial, The Young & Active Controlled Trial	PA: 20mSRT HRQoL: Norwegian version of KISDCREEN Motivation Body image Wt & Ht	**Δ <u>BMI at BL & 12 wk</u>** Mean diff (95% CI) I: -0.10 (-0.31 to 0.10), P=0.32 C: 0.29 (0.06 to 0.53) P=0.02	**NR**	**Δ <u>20mSRT (km/hr)BL to 12 wk</u>** Mean diff (95% CI) I: 0.14 (0.03 to 0.25), P = 0.01 C: 0.00 (-0.08 to 0.08) P = 1.0	**NR**	**NR**	**Δ KIDSCREEN 10** Mean diff (95% CI) I: 4.59 (2.08 to 7.10), P <0.01 C: -0.63 (-4.05 to 2.80), P = 0.71	Body image Relative autonomy index	Wt: Y QoL Y PA: Y	NR

Ruotsalainen et al. 2015[73]	RCT, NS	Wt & Ht: measured PA: PA monitor SB & PA: self-reported PA and screen time questionnaire	**Δ <u>BMI at BL & 12 wk</u>** Mean diff (SD) I1: -0.6 (0.9) I2: -0.1 (0.9) C: -0.0 (0.9) P ns **Differences between groups** NR	**NR**	**Δ moderate PA BL to 12 weeks** (min,day) Mean diff (SD) I1: 0.7 (18.0) I2: 2.8 (20.1) C: 0.7 (14.6) P ns Also reported light PA, vigorous PA, vigorous plus PA **Differences between groups**	**Δ sedentary time or very light PA (min/day)** Mean diff (SD) I1: −48.7 (76.9) I2: −94.5 (112.7) C: −58.7 (60.2) P ns	**NR**	**NR**	–	Wt: N PA: N	**NR**

					Small decrease in SB time in Fb+Act group cf control p=0.02						
Straker et al. 2014; Smith et al. 2015; Howie et al. 2015; Howie et al. 2016[67-70]	Non-randomised experimental trial, CAFAP	Wt and Ht: measured PA & SB: measured 7d (Actical monitors), activity diary Diet: 3d diet records (1d weekend), eating behaviour questionnaire	**BMI z** [70] *ns* change during waitlist (baseline to T_{0w}) or intervention periods (T_{0w} to T_{8w}) **T_{0w} to T_{12w} to T_{26w} to T_{52w}** 2.11±0.02 to 2.05±0.02* to 2.03±0.02* to 2.03±0.04 ***p<0.05 from T_{0w}** No sign. differences for rate of change	**Baseline to T_{0w} to T_{8w} to T_{12w} to T_{26w} to T_{52w}** **Fruit (serves/d)** 0.8±0.1 to 0.6±0.1) to 1.1±0.12* to 1.1±0.1* to 0.9±0.1* to 1.0±0.2* ***p<0.05 from T_{0w}** **Veg (serves/d)** 1.3±0.2 to 1.3±0.1 to 1.3±0.2, to 1.4±0.2 to	**Light activity (mins/d)** Baseline 199.7±2.7 to T_{0w} 186.4±3.5, p<0.05 **Moderate activity (mins/d)** ns changes **Vigorous activity (mins/day**	**Sedentary time (mins/d)** Baseline 532.3±3.3 to T_{0w} 548.2±3.7, p<0.05 **Δactivity (mins/d) baseline to T_{0w} (waitlist period)** SB: 5.3 (1.8, 8.8), p=ns **Δactivity (mins/d)**			- Fitness[68] - Food behaviours[69] Reported at T_{8w}, T_{52w}: Patterns of PA (week-end vs school days vs afterschool	Wt: N HE: Y (fruit, junk food) PA: Y (moderate) SB: Y	Wt: Y (T_{0w} to T_{12w}, T_{0w} to T_{26w}) HE: Y (veg T_{0w} to T_{26w}) PA: N

