Supplementary Online Content

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This supplementary material has been provided by the authors to give readers additional information about their work.

eTable 1. Search strategy used on the Ovid platform with the Medline database

Search terms contained reference to all three criteria: overweight/obesity, dietary treatment interventions, and depression/anxiety. Medical Subject Headings (MeSH) are bolded, and key word searches are italicised.

1 exp **Obesity/**	21 *depress*.tw.*
2 exp **Overweight/**	22 **depression/**
3 *obes*.tw.*	23 **Anxiety/**
4 *overweight.tw.*	24 *anxi*.tw.*
5 1 or 2 or 3 or 4	25 *selfesteem.tw.*
6 **weight loss/**	26 **"feeding and eating disorders"/ or anorexia nervosa/ or binge eating disorder/ or bulimia nervosa/ or "feeding and eating disorders of childhood"/**
7 exp **diet therapy/**	
8 exp **bariatrics/**	
9 exp **exercise/**	27 19 or 20 or 21 or 22 or 23 or 24 or 25 or 26
10 **anti-obesity agents/ or appetite depressants/**	28 **feeding behavior/**
11 *(diet* adj2 therap*).tw.*	29 *(bulimi* adj4 symptom*).tw.*
12 *bariatric*.tw.*	30 *(disorder* adj4 eat*).tw.*
13 *(low adj4 (energy or calor*) adj4 diet).tw.*	31 *(emotion* adj4 eat*).tw.*
14 *((pharma* or diet* or obes* or lifestyle or behavio*) adj4 (interven* or treat* or therap*)).tw.*	32 *(external adj4 eat*).tw.*
15 *((calori* or diet*) adj4 (reduc* or restrict*)).tw.*	33 *(diet* adj4 restrain*).tw.*
16 *(weight adj4 (manag* or los*)).tw.*	34 *(binge adj4 eat*).tw.*
17 *exercise.mp. or physical activity.tw*.	35 *extreme weight loss.tw.*
18 6 or 7 or 8 or 9 or 10 or 11 or 12 or 13 or 14 or 15 or 16 or 17	36 28 or 29 or 30 or 31 or 32 or 33 or 34 or 35
19 **Body Image/**	37 5 and 18 and 27
20 *(body adj4 (accept* or dissatisf* or image or satisf* or appreciat*)).tw.*	38 limit 37 to (english language and humans and "all child (0 to 18)

eTable 2. Characteristics of included studies

Author, year; program name (if applicable); country; study design; setting; quality rating	**Baseline characteristics of sample – # participants (n), %F; age (y), range and mean (SD); BMI related inclusion criteria, mean (SD) BMI z-score/BMI**	**Intervention duration and intensity; duration of follow-up; retention (R)**	**Intervention design: intervention groups (IG)/control (CG); nutrition; physical activity (PA); behavioural components** **Personnel (P) delivering the intervention**	**Change in weight-related outcomes, mean change (SE)**	**Depression (↓, ↑, –)**	**Anxiety (↓, ↑, –)**
Ampolos et al. 2014[1]; USA; setting NR; RCT; neutral	n=50, 62% F 8-12y, 10.4 (1.35)y BMI ≥ 85th percentile, BMI 24.61 (2.43) kg/m^2 Groups combined for all analysis	Intervention duration and intensity NR Follow-up 6 mo post-intervention **R:** 86%	**IG:** TLD; PA education; behaviour change including self-monitoring, stimulus control, goal-setting, and parenting skills **Wait-list CG:** delayed treatment **P:** NR	**BMI** Pre-post: -0.69 (0.30) kg/m^2* Pre-FU: -0.11 (0.33) kg/m^2	–	
Boutelle et al. 2018[2]; Preventing Emotional Eating Routines (PEER); USA; pre-post; tertiary outpatient; neutral	n=30, 87% F 13-17y, 14.6 (1.2)y BMI 85-99th percentile BMI z-score 2.27 (0.41)	4 mo 16 weekly sessions (60 or 90 min), adolescent alone, parent alone, adolescent and parent combined Follow-up 7 mo from baseline	**IG:** four treatment components - DBT to target emotion regulation, FBT for weight loss (nutrition and PA education; stimulus control, planning ahead, and relapse prevention), behavioural coaching to encourage adherence to DBT and FBT skills, and Emotion-Focused parent training to support the adolescent **P:** Graduate students, post-doc researchers	**BMI z-score** Pre-post: -0.06 (0.06) Pre-FU: -0.09 (0.06) **BMI** Pre-post: -0.60 (0.81) kg/m^2 Pre-FU: -1.0 (0.78) kg/m^2	↓	

		R: 70% at 4mo; follow-up NR				
Brehm et al. 2003[3]; USA; community; pre-post; neutral	n=92, 100% F 8-15y, 11.09 (1.65)y 120-130% above ideal body weight BMI 29.34 (4.73) kg/m^2	6 mo 12x90 min sessions Follow-up 12 mo from baseline **R:** 62%	**IG:** Multidisciplinary weight-management program, group nutritional education; exercise techniques for stress management; behaviour modification including goal setting, self-reward, buddy system, body image, self-esteem, anxiety **P:** Multidisciplinary team	**BMI** Pre-post: 0.31 (0.49) kg/m^2 Pre-FU: 1.01 (0.50) kg/m^2		↓
Brennan et al. 2012[4]; CHOOSE Health Program; Australia; community; RCT; positive	n=63 (IG 42, CG 21), 54% F 11-19y, 14.3 (1.9)y Overweight/obesity BMI z-score IG 2.08 (0.37), CG 2.08 (0.40)	16 wk 10x60 min weekly individual face-to-face sessions + one phone call, then 2x60 minute sessions biweekly 6 mo maintenance phase: 2x60 min visits + 7x15 min phone calls Nil follow-up **R:** IG 48%, CG 67%	**IG:** nutrition and PA education; CBT to assist adolescent and family to manage the environmental, social and psychological barriers to change, goal setting, self-monitoring, eating behaviours, problem solving **Wait-list CG:** offered treatment after 6 mo while IG in the maintenance phase **P:** Psychologist	**BMI z-score** IG, Pre-post: -0.09 (0.05) Pre-FU: -0.10 (0.053) CG, pre-post: 0.01 (0.07) Nil FU	–	–
Croker et al. 2012[5]; UK; primary care; RCT; positive	n=72 (IG 37, CG 35), 69% F 8–12y, 10.3 (1.6)y Overweight/obesity defined by IOTF BMI z-score 3.14 (0.72)	6 mo 15 sessions: 10 weekly, 3 biweekly, 2 monthly Follow-up 10 mo from baseline	**IG:** FBT including whole family lifestyle change; nutrition education based on the TLD and Eatwell plate; PA education; behavioural programme including self-monitoring, goal setting, and stimulus control	**BMI z-score** IG, pre-post: -0.11 (0.028)* CG, pre-post: -0.10 (0.027)* **BMI** IG, pre-post:	–	

