

Treatment of obesity, with a dietary component, and eating disorder risk in children and adolescents: a systematic review with meta-analysis

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Table S1. 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 eating disorder related outcome measures. Medical Subject Headings (MeSH) are bolded, and key word searches are italicised.

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

Table S2: Characteristics of included studies reporting change in ED prevalence, ED risk and related symptoms following obesity treatment, with a dietary component, in children and adolescents with overweight or obesity

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)	Eating disorder related outcomes reported (tool used)
Bonham et al. 2017 ¹ ; JenMe; Australia; RCT; Commercial program; positive	n=74 (IG 42, CG 32), 74% F 13-17y, 15.3 (1.3)y BMI ≥ 85 th percentile BMI IG 33.5 (6.0) kg/m ² , CG 31.6 (4.0) kg/m ²	13 wk Weekly, one-on-one sessions Follow-up 36 wk from baseline R: IG 76%, CG 72% at 13 wk; 36% at 36 wk (IG only)	IG: Three education topics: Eat Well, Move more and Live life; individualized menu with pre-packaged food provided by the commercial program combined with own grocery items; worked with consultant towards using all of their own foods; PA education, overcoming barriers; goal setting, encouraged to modify small behaviours, body image, monitoring of progress Wait-list CG: received 'Healthy Eating for Children' booklet based on healthy eating guidelines; advised to maintain current lifestyle habits for the control period P: Trained Jenny Craig consultants	BMI z-score IG, pre-post: -0.21 (0.05)* Pre-FU: -0.36 (0.12)* CG, pre-post: 0.00 (0.06), nil FU BMI IG, pre-post: -2.0 (0.76) kg/m ² * Pre-FU: -3.5 (0.89) kg/m ² * CG, pre-post: 0.5 (0.57) kg/m ² , nil FU	Bulimia (EAT-26) ED risk (EAT-26) Outcomes NR at follow-up
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 85-99 th 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 R: 70% at 4mo; follow-up NR	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	Emotional eating (EES)
Braet et al. 2000 ³ ; Belgium; RCT;	n=136 (IG1 26, IG2 16, IG3 36, IG4 58),	12 mo	All groups received 12-session CBT protocol designed to help the child change lifestyle behaviours,	%overweight IG1, pre-post: -12.0	Emotional eating (DEBQ)

camp and outpatient; neutral	68% F 7-17y, 11 (2.5)y ≥ 20% overweight % overweight IG1 52 (13)%, IG2 50 (19)%, IG3 60 (23)%, IG4 52 (22)%	Varied intensity and mode of delivery IG1: group therapy, 6 x 90 min biweekly sessions, for 3-4 mo IG2: Individual therapy, 12 x 60 min sessions IG3: 10d summer camp, IG1/2/3: monthly parent/child follow-up sessions to 12 mo IG4: 1 x 90 min family session Follow-up 4.6 years from baseline R: IG1 73%, IG2 81%, IG3 83%, IG4 81% at 4.6y	enhance self-regulation and problem-solving skills; nutrition education; daily aerobic exercise promoted; behaviour change diary. IG1: outpatient group therapy IG2: individual therapy IG3: summer camp; meals at camp based on 1500kcal/d; 5 hr/d exercise IG 4 (self-selected controls): advice only; children and parents received the same information as other groups during one family session P: Multidisciplinary team	(2.4)%* Pre-FU: -18.0 (3.1)%* IG2, pre-post: -8.0 (3.8)%* Pre-FU: -11.0 (4.8)%* IG3, pre-post: -18.0 (3.1)* Pre-FU: -15.0 (3.1)%* IG4, pre-post: -6.0 (2.5)%* Pre-FU: -7.0 (3.1)%*	Outcome reported between baseline and follow-up only
Braet et al. 2004 ⁴ , Braet et al. 2006 ⁵ ; Belgium; pre-post; inpatient; neutral Braet et al. 2003 ⁶ (subsample of the above study with a non-randomised control group)	n=150, 66% F 7-17y, 12.7 (2.3)y BMI>95 th percentile BMI 32.2 (5.2) kg/m ²	10 mo Inpatient program Follow-up 24-36 months from baseline R: 81% at 10 mo (n=21 completed early); 73% at 36 mo	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 biweekly, on preparing healthy food, shopping and aerobic exercises Wait-list CG (Braet et al. 2003 only), did not complete ED related questionnaires P: Multidisciplinary team	BMI IG, pre-post: -8.6 (0.4) kg/m ² * pre-FU: -4.9 (0.4) kg/m ² * Braet et al. 2003 n=76 (IG 38, CG 38) Weight, median (range) IG, pre-post: -19 kg (+2 to -41kg) CG, pre-post: +4 kg (+21 to -11kg)	Binge eating EDE Binge eating disorder (EDE) Bulimic symptoms (EDI) Bulimia nervosa (EDE) ED risk (EDE) Drive for thinness (EDI) Eating concern (EDE) Emotional eating (DEBQ)
Brennan et al. 2012 ⁷ ; CHOOSE Health Program; Australia; community; RCT; positive	n=63 (IG 42, CG 21), 54% F 11-19 y, 14.3 (1.9)y Overweight/obesity BMI z-score IG 2.08	16 wk 10x60 min weekly individual face-to-face sessions + one phone call, then 2x60 minute sessions biweekly	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	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	Bulimic symptoms (EDI-II) Drive for thinness (EDI-II)