			<u>Baseline to T_{0w} to T_{8w} to T_{12w} to T_{26w} to T_{52w}</u> **BMI z [67]:** 2.14±0.01 to 2.12±0.01 to 2.11±0.01 to 2.09±0.02 to 2.07±0.02* to 2.04±0.04* to *T_{0w} **<u>WC:</u>** 102.7±0.7 to 101.1±0.6 to 100.6±0.6 to 101.2±0.7 to 99.8±1.7 to 102.5±1.0 to *T_{0w}	1.7±0.2* to 1.4±0.2 *T_{0w} **Junk food (serves/d)** 4.6±0.3 to 4.6±0.4) to 3.2±0.3* to 3.4±0.3* to 3.3±0.4* to 4.3±0.5, *T_{0w} **ΔHE baseline to T_{0w} (waitlist period)** Fruit: 0.94 (0.86, 1.03), p=ns Veg: 1.00 (0.91, 1.10), p=ns	ns changes **Δactivity (mins/d) baseline to T_{0w} (waitlist period)** Light: -4.4 (-7.6, -1.2), p=ns Moderate: -0.9 (-2.1, 0.3), p=ns Vigorous: -0.1 (-0.3, 0.1), p=ns **Δactivity (mins/d) T_{0w} to T_{8w} (intervention period)**	**T_{0w} to T_{8w} (intervention period)** SB: -5.1 (-11.0, 0.8), **p <0.05** **Δactivity (mins/d) T_{8w} to T_{52w} (maintenance period)** SB: 0.7 (-0.8, 2.2), p=ns			- Duration and intensity (Howie et al 2015b)		

				Junk food: 1.00 (0.95, 1.06), p=ns * *monthly incidence rate ratio, 95%CI* **ΔHE T_{0w} to T_{8w} (intervention period)** Fruit: 1.33 (1.11, 1.60), **p<0.05** Veg: 1.00 (0.85, 1.18), p=ns Junk food: 0.83 (0.74, 0.94), **p<0.05** * *monthly incidence rate ratio, 95%CI* **ΔHE T_{8w} to T_{12m} (maintenance period)** Fruit: 0.99 (0.97, 1.02), p=ns	Light: 3.2 (-2.5, 8.9), p=ns Moderate: 1.8 (-0.04, 3.6), **p <0.05** Vigorous: 0.1 (-0.1, 0.4), p=ns **Δactivity (mins/d) T_{8w} to T_{52w} (maintenance period)** Light: -0.6 (-2.0, 0.8), p=ns Moderate: -0.1 (-0.5, 0.4), p=ns Vigorous: 0.04 (-					

				Veg: 1.01 (0.98, 1.03), p=ns Junk food: 1.02 (1.00, 1.05), p=ns ** monthly incidence rate ratio, 95%CI*	0.04, 0.1), p=ns						
Vos et al. 2012[44]	RCT	Wt Ht: measured HRQoL: DISABKIDS parent and adolescent-reported	**BMI z** mean ± SD I: BL: 4.2 ± 0.7 3 m FU: 4.0 ± 0.9 (sig diff to BL) 12m FU: 3.8 ± 1.1 (sig diff to BL) C: BL: 4.3 ± 0.7 3 m FU: 4.2 ± 0.7 (ns) 12 m FU: 4.2 ± 0.7 (ns)	–	–	–	–	**HRQoL (total)** mean (95% CI) I BL: 80.2 (78.4 – 87.2) 3 m FU: 84.1 (80.8 – 87.5) 12 m FU: 86.8	also, report QoL dimensions (×5; physical, independence, emotion, social exclusion, social inclusion) and parent reported HRQoL	BMI: Y HRQoL: N	BMI: Y HRQoL: Y (9 m post-program)

								(83.3 – 90.3) C BL: 82.8 (78.4 – 87.2) 3 m FU: 83.9 (79.3 – 88.6) 12 m FU: 85.6 (81.2 – 89.9)			
Sallinen et al. 2013[41]	Case series (pre- post), MPOWER	Wt Ht: measured	**BMI** ΔBL – 3m -1.0 ± 1.4 kg/m^2 50% had decrease ≥1.0 kg/m^2	–	–	–	–	–	sleep associations with reduction in BMI	BMI: Y	–

Woolford et al. 2011[42]			**BMI** ΔBL – 6 m (post-program) Completers (*n* = 48): -2.3 kg/m^2 DNC: -0.7 kg/m^2	–	–	–	–	–	body fat: -5.1%	BMI: Y	–