		R: IG 59%, CG 97% at 6 mo and 10 mo	**Waitlist-CG:** completed treatment following 6 mo on wait-list **P:** Multidisciplinary team	-0.36 (0.19) kg/m^2* CG, pre-post: -0.03 (0.18) kg/m^2		
Daley et al. 2006[6]; The Sheffield Obesity Trial; England; RCT; community; positive (only the IG and wait-list control group have been included in analysis)	n=81 (IG 28, placebo CG 23, wait-list CG 30), 56% F 11-16y, 13.1y (SD NR) BMI > 98th percentile BMI z-score IG 3.17 (0.33), placebo CG 3.22 (0.61), wait-list CG 3.32 (0.37)	14 wk 3 x 1 hr, one-on-one sessions/wk for 8 wk, then 6 wk unsupervised home exercise program Follow-up 28 wk from baseline **R:** IG 86%, placebo CG 96%, wait-list CG 83%	**IG:** dietary advice information sheet trial entry, nutrition education; 30 min moderate intensity aerobic exercise sessions including games for 8 wk, then 6 wk individualised home exercise program; CBT strategies, goal setting, self-monitoring, social support with structured curriculum. **Wait-list CG:** Offered exercise therapy at the follow-up assessment **Personnel:** Researcher	**BMI z-score** IG, pre-post: 0.05 (0.05) Pre-FU: -0.01 (0.05) Placebo CG, pre-post: 0.02 (0.11) Pre-FU: 0.01 (0.10) Wait-list CG, pre-post: -0.10 (0.05)* Pre-FU: -0.15 (0.05)*	↓	
Danielsen et al. 2013[7]; Norway; RCT; community; neutral	n=49 (IG 23, CG 26), 49% F 7-13y, 10.68 (1.24)y Obesity as defined by IOTF BMI z-score 2.53 (0.34)	9 mo 12x 45 min/wk family meeting, booster session 6 mo post-treatment Follow-up 15 mo from baseline **R:** IG 87%, CG 69%	**IG:** FBT; nutrition education based on Nordic dietary guidelines; increase PA (30 min/d), reduce sedentary activity; CBT, develop family and individual coping skills e.g. goal setting, self-monitoring, self-esteem, body image, problem solving, and a positive self-perception. **Waitlist-CG:** commenced treatment after 12 wk on wait-list **P:** Clinical psychologist	**BMI z-score** Combined groups Pre-post: -0.18 (0.051)* Pre-FU: -0.18 (0.06)*	↓	
DeBar et al. 2012[8]; USA; RCT; primary care; positive	n=208 (IG1 105, IG2 103), 100% F 12-17y, 14.1 (1.4)y	5 mo	**IG1:** nutrition education, 1600-1800 kcal/d; PA education with targets of 30-60 min of PA/d, on 5 d/wk, 15 min/d yoga, limiting screen time to 2 hr/d; behavioural	**BMI z-score** IG1, pre-post: -0.12 (0.03)* Pre-FU: -0.15 (0.04)*		

	BMI≥90th percentile BMI z-score IG1 2.00 (0.34), IG2 2.00 (0.33)	90 min meeting/wk for 3 mo, then biweekly for 2 mo Follow-up 12 mo from baseline **R:** IG1 95%, IG2 92% at 5 mo; IG1 86%, IG2 81% at 12 mo	component including self-monitoring, goal setting, stimulus control and addressing issues associated with obesity in adolescent girls including depression, disordered eating and body image **IG2:** usual care; written education material, including evidence-based approaches to weight management; parents' guide, local resources, suggested books and online materials **P:** Nutritionist, clinical psychologist	IG2, pre-post: -0.06 (0.029)* Pre-FU: -0.08 (0.03)*	↓	
de Carvalho-Ferreira et al. 2015[9]; Brazil; pre-post; outpatient; neutral	n=75, 60% F 13-19y, 16.28 (2.37)y BMI ≥ 95th percentile BMI z-score 2.21 (0.27)	12 mo Weekly nutrition and psychological groups + 3x1 hr supervised exercise classes/wk; individual nutrition consult 1/mo Nil follow-up **R:** 100%	**IG:** nutrition education, energy intake set at recommended levels based on dietary reference intake for participants with low levels of PA by age and gender; supervised aerobic and resistance exercise training, 30 min/session; psychological group to discuss skills to manage emotional issues associated with obesity, for example binge eating, bulimia nervosa, depression, anxiety, body image; individual psychological consultations for those with greater need. **P:** Multidisciplinary team	**BMI z-score** Pre-post: -0.38 (0.034)* **BMI** Pre-post: -4.04 (0.40) kg/m^2*	↓	
Edwards et al. 2006[10]; UK; pre-post; tertiary outpatient; neutral	n=33, 70% F 8-13y, 10.1 (1.6)y BMI≥98th percentile BMI z-score 3.23 (0.48)	4 mo 1.5 hr group sessions, 8 weekly then 4 biweekly sessions	**IG:** FBT with concurrent parent and child group sessions; nutrition education based on the TLD; PA education, increase to 60 mins/d; behaviour modification techniques including self-monitoring, goal setting, stimulus control. Parent education in	**BMI z-score** Pre-post: -0.15 (0.08)* Maintained at follow-up p<0.001 (data NR)	↓	

		Follow-up 7 mo from baseline **R:** 82% at 4mo; 61% at 7 mo	behaviour management to support behaviour change for the child **P:** NR			
Fenner et al. 2016[11]; Curtin University's Activity, Food, and Attitudes Program (CAFAP); Australia; NRCT; community; neutral	n=68, %F NR 11-16y, 3.9 (1.5)y BMI > 85th percentile BMI z-score 2.1 (0.3)	8 wk 2 hr session twice/wk (1 hr adolescent PA, 1 hr parent education, 1 hr joint group) Follow-up 12-mon from baseline **R:** 82%	**IG:** circuit training exercise class; parent only education on supporting the adolescent e.g. goal setting and parenting styles. Joint parent and adolescent education included topics such as setting goals, nutrition principles, behaviour change, barriers, problem solving, and family cohesion **CG:** Participants as own control during the pre-intervention period **P:** Multidisciplinary team	No significant change in BMI z-score (data not reported)	↓	
Fennig et al. 2015[12]; Israel; pre-post; inpatient + outpatient; neutral	n=17, 67% F 8-17y, 14.47 (2.61)y BMI>40 with complications or BMI>50 BMI 44.79 (10.27) kg/m^2	12 wk 4-wk hospital admission, then hospital visits 2 d/wk for 8 wk Nil follow-up **R:** 88%	**Hospital intervention:** calorie restriction 1400-1600 kcal/d, family intervention, behavioural and cognitive therapy, PA education **Post-hospital:** Individual daily menu (1400-1600 kcal/d, 3 meals, 3 snacks); individual PA plan, biweekly exercise classes; CBT 2d/wk, including regular weighing, self-monitoring, addressing self-evaluation of body shape, weight and eating habits **Family intervention:** weekly parent education with dietitian and in a group to address behaviour change to facilitate and maintain weight loss	**BMI** Pre-post: -3.15 (2.05) kg/m^2*	–	