	(0.37), CG 2.08 (0.40)	6 mo maintenance phase: 2x60 min visits + 7x15 min phone calls Nil follow-up R: IG 48%, CG 67%	P: Psychologist		
Carnier et al. 2008 ⁸ ; Lofrano-Prado et al. 2009 ⁹ ; 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>95 th percentile BMI girls 35.53 (4.19) kg/m ² , boys 35.78 (4.25) kg/m ²	6 mo 5 x 1-hr sessions/wk (3 x supervised exercise, 1 nutrition, 1 psychological group sessions) + 1/mo visit with endocrinologist Nil follow-up R: 88%	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 P: Multidisciplinary team	BMI Girls, pre-post: -2.94 (0.66) kg/m ² * Boys, pre-post: -3.74 (0.88) kg/m ² *	Binge eating (BES) Bulimic symptoms (BITE)
Carnier et al. 2010 ¹⁰ ; Carnier et al. 2012 ¹¹ ; Damaso et al. 2013 ¹² ; Brazil; pre-post; tertiary outpatient; neutral	n=97, 58% F 15-19y, mean age NR BMI > 95 th percentile BMI 37.0 (4.95) kg/m ²	1 year 5 x 1-hr sessions/wk (3 x exercise, 1 x nutrition, 1 x psychological group sessions); 1/mo visit with endocrinologist Nil follow-up R: 79%	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 P: Multidisciplinary team	BMI IG, pre-post: -4.1 (0.46) kg/m ² *	Binge eating (BES) Bulimic symptoms (BITE)
Chirita-Emandi et al. 2014 ¹³ ; Romania; NRCT; outpatient; neutral	n=40 (IG 17, 58% F, CG 23, 50% F) 6-18 y, IG 11.2y, CG 10.9y (SD NR) BMI>85 th percentile BMI z-score IG1 2.79, IG2 2.76 (SD NR)	10 wk IG1: 20 biweekly sessions IG2: one education session Follow-up 6 months from baseline R: IG1 71%, IG2 96% at 6 mo	IG1: Lifestyle intervention with whole family approach; nutrition education, avoid restrictive feeding behaviour allowing child to self-regulate meals; PA education to aim for >1hr per day PA, reducing screen time <2hrs per day. <i>Plus</i> 20x30 min individual infra- low-frequency neurofeedback training IG2: Lifestyle intervention only P: Counsellor	BMI z-score (SE NR) IG1: pre 2.79, post 2.5, FU 2.48 IG2: pre 2.76, post 2.39, FU 2.2	Emotional eating (TFEQ)
Cohen et al.	n=78 (IG1 25, IG2 25,	8 mo	All groups (including CG) received the same nutrition and PA	BMI z-score	Emotional eating

<p>2018¹⁴; McGill Youth Lifestyle Intervention with Food and Exercise (MY LIFE) Study; Canada; RCT; outpatient; positive</p>	<p>CG 28), 58% F 6-8y, 7.8 (0.8)y BMI≥85th percentile Mean BMI NR</p>	<p>1-5 mo: 5 x 1.5 hr group sessions 1 x group sessions at 8 mo Follow-up at 12 mo from baseline R: IG1 92%, IG2 96%, CG 93% at 12 mo</p>	<p>education at baseline. Intervention groups: nutrition and PA education; managing hunger; encourage daily PA; FBT components using motivational interviewing techniques, reflective listening, sharing decision making with the child and families, and realistic goal setting with the child. IG1: standard treatment – recommends two serves per day of milk and alternatives IG2: modified treatment - recommends four serves per day of milk and alternatives CG: no additional treatment. Offered treatment 6 mo after the 12 mo study period P: bilingual registered dietitian with experience in physical education</p>	<p>IG1: reduced at 6* and 12* months IG2: reduced at 6* and 12* months</p>	<p>(CEBQ)</p>
<p>Croker et al. 2012¹⁵; UK; primary care; RCT; positive</p>	<p>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)</p>	<p>6 mo 15 sessions: 10 weekly, 3 biweekly, 2 monthly Follow-up 10 mo from baseline R: IG 59%, CG 97% at 6 mo and 10 mo</p>	<p>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 Waitlist-CG: completed treatment following 6 mo on wait-list P: Multidisciplinary team</p>	<p>BMI z-score IG, pre-post: -0.11 (0.028)* CG, pre-post: -0.10 (0.027)* BMI pre-post IG -0.36 (0.19) kg/m²* CG -0.03 (0.18) kg/m²</p>	<p>Bulimic symptoms (ChEAT) ED risk (ChEAT) Outcomes NR at follow-up</p>
<p>DeBar et al. 2012¹⁶; USA; RCT; primary care; positive</p>	<p>n=208 (IG1 105, IG2 103), 100% F 12-17y, 14.1 (1.4)y BMI≥90th percentile BMI z-score IG1 2.00 (0.34), IG2 2.00 (0.33)</p>	<p>5 mo 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</p>	<p>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 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</p>	<p>BMI z-score IG1, pre-post: -0.12 (0.03)* Pre-FU: -0.15 (0.04)* IG2, pre-post: -0.06 (0.029)* Pre-FU: -0.08 (0.03)*</p>	<p>Binge-related ED (QEWP-A)</p>
<p>De Niet et al.</p>	<p>n=141 (IG1 73, IG2</p>	<p>1 y</p>	<p>All families are enrolled in 'Big Friends Club' (BFC) FBT</p>	<p>BMI z-score</p>	<p>Emotional eating</p>