Abbreviations: 20mSRT, 20 metre shuttle run test; AA, athletic achievement; AF, Aerobic Fitness; AGHE: Australian Guide to Healthy Eating; ALP, Adolescent Lifestyle Profile; B, beta; B, baseline;; BES, Body Esteem Scale; BF, breakfast; BL, baseline BWC, behavioural weight control; C, control; CAFAP, Curtin University's Activity, Food and Attitudes Program; CBSA, Self-Perception Profile for Adolescents (Competentie Belevingsschaal voor Adolescenten); CHQ, Child Health Questionnaire; Comp, computer; Decr, decrease; DEXA, dual-energy X-ray absorptiometry; DNC, did not complete; FFQ, Food Frequency Questionnaire; FU, Follow Up; G-FCQ-T, General Food Craving Questionnaire Trait; GSW, Global self-worth; HDL, high-density lipoprotein; HE, Healthy Eating; HOMA-IR, homeostasis model assessment of insulin resistance; HL, healthy lifestyle; I, Intervention; Incr, increase; IWQOL, Impact of Weight on Quality of Life; LDL, low-density lipoprotein; m, months; M, male; MET, metabolic equivalent; MD, mean difference; m/d: minutes per day; MHI-5, Mental Health Inventory; MVPA moderate/vigorous physical activity; N, No; NA, not available; NR, Not Reported; NS, not specified; ns, not significant; OC, outcomes; P, participants; PAQ-A, Physical Activity Questionnaire for Adolescents; PedsQL, Pediatric Quality of Life Inventory; PEAT, Peer-based Adventure Therapy; PHQ-A, Patient Health Questionnaire for Adolescents; PhysA, physical appearance; PHS, Physical health score; PSHS, Psychosocial health score; Psych, Psychology; PA, Physical Activity; PI, Physical Inactivity; Q, Questionnaire; QEWP-A, Questionnaire of Eating and Weight Patterns-Adolescent Version; QoL, Quality of Life; RCT, Randomised Controlled Trial; SAT, subcutaneous abdominal adipose tissue; SB, Sedentary Behaviour; SE, self-esteem; sig: significant; SLPA sedentary/light physical activity; ST, screen time; svs: serves; TV, television; V, vegetables; VAT, visceral adipose tissue; WC, waist circumference (cm); wks, weeks; Wt, Weight; WHtR, waist to height ratio; Y, Ye. ; %ile, percentile; % over BMI, (BMI – BMI at 50th percentile for age and gender)/BMI at 50th percentile·× 100)

Appendix Six

The list of developing countries shown below is adhered to by the ISI, effective from 1 January until 31 December 2017 (World Bank Country Classifications; https://www.isi-web.org/index.php/resources/developing-countries accessed 6/3/2017

Afghanistan
Albania
Algeria
Angola
Argentina
Armenia
Azerbaijan
Bangladesh
Belarus
Belize
Benin
Bhutan
Bolivia
Bosnia and Herzegovina
Botswana
Brazil
Bulgaria
Burkina Faso
Burundi
Cabo Verde
Cambodia
Cameroon
Central African Republic
Chad
China
Colombia
Comoros
Congo, Dem. Rep
Congo, Rep.
Costa Rica
Côte d'Ivoire
Cuba
Djibouti
Dominica
Dominican Republic
Ecuador
Egypt, Arab Rep.
El Salvador
Eritrea
Ethiopia
Fiji
Gabon
Gambia, The
Georgia
Ghana
Grenada
Guatemala
Guinea
Guinea-Bissau
Guyana
Haiti
Honduras
India
Indonesia
Iran, Islamic Rep.
Iraq
Jamaica
Jordan
Kazakhstan
Kenya
Kiribati
Korea, Dem Rep.
Kosovo
Kyrgyz Republic
Lao PDR
Lebanon
Lesotho
Liberia
Libya
Macedonia, FYR
Madagascar
Malawi
Malaysia
Maldives
Mali
Marshall Islands
Mauritania
Mauritius
Mayotte
Mexico
Micronesia, Fed. Sts.
Moldova
Mongolia
Montenegro
Morocco
Mozambique
Myanmar
Namibia
Nepal
Nicaragua
Niger
Nigeria
Pakistan
Palau
Panama
Papua New Guinea
Paraguay
Peru
Philippines
Romania
Russian Federation
Rwanda
Samoa
São Tomé and Principe
Senegal
Serbia
Sierra Leone
Solomon Islands
Somalia
South Africa
South Sudan
Sri Lanka
St. Lucia
St. Vincent and the Grenadines
Sudan
Suriname
Swaziland
Syrian Arab Republic
Tajikistan
Tanzania
Thailand
Timor-Leste
Togo
Tonga
Tunisia
Turkey
Turkmenistan
Tuvalu
Uganda
Ukraine
Uzbekistan
Vanuatu
Venezuela, Bolivarian Rep. of
Vietnam
Palestine, State of
Yemen, Rep.
Zambia
Zimbabwe