			P: Dietitian, therapist			
Fonseca et al. 2014[13]; Portugal; pre-post; camp; neutral	n=28, 54% F >12y, 13.3 (1.7)y BMI > 95th percentile BMI 30.2 (5.4) kg/m^2	2 wk Follow-up 6 mon from baseline (data not reported) **R**: 100%	**IG:** Diet of 1800 kcal/day, 6 meals planned by nutritionists and based on dietary guidelines; nutrition/cooking classes; structured PA of 120 mins/day; psychoeducation sessions focused on increasing motivation and addressed topics including body image, self-esteem, physical appearance, stigma **P:** Multidisciplinary team	**BMI** Pre-post: –0.60 (0.75) kg/m^2	↓	
Goldfield et al. 2015[14]; Healthy Eating Aerobic and Resistance Training in Youth (HEARTY); Canada; RCT; community; positive	n=304 (IG1 75, IG2 78, IG3 75, IG4 76), 70% F 14-18y, 15.6 (1.4)y BMI ≥ 95th percentile BMI IG1 34.6 (4.2) kg/m^2, IG2 35.1 (4.6) kg/m^2, IG3 34.6 (4.2) kg/m^2, IG4 34.1 (4.9) kg/m^2	6 mon 4 wk run-in period, then 4 sessions/wk (increasing from 20 to 45 min) for 22 wk; dietitian visit at baseline, 3 and 6 mon, phone support at 6 wk and 4 mon Nil follow-up **R:** IG1 76%, IG2 73%, IG3 77%, IG4 75%	All participants received counselling by a dietitian to promote healthy diet with an energy deficit of 250 kcal/d, and nutrition education. **IG 1:** aerobic exercise, 60-85% max heart rate **IG 2:** resistance training with weights, increasing duration and intensity **IG 3:** Combination of aerobic and resistance training **IG4:** nutrition only; no PA component **P:** Dietitian, personal trainer	Not reported	**–/↓**	
Goossens et al. 2011[15]; Belgium; pre-post; inpatient; neutral	n=108, 68% F 10-17y, 13.06 (1.99)y BMI >95th percentile BMI 31.9 (4.43) kg/m^2	10 mo Inpatient program Follow-up 6y from baseline	**IG:** 'non-diet' healthy lifestyle program; 1400-1600 kcal/d energy intake, 3 meals and 2 snacks; structured PA, 4 hr/wk individualised program and 10 hr/wk organised sport; small group CBT program for 12 wk including self-regulation, self-evaluation, self-reward, and development	**BMI** Pre-FU: -0.36 (0.48) kg/m^2	**–**	

		R: 52% at 6y	of a personal plan. Parents education biweekly, on preparing healthy food, shopping and aerobic exercises **P:** Multidisciplinary team			
Gunnarsdottir et al. 2012[16]; Iceland; pre-post; community; neutral	n=61, 45% F 7.5-13.6y, 11 (1.4)y Clinical sample of children with obesity (IOTF) BMI z-score 3.11 (0.5)	18 wk 12 sessions, child/parent dyads, 1 x individual counselling (20 min) + 1 x group (60-90 min) Follow-up 15 mon from baseline **R:** 73%	**IG:** nutrition education, TLD; PA education aiming for 30 min of activity 6 d/wk; group behavioural therapy using standardised treatment manuals **P:** Multidisciplinary team	**BMI z-score** Pre-post: -0.39 (0.05)* Pre-FU: -0.35 (0.05)*	↓	↓
Jacobson 2009[17] and Jacobson et al. 2012[18]; Healthy Choices Intervention (HCI) Program; USA; pre-post; primary care; neutral	n=17, 65% F 9-12y, 129.03 (15.19)mon BMI ≥ 85th percentile BMI z-score 1.91 (0.42)	7-13 wk, 9.45 (2.2) wk 4 clinic sessions (30-60 min) + 3 telephone sessions (30-45 min) Nil follow-up R: 88%	**IG:** nutrition education; PA education, use of pedometer; CBT based behaviour component including goal setting, self-esteem, response to stress, coping techniques **P:** NR	**BMI z-score** Pre-post: -0.18 (0.087)* **BMI** Pre-post: -1.01 (0.65) kg/m^2	–	–
Kelly et al. 2011[19]; Teaching, Encouragements, Exercise, Nutrition and Support (TEENS); USA; pre-post; community; neutral	n=98, 68% F 11-18y, 13.66 (1.83)y BMI >95th percentile BMI percentile 99.28 (0.54)	6 mon Weekly exercise classes + biweekly dietitian and behavioural specialist (alternating parent and adolescent) visits; 70% attendance required	**IG:** parent and adolescent dyads; nutrition education; exercise class 1 d/wk (60 min) plus requirement to complete 2 d/wk and record in diary; either support group classes or individual consults based on assessment by behavioural specialist **P:** Dietitian, behavioural specialist	**BMI** Pre-post: -0.76 (0.19) lb/in^2*	–	

		Nil follow-up **R:** 33%				
Kerkar et al. 2013[20]; UK; NRCT; tertiary outpatient; neutral	n=48, % F NR 8-17y, 12.27 (2.34)y BMI > 97th percentile with NAFLD BMI 28.95 (4.57) kg/m^2	6 mon Varying number of visits and duration based on standard clinical practice Nil follow-up **R:** 69%	**IG:** standard clinical care consistent with recommendations for NADLF management including regular visits at the clinic, liver imaging and biopsy as required; nutrition education with the option to consult a nutritionist and endocrinologist to assist with implementing dietary change; PA education **CG:** no-treatment control without NAFLD (data NR) **P:** MDT	**BMI** Pre-post: -0.15 (0.61) kg/m^2	↓	
Kotler et al. 2006[21]; USA; pre-post; tertiary outpatient; neutral	n=16, 100% F 12-15y, 13.2 (1.1)y BMI≥95th percentile BMI 36.8 (5.5) kg/m^2	6 wk Daily attendance at the service for adolescents; weekly parent group Nil follow-up **R:** 100%	**IG:** program focused on healthy eating and PA education without explicit focus on large amounts of weight loss; shopping and cooking, all meals provided at the program (no energy prescription reported), PA provided through trips to recreational facilities; behavioural therapy group, art therapy and yoga **P:** NR	No significant change in BMI (data NR)	↓	
Kulik 2012[22]; USA; RCT; community; neutral	n=41 (IG1 23, IG2 18), 100% F 13-17y, 15.2 (1.5)y 30-130% overweight	16 wk 1.5 hr group meetings, weekly for the first month, biweekly for	**IG1** and **IG2** received a CBT based nutrition education, calorie goal of 1200-1800 kcal/d based on height and weight; exercise recommendation to increase current PA by 15 min, gradually increasing to at least 60 min/d of moderate to	**Change in %overweight** IG1, Pre-post: -6.25 (1.51)%* IG2, Pre-post: -6.57 (1.31)%*	–	

	mean % overweight IG 64.84 (20.0)%, IG2 74.67 (28.1)%	second mon, monthly for the last two mon Nil follow-up **R**: IG1 83%, IG2 94%	vigorous; behaviour skills including self-monitoring, goal setting, stimulus control, behavioural substitution, relapse prevention, problem solving, cognitive restructuring Parents/guardian education (3 meetings) on how to manage expectations for the program, how to help their teen in planning meals, helpful and unhelpful parent and family behaviours related to weight loss, and maintenance after the program **IG1:** additional peer social support component, including weight loss support, buddy system, online support chats with participants and support providers **IG2:** education only, limited peer-to-peer interaction **P:** Trained weight loss interventionist, group treatment providers			
Lane-Tillerson et al. 2005[23]; Lifesteps; USA; pre-post; community; neutral	n=31, 100% F 13-17y, 15 y (SD NR) Overweight Weight 90.72kg (SD NR)	5 mon 16 x 1.5 hr group sessions Nil follow-up **R:** 58%	**IG:** Groups conducted as girls alone, girls with mother, or mothers alone; nutrition education based on a low-calorie diet, using goal setting strategy for dietary monitoring; culturally appropriate freestyle dance sessions; behaviour change focus including goal setting and development of action plan **P:** NR	**BMI** significantly reduced between pre-and post-intervention (data NR)	↓	