2012 ¹⁷ ; Short Message Service Maintenance Treatment (SMSMT); Netherlands; RCT; tertiary outpatient; positive Data from baseline to 3-mo used in meta-analysis	68), 64% F 7-12y, 9.9 (1.3)y Overweight/obesity BMI z-score 2.59 (0.45)	3 mo BFC program: 6 weekly sessions + 2 biweekly sessions Group sessions at 6, 9, and 12 mo Nil follow-up R: IG1 86%, IG2 69%	intervention at baseline - provides nutrition and PA education; parents discussion of strategies for healthy eating and physical activity; children exercise together during group sessions At 3 mo, families transition to reduced intensity intervention and randomised to receive an SMS maintenance treatment, or no SMS. IG1: received SMS support messages for 9 mo following the intensive phase; focus on self-monitoring, personalised feedback, behaviour change IG2: groups sessions only, no SMS support P: Multidisciplinary team	IG1, pre-post: -0.25 (0.05)* IG2, pre-post: -0.20 (0.05)*	(DEBQ)
De Miguel-Etayo 2016 ¹⁸ ; Spain; pre-post; outpatient; neutral	n=156, 54% F 13-16y, median age (25% CI) 14.59 (13.62-15.50)y Overweight/obesity BMI males 31.82 (4.48) kg/m ² , females 31.69 (5.39) kg/m ²	13 mo Weekly groups for 2 mo, then monthly for 11 mo Nil follow-up R: 72%	IG: calorie restriction of 10-40% based on BMI category, meal plan for first 3 wk, followed by food portion exchange protocol for 6 wk, then flexible meal plans based on food-portion exchanges; goal to achieve at least 60 min of moderate-to-vigorous physical activity 3-5 d/wk; psychological support included workshops focusing on eating and PA behaviour patterns, troubleshooting techniques to encourage adherence and prevent relapse P: paediatricians	BMI Females, pre-post: -1.66 (0.45) kg/m ² * Males, pre-post: -1.43 (0.45) kg/m ² *	Bulimic symptoms (EDI-II) Drive for thinness (EDI-II)
Edwards et al. 2006 ¹⁹ ; UK; pre-post; tertiary outpatient; neutral	n=33, 70% F 8-13y, 10.1 (1.6)y BMI≥98 th percentile BMI z-score 3.23 (0.48)	4 mo 1.5 hr group sessions, 8 weekly then 4 biweekly sessions Follow-up 7 mo from baseline R: 82% at 4mo; 61% at 7 mo	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 behaviour management to support behaviour change for the child P: NR	BMI z-score Pre-post: -0.15 (0.08)* Maintained at follow-up p<0.001 (data NR)	ED risk (ChEAT) Outcomes NR at follow-up
Epstein et al. 2001 ²⁰ ; USA; RCT; tertiary outpatient; neutral	n=67, 47% F 8-12y, 10.3 (1.1)y 20-100% overweight	6 mo 15-30 min individual + 30 min group/wk for 16wk, then 2 biweekly meetings	All participants were provided similar nutrition, PA and behaviour change education at each visit. Individual therapist and separate child and parent groups TLD with initial caloric goal of 1000-1200 kcal/d, adjusted to	% overweight Combined groups, pre-FU: -12.50 (1.97)%*	ED risk (KEDS) Bulimic symptoms (KEDS)