Levine et al. 2001[24]; USA; pre-post; community; neutral	n=24, 46% F 8-12y, 10.2 (1.5)y >160% of ideal body weight (WHO reference charts) BMI 34.5 (5.2) kg/m^2	10-12 wk Weekly group sessions Follow-up 7-16 mo from baseline (mean 11 mo) **R:** 67% post-intervention; 50% follow-up	**IG:** Behavioural group program; nutrition education of Stoplight Diet, calorie target of 1200-1500kcal/d based on child's initial weight; exercise goals to work towards 30 min/d of activity on 5 d/wk and reduce sedentary behaviours, plus weekly group exercise activity e.g. walk; self-monitoring, portion size control, emotions, teasing and relapse prevention **P:** NR	**BMI** Pre-post: -1.70 (1.06) kg/m^2 No significant change between baseline and follow-up	↓	↓
Lochrie et al. 2013[25]; USA; RCT; tertiary outpatient; positive	n=130 (IG 1 65, IG2 65), 63% F 8-11y, 9.9 (1.1)y BMI ≥85th percentile BMI z-score, combined groups 2.2 (0.4)	6 mon IG1: 60-90 min groups - 8 weekly, then 4 bimonthly, then 2 monthly sessions IG2: 1 group session Follow-up 12 mon from baseline **R:** 68% at 6 mo, 55% at 12 mo (NR by group)	**IG1:** Lifestyle intervention; nutrition education; PA education including benefits of exercise, creative ways to exercise, safe and effective techniques **IG2:** usual care control group; typical educational and consultative intervention provided in the specialty clinic; general nutrition and PA education; no behaviour change; list of community resources **P:** Dietitian, psychologist (IG1 only)	**BMI z-score** IG1, Pre-post: -0.18 (0.04)* Pre-FU: -0.23 (0.03)* IG2, Pre-post: -0.08 (0.04)* Pre-FU: -0.13 (0.03)*	**–/↓**	
Lofrano-Prado et al. 2009[26]; Brazil; pre-post; tertiary outpatient; neutral	n=66, 62% F 15-19y, girls 16.56 (1.99)y, boys 16.20 (2.09)y BMI>95th percentile	6 mo 5 x 1-hr sessions/wk (3 x supervised exercise, 1 nutrition, 1 psychological group sessions) + 1/mo visit with endocrinologist	**IG:** nutrition education, encouraged to follow a balanced diet and reduce food intake; supervised personalised moderate intensity exercise program; psychological group sessions to discuss body image, eating disorders, food and feelings, individual therapy when problems identified	**BMI** Girls, pre-post: -2.94 (0.66) kg/m^2* Boys, pre-post: -3.74 (0.88) kg/m^2*	**–/↓**	↓

	BMI girls 35.53 (4.19) kg/m^2, boys 35.78 (4.25) kg/m^2	Nil follow-up **R:** 88%	**P:** Multidisciplinary team			
Luca et al. 2015[27]; Sick Kids Team Obesity Management Program (STOMP); Canada; NRCT; tertiary outpatient; neutral (reporting 12 mon data from 2y program)	n=117 (IG 75, CG 42), IG 65% F; CG 59% F 12-17y, IG 15.1 (1.8)y, CG 14.9 (2.0)y BMI ≥ 99th percentile OR BMI >95th percentile with comorbidities BMI IG 44.87 (7.8) kg/m^2, CG 34.5 (8.0) kg/m^2	24 mon 2-hr session/wk for 6 wk, then 1.5-hr biweekly sessions for 6 mon, individualised follow-up and transition from 12-24 mon Nil follow-up **R:** IG 80%, CG 83% at 12 mo	**IG:** Four phases: first stage, intensive nutrition education + cooking sessions, group exercise plus individual sessions if needed, mental health component; second stage, ongoing intervention at decreased frequency; third stage, begins at 12 mon,1.5 hr session/mon; fourth phase: begins at 18 mon, focus on transition, optional 1.5 hr group/mon, transition to local community services and a small number of participants have bariatric surgery. **CG:** non-enrolled control **P:** Multidisciplinary team	**BMI** IG, pre-post: 0.8 (0.07) kg/m^2* CG, pre-post: 1.2 (0.07) kg/m^2*	↓	
Mellin et al. 1987[28]; Shapedown; USA; RCT; community; neutral	n=63 (IG 37, CG 29), IG 81% F, CG 76% F IG 12-18y, 15.6y; CG 14-18y, 15.6y (SD NR) Weight, mean (range) IG 79.2 (58.05-134.55) kg, CG 76.95 (59.4-121.95) kg	14 wk Weekly 90 min group; two parent sessions Follow-up 15 mon from baseline **R:** IG 92%, CG 100% at 14 wk and 15 mon	**IG:** self-directed change format aiming for small sustainable change; nutrition education; weekly exercise as part of group sessions; cognitive, behavioural, affective and interactional techniques adapted to adolescents; parent education on how to support the adolescent, family diet and activity, communication **CG:** no treatment control **P:** Dietitian, nutritionist	**Weight** IG, pre-post: -5.9 (1.16) kg* Pre-FU: -9.9 (2.46) kg* CG, pre-post: -0.3 (1.23) kg Pre-FU: -0.1 (2.45) kg	↓	

Moon at al. 2004[29]; Korea; NRCT; school; neutral	n=69 (IG 41, CG 28), 39% F 4th-6th grade elementary school aged, mean age NR >20% degree of obesity BMI NR	8 wk 60-70 min group/wk Nil follow-up **R:** IG 83%, CG 100%	**IG:** behaviour modification program; nutrition education, eating habits; PA education; behaviour modification including self-monitoring, stimulus control, social support, changing perception, development of long term plan **CG:** no treatment control **P:** School nurse	**Body fat %** IG, pre-post: -0.4 (0.78)% CG, pre-post: 4.0 (0.91)%	–	
Munsch et al. 2008[30]; Training of obese children and their parents (TAKE program); Switzerland; RCT; tertiary outpatient; positive	n=56 (IG1 31, IG2 25), 60% F 8-12y, IG1 10.3 (1.4)y, IG2 10.6 (1.5)y BMI > 85th percentile BMI IG1 26.5 (3.3) kg/m^2, IG2 28.0 (5.4) kg/m^2	40 wk 10 weekly group sessions, then 6 x monthly sessions Nil follow-up **R:** IG1 65%, IG2 28%	**IG1:** Mother-Child CBT treatment **IG2:** Mother only CBT treatment, children attended relaxation training **CBT treatment:** nutrition education using the Stoplight Diet, encouraged to follow three rules: 1) any food on the table may be eaten by all family members, 2) offer restricted amounts of high fat foods, 3) offer sufficient amount of low-fat foods so child can eat until satiated; modelling of PA by mothers; behavioural intervention including self-monitoring, motivation, goal achievement, relapse prevention **P:** Psychotherapist	**% overweight (SD NR)** IG1: pre 56.76, post 54.85* IG2: pre 65.09, post 60.57*	↓	↓
Murdoch et al. 2011[31]; UK; pre-post; community; neutral	n=17, 53% F 7.5-14y, 10.5 (1.82)y BMI>98th percentile BMI z-score 3.16 (0.56)	6 mon 1.5 hr group sessions, 10 weekly then 5 biweekly	**IG:** Children attend group with one parent; nutrition education based on TLD; PA education, encourage 60 min/d and reduced sedentary time; behavioural therapy including self-monitoring, goal setting, positive reinforcement, stimulus	**BMI z-score** Pre-post: -0.06 (0.10)	↓	

		Nil follow-up **R:** 61%	control, teasing, problem-solving; parent education on supporting the child **P:** Dietitian, psychologist			
Nobles et al. 2016[32]; Self, Help, Independence, Nutrition and Exercise (SHINE); UK; retrospective review; community; neutral	n=435, 49% F 10-17y, 12.9 (2.0)y Severe obesity (BMI z-score ≥ 2.67) or obesity (BMI z-score ≥ 2.00) with comorbidities BMI z-score 3.13 (0.5)	Up to 15 mon **Phase 1**, 1x 1-1.5 hr individual session **Phase 2** 2 hr group session/wk for 3 mon **Phase 3** (optional maintenance phase), 3 x 12 wk modules with 1 hr group/wk Nil follow-up, families have the option to access the service until the child is 18y **R:** 76%	**IG:** nutrition education; group PA sessions run throughout the week using local facilities, 7 hr/wk of optional activities available; behavioural modification including CBT, satiety, self-control and stress management, optional one-on-one counselling sessions if required **P:** Trained postgraduate students, senior experienced members of staff Depression and anxiety measured at baseline and 3 months only in a subsample of the cohort (n=168)	**BMI z-score** Pre-post: -0.27 (0.02)* **BMI** Pre-post: -1.67 (0.16) kg/m^2*	↓	↓
Panagiotopoulos et al. 2011[33]; Centre for Healthy Weights-Shapedown BC (CHW-SB); Canada; NRCT; tertiary outpatient; neutral	n=119, 43% F 6-17y, 11.6 (2.6)y BMI ≥ 95th percentile or ≥ 85th percentile with co-morbidity BMI z-score 2.26 (0.33)	10 wk 2 hr group session/wk Nil follow-up **R:** 71%	**IG:** Parent and participant nutrition education sessions; 30 min/wk exercises session for children, focused on strength, flexibility and endurance; psychology sessions including goal setting communication, appropriate limit-setting and expectations, problem-solving and managing challenges, building self-esteem, developing realistic thinking, and dealing with teasing/bullying.	**BMI z-score** (NR pre-program) Pre-post: -0.06 (0.029)* **Weight trajectory** Control period: 0.89% (95%CI 0.69 to 1.09) monthly increase in weight Intervention period: 0.37% (95%CI 0.17 to 0.58) monthly decline	−	↓

			CG: participants used as own controls prior to program commencement **P:** Multidisciplinary team			
Pathmasiri et al. 2012[34]; Take Off 4-Health (TO4-H); USA; pre-post; camp; neutral	n=19, 68% F 12-18y, mean age NR BMI ≥ 95th percentile BMI z-score 2.43 (0.37)	3 wk Daily nutrition and PA sessions, behavioural groups twice/wk Nil follow-up **R:** 100%	**IG:** nutrition education groups and individualised energy target, able to self-select meals from options provided; PA education and 2-4 hr/d of fun structured PA e.g. walking, swimming; group and individual CBT **P:** Multidisciplinary team	**BMI z-score** Pre-post: -0.05 (0.07)* **BMI** Pre-post: -0.92 (1.77) kg/m^2*	–	
Pott et al. 2010[35]; Fit Kids; Germany; pre-post; tertiary outpatient; neutral	n=136, 54% F 7-15y, 11.5 (1.85)y BMI >97th percentile or BMI > 90th percentile with comorbidity BMI z-score 2.46 (0.43)	12 mon Phase 1 (3 mon): 3 hr session/wk (90 min education, 90 min exercise) Phase 2 (4-12 mon): 90 min exercise session/wk, monthly parent education Nil follow-up **R:** 85%	**IG:** Phase 1; weekly behavioural therapy sessions alternating between a dietary training course and a parent course to facilitate transfer into everyday family life; exercise program Phase 2; exercise program; monthly parent course **P:** NR	**BMI z-score** Pre-post: -0.3 (0.31)* **BMI** Pre-post: -1.01 (0.19) kg/m^2*	↓	
Pratt et al. 2013[36]; USA; pre-post; tertiary outpatient; neutral	n=267, 54% F 8-18y, mean age NR Youth referred due to concern about	Median of 170d Three visits at a tertiary outpatient clinic, appointments every 1-3 mon	**IG:** tertiary outpatient clinic with a multidisciplinary team using an integrated care model coordinated by both medical and mental health providers **P:** Multidisciplinary team	**BMI z-score** Pre-post: 0.03 (0.04) **BMI** Pre-post: 1.1 (1.26) kg/m^2	↓	

	weight and risk of weight-related comorbidities BMI z-score 2.50 (0.34)	Nil follow-up **R:** 42% at second visit, 18% at third visit				
Quinlan et al. 2009[37]; Healthy Kids Camp Inc; USA; pre-post; camp; neutral	n=130, 70% F 9-18y, 12.8 (1.9)y Overweight/obesity BMI z-score 2.2 (0.37)	8 wk, participants attended for mean (SD) 4.3 (1.9) wk 1 hr/wk group nutrition and behavioural therapy Nil follow-up **R:** 100%	**IG:** nutrition education and cooking classes, calorie target of 1800 kcal/d (400kcal breakfast, 500kcal lunch, 600kcal dinner, 2x150kcal snacks); 5hrs/d supervised PA including cardiovascular, weight-training and sport-specific exercise; behavioural groups on range of topics including self-esteem, body image, emotional eating, teasing, family and peer support **P:** Nutritionist, behavioural psychologist	**BMI z-score** Pre-post: -0.23 (0.01)* **BMI** Pre-post: -2.9 (0.38) kg/m^2*	**–**	
Shomaker et al. 2017[38]; USA; RCT; tertiary outpatient; positive (only healthy eating arm included)	n=14, 79% F 8-13y, 11.0 (1.0)y BMI≥85th percentile BMI z-score 2.0 (0.4)	12 wk Weekly 45 min individual sessions Follow-up 12 mo from baseline **R:** 86% at 12 wk; 57% at 12 mo	**IG:** FBT delivered to parent/child dyads; healthy eating principles; exercise and PA education and home options **P:** Clinical psychologist, clinical psychology students	**BMI** Pre-post: 7.92 (1.79) kg/m^2* Pre-FU: 11.92 (2.53)* **BMI z-score** Pre-post: 0.01 (0.02) Pre-FU: -0.04 (0.05)	**–**	**–**
Small et al. 2017[39]; USA; RCT; community; positive	n=67 children (IG 33, CG 27), 60% F 4-8y, 5.58 (1.43)y, BMI ≥ 85th percentile	Up to 17 wk 4 x 20-45 mins sessions, every 3-4 wk to mimic normal paediatric	Children in both groups given a group-specific bag of toys to facilitate activities that parents would be encouraged to complete with their child. Before each sessions, parents were provided with age-	**BMI percentile** IG, pre-post: -2.98 (0.97)* Pre-FU: -1.59 (0.62)* CG, pre-post: -0.66 (0.97)	**↓/–**	**–**