Reports follow-up only	BMI 27.4 (3.2) kg/m ²	and 2 monthly meetings Follow-up 2 y from baseline R: 70% at 2y	promote weight loss of ~0.5 lb/wk in children and 1 lb/wk in adults, with the lower caloric level never <1000 kcal/d; education to increase PA; goal setting and praise for targeting eating and activity behaviours IG1: problem-solving skills taught to parent and child IG2: problem-solving skills taught to child only IG3: no additional problem-solving skills P: Therapist		
Estabrook et al. 2009 ²¹ ; USA; RCT; tertiary outpatient; positive Reports follow-up only	n=220 (IG1 50, IG2 85, IG3 85), 46% F 8-12y, 10.7 (1.4)y BMI ≥ 85 th percentile BMI z-score IG1 2.04 (0.02), IG2 2.06 (0.04), IG3 2.03 (0.04)	1-12 wk IG1: 1 week IG2: 2 weeks, 2 x 2 hr group sessions IG3: 12 wk, 2 x 2 hr group sessions + 10 telephone counselling sessions Follow-up 12 mo from baseline R: IG1 72%, IG2 67%, IG3 74% at 12 mo	IG1: Family Connections (FC) workbook for parents; homework assignments to encourage lasting change; promoted increased fruits and vegetables and decreased sugared-drink; increased PA IG2: FC- workbook for parents + two small group sessions with a registered dietitian IG3: FC- workbook + two small group sessions with a registered dietitian + automated telephone counselling sessions on goal setting related to eating and PA P: Research assistants (IG1), dietitian (IG2, IG3)	BMI z-score IG1, pre-FU: -0.06 (0.02)* IG2, pre-FU: -0.02 (0.03) IG3, pre-FU: -0.08 (0.03)*	ED risk (KEDS)
Fennig et al. 2015 ²² ; 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 P: Dietitian, therapist	BMI Pre-post: -3.15 (2.05) kg/m ² *	Bulimic symptoms (EDI) Eating concern (EDE-Q) ED risk (EDE-Q)
Follansbee-Junger et al. 2010 ²³ ; USA; RCT; community; neutral	n=67 (IG1 24, IG2 24, IG3 19), 48% F 8-13y, 10.7y (SD NR)	4 mo 12 x 90 min group sessions, weekly for 8 wk, then biweekly for 8 wk	Group sessions based on Stoplight Program; nutrition education, use of food diary but did not track energy intake; increased PA using a pedometer-based step program, reduced sedentary time; goal setting, addressed self-esteem, body image and behavioural management techniques	BMI z-score ^a IG1, pre-post: -0.14 (0.06)* Pre-FU: -0.09 (0.06)	ED risk (ChEAT)

	Overweight/obesity BMI z-score IG1 2.15 (0.24), IG2 2.15 (0.46), CG 2.15 (0.42)	Follow-up 10 mo from baseline R: 85% at 4 mo; IG1 75%, IG2 71%, IG3 79% at 10 mo	IG1: Parents only group IG2: Family based group – parents and children participated in simultaneous but separate groups; youth sampled a healthy snack each wk and participated in fun PA CG: Wait-list control group P: NR	IG2, pre-post: -0.08 (0.07) Pre-FU: -0.12 (0.08) CG, pre-post: -0.01 (0.08) Pre-FU: 0.02 (0.08)	
Goldschmidt et al. 2014 ²⁴ ; USA; RCT; tertiary outpatient; neutral	n=150 (IG1 51, IG2 50, IG3, 49), 69% F 7-12y, 9.85 (1.3)y 20-100% above their age- and sex-specific median BMI BMI z-score 2.21 (0.30)	9 mo FBT, 5 mo: 20 weekly sessions (20 min individual families, 40-min groups) Maintenance, 4 mo: 16 weekly sessions Follow-up 29 mo from baseline R: IG1 92%, IG2 94%, IG3 94% at 9 mo; IG1 84%, IG2 86%, IG3 78% at 29 mo	All groups completed FBT before randomisation to a maintenance program FBT: separate parent and child group sessions; basic weight control strategies using TLD, energy target of 1200-1500 kcal/d to facilitate weight loss of 0.5-1 lb/week; goal to achieve 90 min/wk moderate-intense PA; behavioural skills for weight control in the family context including self-monitoring, parent modelling, positive reinforcement, stimulus control IG1: Behavioural skills maintenance treatment - focused on helping families develop behavioural weight maintenance skills; modify energy intake from weight loss treatment to an individualised level consistent with weight maintenance IG2: Social facilitation maintenance – helping families change social environment and body image to support weight maintenance e.g. forming friendships with physically active peers; modify energy intake from weight loss treatment to an individualised level consistent with weight maintenance IG3: FBT only, no maintenance treatment P: NR	BMI z-score IG1, pre-post: -0.27 (0.04)* Pre-FU: -0.19 (0.05)* IG2, pre-post: -0.27 (0.05)* Pre-FU: -0.24 (0.05)* IG3, pre-post: -0.27 (0.04)* Pre-FU: -0.22 (0.05)*	ED risk (ChEDE) Outcomes NR at follow-up
Goossen et al. 2011 ²⁵ ; Belgium; pre-post; inpatient; neutral Reports follow-up only	n=108, 68% F 10-17y, 13.06 (1.99)y BMI >95 th percentile BMI 31.9 (4.43) kg/m ²	10 mo Inpatient program Follow-up 6 years 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 of a personal plan. Parents education biweekly, on preparing healthy food, shopping and aerobic exercises	BMI Pre-FU: -0.36 (0.48) kg/m ²	Binge eating (ChEDE) Binge eating disorder (ChEDE) Bulimic symptoms (EDI-II) Eating concern