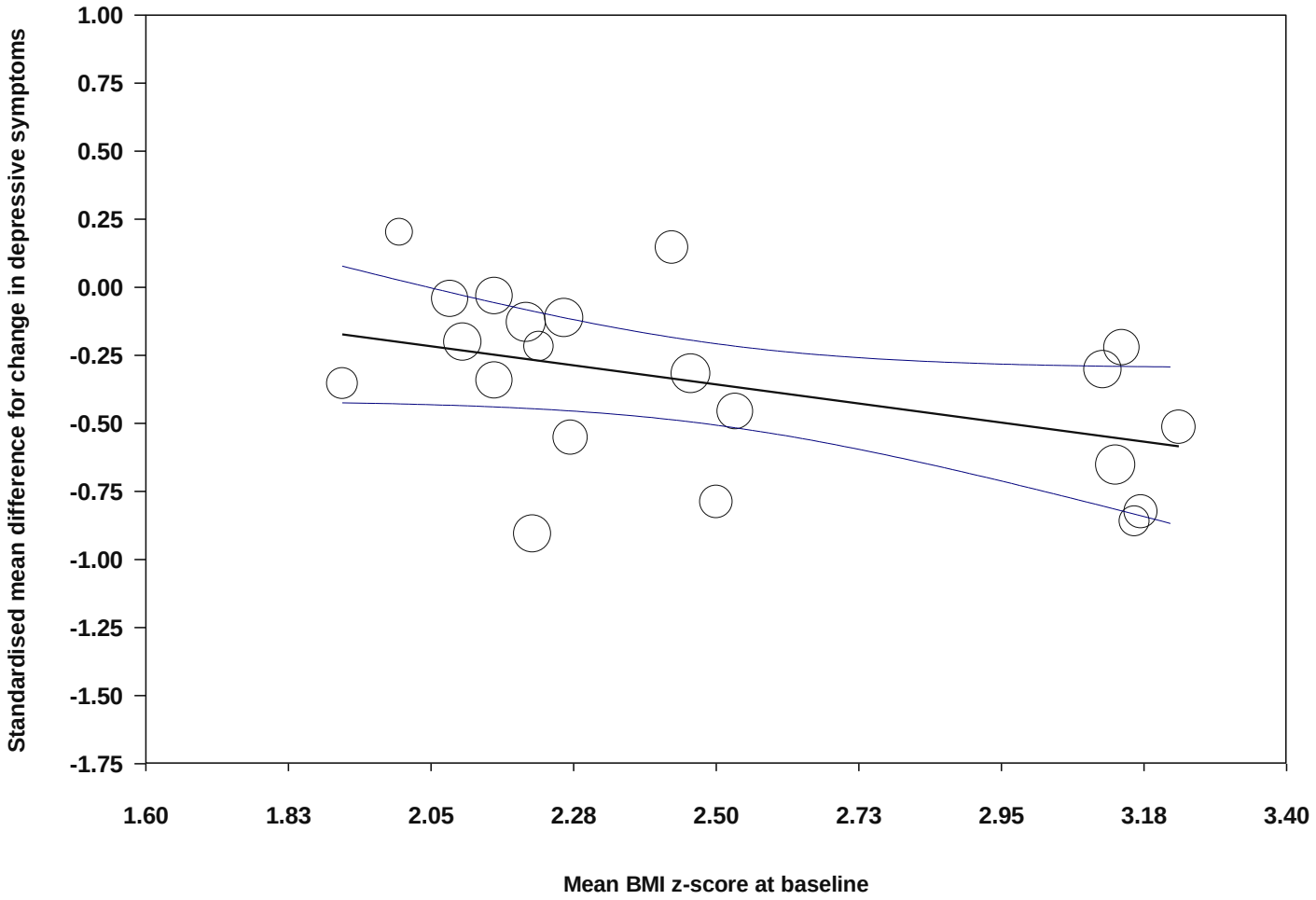
	BMI percentile IG 96.72 (4.02), CG 95.40 (4.55)	counselling visits, phone calls between visits Follow-up 16 mon from baseline **R:** data collected for 90% (NR by group)	appropriate, audiotaped, educational information on a range of topics **IG:** CBT, healthy lifestyle skill building intervention; nutrition education including healthy habits in young children; increasing PA and decreasing sedentary time; goal setting, motivational support, and skill-building **CG:** no lifestyle intervention provided; age-specific health and safety parent education intervention (e.g., thermal injuries, first-aid, insect bites and stings) **P:** trained interventionists	Pre-FU: -0.66 (0.83)		
Sothern et al. 1999[40]; USA; pre-post; tertiary outpatient; neutral	n=87, 55% F 7-17y, mean age NR ≥ 120% of ideal body weight BMI 33.34 (7.46) kg/m^2	12 mon Intensive phase: 2 hr visit/wk for 10-20 wk Maintenance phase: up to 1y from baseline Nil follow-up **R:** 100% at 10wk	**Intensive phase:** including protein-sparing modified fast (PSMF) diet, 800 kcal/d (protein up to 100g/d, carbohydrate limited to 20-25g/d); home-based exercise video and 30-45 min moderate intensity exercise during the weekly intervention for participants and family members; behaviour modification including self-monitoring, cue elimination, stimulus control, symptom substitution, cognitive restructuring and goal setting **Maintenance phase:** maintenance program was prescribed once the next lower level or phase of obesity was achieved (not described) **P:** Therapist, exercise physiologist	**BMI** Pre-post: -5.00 (0.61) kg/m^2*	↓	

Stella et al. 2005[41]; Brazil; NRCT; community; negative	n=40 (10 in each group), 100% F 14-19y, 16.0 (1.56)y BMI ≥ 95th percentile BMI IG 1 36.8 (4.1) kg/m^2, IG 2 34.38 (4.81) kg/m^2, IG 3 35.64 (4.78) kg/m^2, CG 33.52 (2.72) kg/m^2	12 wk All groups: weekly nutrition review IG1 & IG2: 3 x 40-60 min exercise sessions/wk IG3: 60 min exercise session/wk Nil follow-up **R:** NR	**All groups:** weekly review with nutritionist **IG1:** aerobic exercise on ergonomic bicycle with increasing intensity **IG2:** anaerobic exercise- interval training with increasing intensity **IG3:** leisure activities including games and exercises at sports centre **IG4:** no exercise intervention, nutrition only **P:** Nutritionist	**BMI** IG1, pre-post: -1.10 (1.05) kg/m^2 IG2, pre-post: -1.13 (1.17) kg/m^2 IG3, pre-post: -1.52 (1.17) kg/m^2 IG4, pre-post: -1.86 (0.62) kg/m^2*	↓/−	−/↓
Toulabi et al. 2012[42]; The ‘‘behavior modification’’ interventional program; Iran; RCT; community; positive	n=152 (IG 76, CG 76), %F NR 14-19y, 15.87 (1.0)y BMI ≥ 28 if 15y, BMI ≥ 29 if 16-17y BMI IG 30.43 (2.39) kg/m^2, CG 30.33 (1.93) kg/m^2	6 wk Weekly parent education; twice/wk student education; 45 min exercise classes 3 d/wk Nil follow-up **R:** only completers reported	**IG:** face-to-face nutritional education for parents supported by an educational booklet; face-to-face nutritional education for students regarding dietary modification and increasing PA supported by an educational booklet; group exercise classes, aerobic exercise and strength training **CG:** no treatment control **P:** Nurse, physical education expert	**BMI** IG, pre-post: -2.92 (0.26) kg/m^2* CG, pre-post: -1.18 (0.22) kg/m^2*	↓	
Van Vlierberghe et al. 2009[43]; Belgium; pre-post; inpatient; neutral	n=76, 67% F (subsample of 39 completed ED related outcomes) 14-18y, 15.11 (1.15)y, subsample 15.23 (1.23)y	10 mo Nil follow-up **R:** 87% whole group, 79% subsample	**IG:** ‘non-diet’ healthy lifestyle program; 1400-1600 kcal/d energy intake, 3 meals and 2 snacks; structured PA, 4 hr/wk individualised program and 10 hr/wk organised sport; small group CBT program for 12 wk including self-regulation, self-evaluation, self-reward, and development of a personal plan. Parents education	**Mean percentage weight loss** Pre-post: 52.5 (2.09)% (range 18.2 to 107.4%)	↓	↓

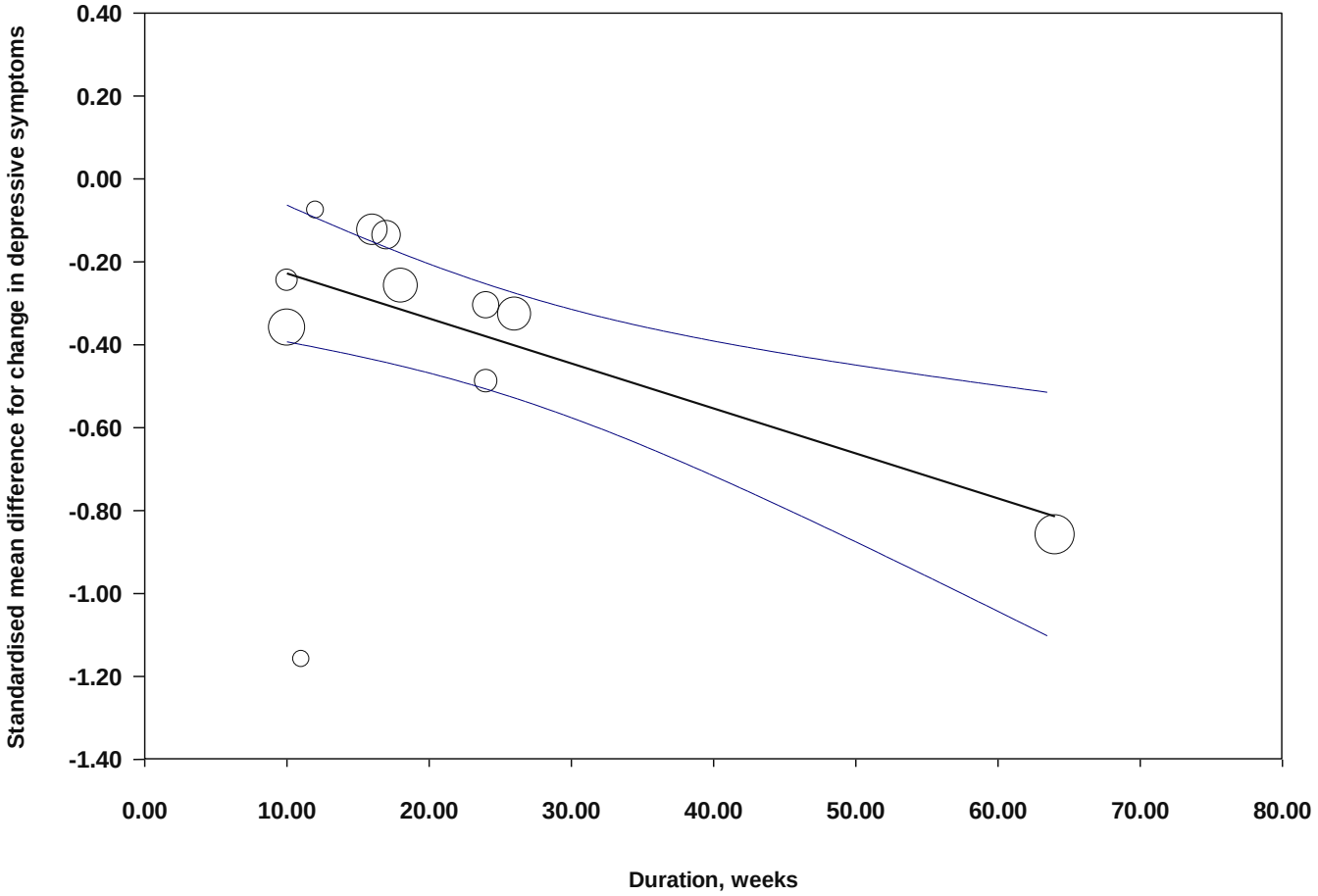
	BMI≥95th percentile BMI z-score 2.25 (0.28)		biweekly, on preparing healthy food, shopping and aerobic exercises **P:** Paediatrician, therapist			
Wadden et al. 1990[44]; WRAP (Weight Reduction and Pride program); USA; RCT; tertiary outpatient; neutral	n=36 (IG 1 19, IG2 14, IG3 14), 100% F 12-16y, 14 years (SD NR) At least 10kg overweight BMI 35.2 kg/m^2 (SD NR)	16 wk 1 hr sessions/wk Follow-up 6 mon from baseline **R:** IG 1 84%, IG2 71%, IG3 71%	All children received the same treatment with the exception of parental involvement; nutrition education including with calorie intake of 1000-1500 kcal/d; increased PA; reward system, addressed modifying self-defeating thoughts concerning weight and food **IG 1:** Child alone **IG 2:** Mother-child together **IG 3:** Mother-child separately **P:** Clinical psychologist	**BMI** Combined groups Pre-post: -1.30 (0.36) kg/m^2* No significant change between baseline and follow-up (data NR)	↓	
Weintraub et al. 2008[45]; The Stanford Sports to Prevent Obesity Randomized Trial (SPORT); USA; RCT; school; neutral (Only the health education group included in review)	n=12, %F NR Age range NR, 10.34 (0.84)y BMI ≥ 85th percentile BMI z-score 2.22 (0.33)	6 mon Weekly group sessions Nil follow-up **R:** 100%	**IG:** nutrition and health education intervention consisting of weekly after-school meetings **P:** Undergraduate and medical students	**BMI z-score** Pre-post: 0.00 (0.07) kg/m^2 **BMI** Pre-post: 0.79 (1.08) kg/m^2	−	

Abbreviations: CG, control group; F, female; FBT, Family-based treatment; FU, follow-up; IG, intervention group; IOTF, International Obesity Task Force; NAFLD, non-alcoholic fatty liver disease; NR, not reported; NRCT, non-randomised controlled trial; PA, physical activity; pre-post, non-controlled trial; RCT, randomised-controlled trial; TLD, traffic light diet
*Change from baseline, P<0.05
↓, statistically significant reduction in symptoms of depression or anxiety between pre- and post-intervention
↑, statistically significant increase in symptoms of depression or anxiety between pre- and post-intervention
−, no statistically significant change in symptoms of depression or anxiety between pre- and post-intervention

eFigure 1. Meta-regression of the effect size for change in symptoms of depression between pre- and post-intervention and mean participant BMI z-score at baseline following professionally administered obesity treatment with a dietary component in children and adolescents with overweight and obesity (R^2=0.18, p=0.02)

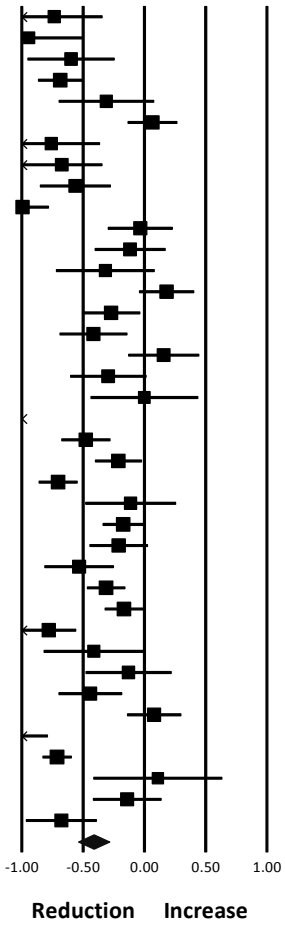


eFigure 2. Meta-regression of the effect size for change in symptoms of anxiety between pre- and post-intervention and intervention duration following professionally administered obesity treatment with a dietary component in children and adolescents with overweight and obesity (R^2=0.82, p<0.001)