		R: 52% at 6y	P: Multidisciplinary team		(ChEDE) Drive for thinness (EDI-II)
Halberstadt et al. 2016 ²⁶ ; HEILOS; Netherlands; pre-post; inpatient and outpatient; neutral	n=120, 67% F 8-19y, 14.8 (2.4)y BMI z-score≥3.0 BMI z-score 3.42 (0.38)	12 mo IG1: Inpatient program 5 d/wk for 6 mo, then 2 d/wk for 6 mo IG2: Inpatient program 5 d/wk for 2 mo, then 2 d/wk biweekly for 4 mo, then 2 d/wk for 6 mo Inpatient stay: individual and group sessions; 4 exercise classes/wk; nutrition education 1/wk, behaviour modification 1/wk Follow-up 24 mo from baseline R: 83% at 12 mo 76% at 24 mo	All participants completed the same treatment with varying duration of inpatient stay. Nutrition education, not primarily aimed at calorie restriction, eating styles (external, emotional, restraint) addressed; exercise classes during inpatient treatment; nutrition and exercise goals for weekends at home; behaviour modification topics including self-regulation, stimulus control, problem solving IG1: 6 mo inpatient component IG2: 2 mo inpatient component P: Multidisciplinary team	BMI Combined groups, pre-post: -4.29 (0.51) kg/m ² * Pre-FU: -1.65 (0.51) kg/m ² * BMI z-score Combined groups, pre-post: -0.41 (0.05)* Pre-FU: -0.25 (0.05)*	Emotional eating (DEBQ)
Ho et al. 2013 ²⁷ ; Gow et al. 2016 ²⁸ ; Researching Effective Strategies to Improve Insulin Sensitivity in Children and Teenagers (RESIST) trial; Australia; RCT; tertiary outpatient; positive	n=111 (IG1 55, IG2 56), 59% F 10-17y, median age (range) 13.2 (10.1 to 17.4)y Overweight/obesity and/or clinical insulin resistance BMI 34.1 (5.37) kg/m ²	12 mo Baseline-3 mo: 4 x 1-hr individual dietitian consults + 2 phone calls + 2 medical consults 4-6 mo: 1 x dietitian consult + 3 support contact (phone, SMS, email) + 1 medical consult + 2 x 60 min gym sessions/wk + 1 x home exercise session/wk 7-12 mo: 1x60 min dietitian consult + 3x support + 1x medical	Three-phase intervention. All participants treated with metformin and received the same lifestyle intervention with differing macronutrient composition. Phase 1: intensive dietary intervention, meal plans provided, nutrition and PA education; coaching framework to support behaviour change, goal setting, self-monitoring, self-efficacy Phase 2: ongoing dietary support; intensive small group exercise program, circuit and resistance training Phase 3: maintenance phase; encouraged to continue with prescribed diet and exercise regime at home Energy prescription for both groups was 6,000 to 7,000 kJ/d (10-14y) or 7,000 to 8,000 kJ/d (15-17y). IG1: high carbohydrate, low fat diet - 55-60% carbohydrate	BMI %95th percentile Combined groups, pre-post: -6.90 (1.00)* Pre-FU: -3.10 (1.80)	Emotional eating (EPI-C)