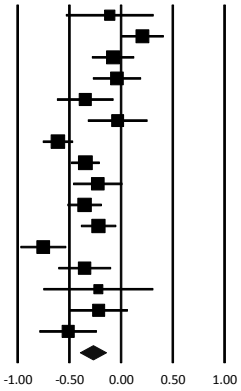
eFigure 3. Meta-analysis of the change in weight-related outcomes between pre- and post-intervention (A) and between baseline and the latest follow-up timepoint (B), following obesity treatment with a dietary component in children and adolescents with overweight and obesity

Study name	Weight outcome	Std diff in means	Standard error	Lower limit	Upper limit	p-Value	Total
Kulik et al. 2011 - IG1	%overweight	-0.7357	0.200	-1.128	-0.343	0.000	19
Kulik et al. 2011 - IG2	%overweight	-0.9424	0.226	-1.385	-0.500	0.000	17
Wadden et al. 1990	BMI	-0.5985	0.181	-0.953	-0.244	0.001	36
Sothern et al. 1999	BMI	-0.6860	0.092	-0.867	-0.505	0.000	87
Levine et al. 2001	BMI	-0.3101	0.198	-0.699	0.078	0.118	16
Brehm et al. 2003	BMI	0.0654	0.103	-0.136	0.267	0.524	57
Lofrano-Prado et al. 2009 - Boys	BMI	-0.7591	0.202	-1.154	-0.364	0.000	19
Lofrano-Prado et al. 2009 - Girls	BMI	-0.6742	0.168	-1.004	-0.344	0.000	26
Kelly et al. 2011	BMI	-0.5630	0.147	-0.852	-0.274	0.000	32
Toulabi et al. 2012	BMI	-0.9934	0.109	-1.206	-0.781	0.000	76
Kerkar et al. 2013	BMI	-0.0334	0.135	-0.298	0.231	0.805	33
Fonseca et al. 2014	BMI	-0.1165	0.147	-0.404	0.171	0.428	28
Fennig et al. 2015	BMI	-0.3182	0.205	-0.720	0.084	0.121	15
Luca et al. 2015	BMI	0.1807	0.114	-0.043	0.404	0.113	47
Ampolos et al. 2014	BMI percentile	-0.2715	0.120	-0.507	-0.036	0.024	43
Small et al. 2017	BMI percentile	-0.4157	0.141	-0.691	-0.140	0.003	33
Daley et al. 2006	BMI z-score	0.1574	0.147	-0.131	0.446	0.285	28
Edwards et al. 2006	BMI z-score	-0.2950	0.158	-0.605	0.015	0.062	25
Weintrub et al. 2008	BMI z-score	0.0000	0.224	-0.438	0.438	1.000	12
Quinlan et al. 2009	BMI z-score	-1.6196	0.103	-1.822	-1.417	0.000	130
Lochrie et al. 2013 - IG1	BMI z-score	-0.4777	0.101	-0.676	-0.279	0.000	65
Lochrie et al. 2013 - IG2	BMI z-score	-0.2123	0.097	-0.403	-0.022	0.029	65
Pott et al. 2010	BMI z-score	-0.7042	0.080	-0.862	-0.547	0.000	116
Murdoch et al. 2011	BMI z-score	-0.1122	0.188	-0.482	0.257	0.552	17
Panagiotopoulos et al. 2011	BMI z-score	-0.1730	0.085	-0.340	-0.006	0.042	84
Brennan et al. 2012	BMI z-score	-0.2100	0.121	-0.447	0.027	0.082	42
Croker et al. 2012	BMI z-score	-0.5325	0.144	-0.815	-0.250	0.000	33
DeBar et al. 2012 - IG1	BMI z-score	-0.3124	0.079	-0.468	-0.157	0.000	100
DeBar et al. 2012 - IG2	BMI z-score	-0.1667	0.080	-0.324	-0.010	0.037	95
Gunnarsdottir et al. 2012	BMI z-score	-0.7800	0.113	-1.002	-0.558	0.000	61
Jacobson et al. 2012	BMI z-score	-0.4124	0.208	-0.821	-0.004	0.048	15
Pathmasiri et al. 2012	BMI z-score	-0.1293	0.178	-0.479	0.220	0.469	19
Danielsen et al. 2013	BMI z-score	-0.4414	0.132	-0.699	-0.183	0.001	38
Pratt et al. 2013	BMI z-score	0.0796	0.112	-0.140	0.299	0.477	48
de Carvalho-Ferreira et al. 2015	BMI z-score	-1.0036	0.110	-1.219	-0.789	0.000	75
Nobles et al. 2016	BMI z-score	-0.7127	0.060	-0.831	-0.595	0.000	347
Shomaker et al. 2017	BMI z-score	0.1100	0.268	-0.415	0.635	0.682	14
Boutelle et al. 2018	BMI z-score	-0.1407	0.142	-0.419	0.138	0.322	30
Mellin et al. 1987	Relative weight	-0.6771	0.147	-0.966	-0.388	0.000	34
		-0.4127	0.065	-0.539	-0.286	0.000	



A – Pre-post intervention

Study name	Outcome	Std diff in means	Standard error	Lower limit	Upper limit	p-Value	Total
Levine et al. 2001	BMI	-0.109	0.215	-0.532	0.313	0.612	13
Brehm et al. 2003	BMI	0.207	0.104	0.004	0.410	0.046	57
Goosen et al. 2011	BMI	-0.078	0.104	-0.281	0.126	0.454	56
Ampolos et al. 2014	BMI	-0.040	0.118	-0.271	0.192	0.736	43
Small et al. 2017 - IG	BMI percentile	-0.346	0.139	-0.618	-0.074	0.013	33
Daley et al. 2006	BMI z-score	-0.033	0.146	-0.320	0.254	0.823	28
Lochrie et al. 2013 - IG1	BMI z-score	-0.610	0.074	-0.755	-0.465	0.000	130
Lochrie et al. 2013 - IG2	BMI z-score	-0.345	0.070	-0.482	-0.208	0.000	130
Brennan et al. 2012	BMI z-score	-0.225	0.121	-0.462	0.012	0.063	42
DeBar et al. 2012 - IG1	BMI z-score	-0.353	0.084	-0.518	-0.188	0.000	90
DeBar et al. 2012 - IG2	BMI z-score	-0.218	0.086	-0.387	-0.049	0.011	83
Gunnarsdottir et al. 2012	BMI z-score	-0.752	0.112	-0.972	-0.532	0.000	61
Danielsen et al. 2013	BMI z-score	-0.353	0.130	-0.606	-0.099	0.006	38
Shomaker et al. 2017	BMI z-score	-0.220	0.270	-0.750	0.310	0.416	14
Boutelle et al. 2018	BMI z-score	-0.217	0.143	-0.497	0.064	0.130	30
Mellin et al. 1987	Relative weight	-0.512	0.141	-0.789	-0.235	0.000	34
		-0.270	0.064	-0.396	-0.145	0.000	



B – Baseline to latest follow-up

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