		consult Follow-up 24 mo from baseline R: 77% at 12mo 38% at 24 mo	(moderate GI), 30% fat (<10% saturated) and 15% protein IG2: moderate carbohydrate, increased protein diet - 40-45% carbohydrate (moderate GI), 30% fat (<10% saturated) and 25-30% protein P: Multidisciplinary team		
Jansen et al. 2011 ²⁹ ; 'Finger in the pie'; Netherlands; RCT; community; neutral	n=98 (IG 59, CG 39) 7-13y, 9.72 (1.6)y ≥130% overweight BMI percentile IG 96.8 (2.93), CG 95.9 (3.38)	10 wk 8 x 2 hr group sessions Follow-up 5.5 mo from baseline R: 85% at 10 wk and 5.5 mo	IG: parent focused CBT; aiming to teach parents to think of solutions themselves rather than present information; creating realistic expectations, modifying eating and exercising habits, how parents can influence the behaviour of their children e.g. rewards, modelling, guilt and low self-esteem Wait-list CG: offered treatment after 6 mo (data combined with IG due to low uptake of treatment) P: Trained CBT therapists	BMI IG pre-post: -2.3 (0.64) kg/m ² * Pre-FU: -2.1 (0.65) kg/m ² * CG, pre-post: -0.1 (0.44) kg/m ² Pre-FU: -0.2 (0.46) kg/m ²	Eating concern (ChEDE-Q)
Kotler et al. 2006 ³⁰ ; USA; pre-post; tertiary outpatient; neutral	n=16, 100% F 12-15y, 13.2 (1.1)y BMI≥95 th 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)	ED risk (EAT)
Levine et al. 2001 ³¹ ; 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	ED risk (ChEAT) Outcome reported between baseline and follow-up only
Murdoch et al. 2011 ³² ; UK; pre-post; community; neutral	n=17, 53% F 7.5-14y, 10.5 (1.82)y BMI>98 th percentile BMI z-score 3.16	6 mon 1.5 hr group sessions, 10 weekly then 5 biweekly Nil follow-up	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 control, teasing, problem-solving; parent education on supporting the child	BMI z-score Pre-post: -0.06 (0.10)	Bulimic symptoms (ChEAT)

	(0.56)	R: 61%	P: Dietitian, psychologist		
Sarvestani et al. 2009 ³³ ; Iran; RCT; community; neutral	n=60 (IG1 30, IG2 30), 100%F 11-15y, IG 13.5 (0.97)y, IG2 12.93 (0.88)y BMI>95 th percentile BMI IG 29.55 kg/m ² , IG2 29.07 kg/m ² (SD NR)	16 wk 4 hr group session/wk (2 hr behaviour modification or nutrition education + 2 hr yoga) Nil follow-up R: 80%	IG1: 4 x visits with dietitian, provided with balanced diet for their age and weight; nutrition education; yoga classes; PA education, aim to exercise 3d/wk; behavioural strategies such as self-assessments, food and activity diary, problem solving IG2: participants attended 3 sessions of the same program P: Dietitian and nurse	BMI (baseline, 6 months, SD NR) IG1: 29.55 kg/m ² , 28.48 kg/m ² IG2: 29.07 kg/m ² , 29.31 kg/m ²	Emotional eating (DEBQ)
Shomaker et al. 2017 ³⁴ ; USA; RCT; tertiary outpatient; positive (Healthy eating arm only met inclusion criteria)	n=14, 79% F 8-13y, 11.0 (1.0)y BMI≥85 th 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)	ED risk (ChEDE) Outcome reported between baseline and follow-up only
Tyler et al. 2016 ³⁵ ; USA; RCT; school based health clinic; positive	n=80 (IG1 38, IG2 42), 57% F 8-12y, 9.4 (1.3)y BMI≥95 th percentile BMI z-score IG 2.25 (0.33), CG 2.23 (0.32)	9 mo IG1: 7 x 30 min visits IG2: 1 x information session+ 3 x data collection only visits Nil follow-up R: IG1 71%, IG2 43%	IG1: negotiated weight management intervention for parent child dyads; focus on weight-related behaviours, nutrition education; given pedometer and jump rope to encourage PA; negotiation techniques based on motivational interviewing principles and strategies IG2: received the same weight management education from a nurse in one session P: Paediatric nurse practitioner	BMI z-score IG1, pre-post: -0.07 (0.05) IG2, pre-post: -0.25 (0.06)*	ED risk (ChEAT)
Van Vlierberghe et al. 2009 ³⁶ ; 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 biweekly, on preparing healthy food, shopping and aerobic exercises	Mean percentage weight loss Pre-post: 52.5 (2.09)% (range 18.2 to 107.4%)	Binge eating (ChEDE) Binge eating disorder (KID-SCID/ChEDE) Bulimia nervosa (KID-SCID/ChEDE) Eating concern

	BMI≥95 th percentile BMI z-score 2.25 (0.28)		P: Paediatrician, therapist		(EDE-Q)
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Abbreviations: BES, Binge Eating Scale; BITE, Bulimic Investigatory Test; CBT, Cognitive behavioural therapy; CEBQ, Children's Eating Behaviour Questionnaire; CG, control group; ChEAT, Children's Eating Attitudes Test; ChEDE, Child Eating Disorder Examination; DBT, Dialectical behaviour therapy; DEBQ, Dutch Eating Behaviour Questionnaire; EAT, Eating Attitudes Test; EAT-26, Eating Attitudes Test – 26 item; EDE, Eating Disorder Examination; EDE-Q, Eating Disorder Examination Questionnaire; EDI, Eating Disorder Inventory; EDI-II, Eating Disorder Inventory- 2nd edition; EES, Emotional Eating Scale; EPI-C, Eating Pattern Inventory for Children; F, female; FBT, Family-based treatment; FU, follow-up; IG, intervention group; KEDS, Kids Eating Disorder Survey; KID-SCID, Structured Clinical Interview for DSM-IV-Childhood version; NR, not reported; PA, physical activity; pre-post, non-controlled trial; QEWP-A, Questionnaire of Eating and Weight; RCT, randomised-controlled trial; TFEQ, Three-Factor Eating questionnaire; TLD, traffic light diet

*Change from baseline, P<0.05

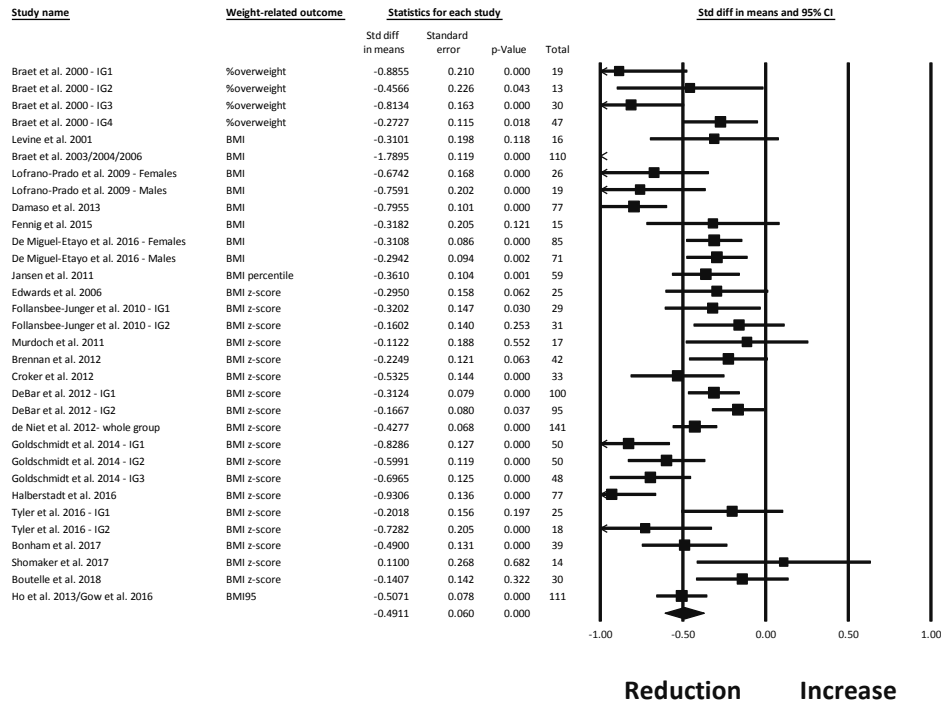
^aPost-treatment data obtained from Janicke et al. 2008³⁷

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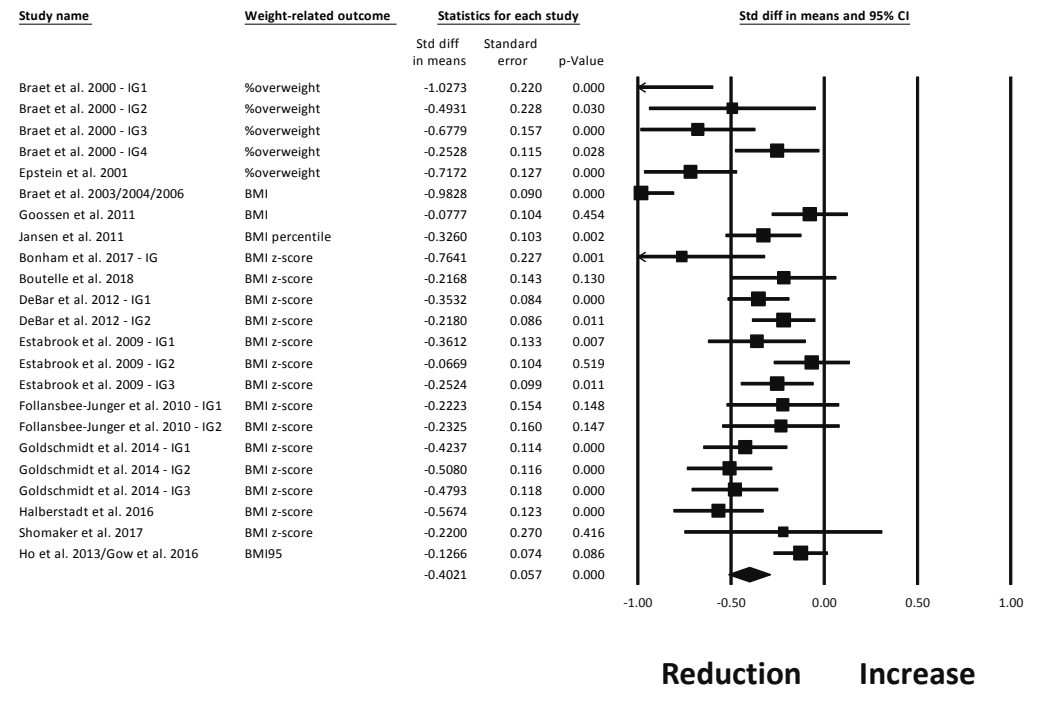
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A – Pre-post intervention



B – Baseline to latest follow-up

Figure S1: 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.

Results are presented as Standardised Mean Difference (SE) using a random effects model

Abbreviations: %overweight, percentage overweight calculated based on normative data; BMI, body mass index; BMI95, BMI expressed as a percentage of the 95th percentile; IG, intervention group

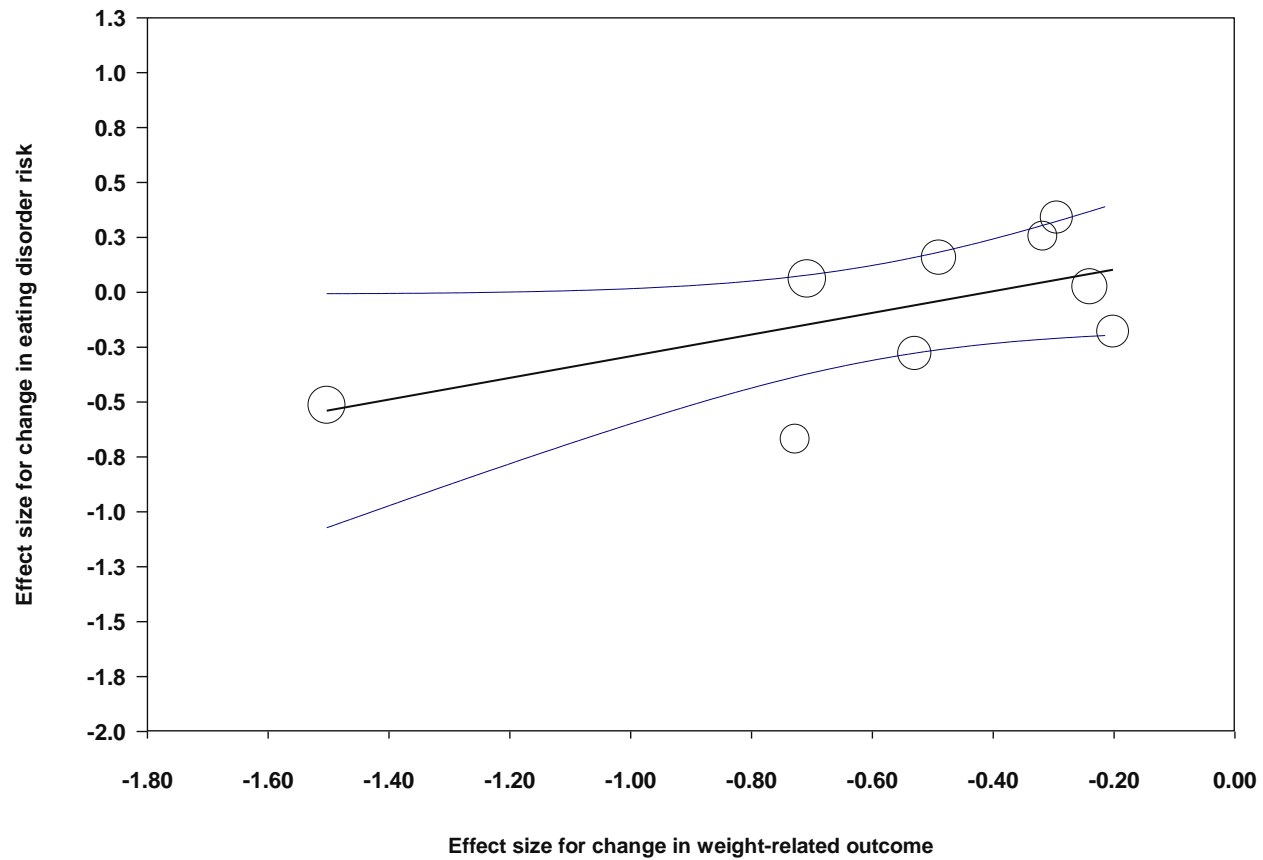


Figure S2: Meta-regression of the effect size for change in eating disorder risk and the effect size for change in weight-related outcomes between pre- and post-intervention following professionally administered obesity treatment with a dietary component in children and adolescents with overweight and obesity ($R^2=0.43$, $p=0.02$)