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The quality of dietary intake methodology and reporting in child and adolescent obesity intervention trials: a systematic review.

Tracy Burrows[1*], Rebecca K Golley[2*], Amina Khambalia[3], Sarah A.McNaughton[4], Anthea Magarey[5], Richard R Rosenkranz[6], Margaret Alllman-Farinelli[7], Anna M Rangan[7], Helen Truby[8], Clare Collins[1].

[1]School of Health Sciences, Faculty of Health, Priority Research Centre for Physical Activity and Nutrition, University of Newcastle, Newcastle, New South Wales, Australia; [2]Public Health, School of Health Sciences, Sansom Institute for Health Research, University of South Australia, Adelaide, Australia; [3]Clinical and Population Perinatal Research, Kolling Institute of Medical Research, University of Sydney at Royal North Shore Hospital, New South Wales, Australia; [4]Centre for Physical Activity and Nutrition Research, School of Exercise and Nutrition Sciences, Deakin University, Burwood, Victoria, Australia;[5]Nutrition and Dietetics, Flinders University, Adelaide, SA, Australia; [6]Department of Human Nutrition, Kansas State University, Manhattan, KS, USA [7]Nutrition and Metabolism, School of Molecular Bioscience, The University of Sydney, NSW, Australia; [8]Nutrition and Dietetics, Monash University, Clayton, Victoria,
Authors are part of the food and nutrition stream of the Australian Child and Adolescent Obesity Research Network (ACAORN). This is a network established to foster and coordinate research collaboration among Australian and New Zealand child and adolescent obesity researchers.

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Address Correspondence to:

Dr Tracy Burrows

PhD, BHSc (N&D), GTTT, Adv APD

School of Health Sciences, Faculty of Health, University of Newcastle,

University Drive, Callaghan, Newcastle, NSW, Australia, 2308

Ph. +61 2 49 215514

Fax +61 2 49 216984

Email Tracy.burrows@newcastle.edu.au

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ABSTRACT

Background: Assessing dietary intake is important in evaluating childhood obesity intervention effectiveness.

Purpose: To evaluate the dietary intake methods and reporting in intervention studies that included a dietary component to treat overweight or obese children.

Methods: A systematic review of studies published in the English language, between 1985 and August 2010 in health databases.

Results: The search identified 2295 papers, of which 335 were retrieved and 31 met the inclusion criteria. Twenty-three studies reported energy intake as an outcome measure, 20 reported macronutrient intakes and 10 studies reported food intake outcomes. The most common dietary method employed was the food diary (n=13), followed by 24-hour recall (n=5), food frequency questionnaire (FFQ) (n=4) and, dietary questionnaire (n=4). The quality of the dietary intake methods reporting was rated as 'poor' in 15 studies (52%) and only three were rated as 'excellent.' The reporting quality of FFQs tended to be higher than food diaries/recalls.

Conclusions: Deficiencies in the quality of dietary intake methods reporting in child obesity studies were identified. Use of a dietary intake methods reporting checklist is recommended. This will enable the quality of dietary intake results to be evaluated, and an increased ability to replicate study methodology by other researchers.

BACKGROUND

Dietary intake is a major determinant in the development, prevention and management of child and adolescent overweight and obesity.[1 2, 3] There are limited published data that report on children's dietary intake in the context of obesity interventions. In a 2006 systematic review of child obesity treatment studies that included a dietary intervention component, 23 of 37 randomized controlled trials (RCTs) indicated that changes in dietary intake were measured.[4] However, only 11 studies actually reported dietary outcomes.[4]

The lack of reporting of dietary outcomes is likely due to the challenges of measuring dietary intake, particularly in children and adolescents.[5] A number of issues need to be considered when assessing dietary intake. This includes whether a comprehensive assessment of usual diet is required versus specific food components or dietary patterns; as well as consideration of subject burden, cost, administrative and analytic burdens. [6] These issues are discussed in detail elsewhere.[1, 5] Additionally, there are many methods to assess dietary intake each with advantages and disadvantages, including threats to deriving reliable and valid estimates of energy, food, or nutrient intake.[1, 5]

Good quality reporting of dietary intake methods is an important part of being able to replicate studies, interpret dietary intake findings and consider potential measurement bias. [6] There are no universal recommendations to guide adequate reporting of dietary methods or the validity of dietary assessment methods. However the checklist by Nelson and colleagues provides an overview of the details required.[7] Similarly the score developed by Serra-Majem and colleagues provides a means of evaluating the quality of dietary intake validation studies.[8] To our knowledge, no research to date has critiqued the dietary assessment methods and reporting used in child obesity intervention studies that include an outcome measure of dietary intake.

Therefore the aim of this review was to evaluate the quality of reporting of dietary intake methods in intervention trials for treatment of overweight or obesity in children and adolescents that included a dietary component and reported a dietary outcome.

METHODS

This systematic review followed a prospectively prepared protocol, and is reported using the PRISMA reporting guidelines for systematic reviews.[9]

Search strategy

A two-phased search strategy was undertaken to identify studies in the English language published between 1985 and August 2010. With the expertise of a librarian, investigators conducted an initial search in MEDLINE and Cumulative Index to Nursing and Allied Health Literature (CINAHL) to establish appropriate search terms. A second systematic search of all relevant databases (PREMEDLINE/MEDLINE, Cochrane Library, EMBASE (Excerpta Medica Database), CINAHL, Web of Science, Scopus and PsycINFO) was performed using key words. These were: dietetic, diet, nutrition, healthy eating and dietary intervention, paediatric (pediatric), child, adolescent, family, parent, school, overweight, obesity, intervention, weight control or weight management or weight loss or healthy weight. An example of a full search strategy is presented in **Table S1**. Full electronic search strategies are available upon request. Electronic searches were supplemented by cross-checking reference lists of relevant publications.

Selection criteria

To be eligible for inclusion, studies needed to: be a RCT or controlled clinical trial; examine an intervention for treatment of overweight and/or obesity that included a dietary component; target children/ adolescents (defined for this review as < 20 years of age) who were defined as overweight or obese; and report a measure of dietary intake as an outcome (i.e. energy intake, macro and/or micronutrient intakes, grams of food groups/ items, percentage of energy from foods groups/ items, frequency of consumption of foods). Studies that only included a dietary-related outcome (i.e. measures of disordered eating, food habits, or dietary knowledge) were excluded. To limit the heterogeneity of studies reviewed, studies that were of overall poor study methodology were excluded. Overall study quality was assessed using the standardised critical appraisal tool from the American Dietetic Association (ADA).[10] Ten quality questions were rated (yes/no) spanning: clarity

of research question, selection bias, randomisation, drop out, blinding, clarity of intervention description, validity of measures, appropriateness of statistical analyses, conclusions drawn, and funding sources. An overall quality rating was assigned: Positive if five or more questions were rated “Yes” (including questions 2, 3, 6, 7); Neutral if questions 2, 3, 6, and 7 were rated “No”; Negative if six or more questions were rated “No” or two or more of questions 2, 3, 6, 7 were rated "No". Only studies rated positive or neutral were included in the review.

Selection strategy and procedures

Articles were assessed for eligibility independently by two investigators in two stages; the first screening stage involved titles and abstracts, and the second involved the full text. In case of discrepancy between the investigators at stage one screening, the paper was automatically included into stage two screening. Any discrepancies at stage two screening were resolved through discussion among three investigators.

Critical appraisal

Dietary assessment methods and reporting quality assessment were performed independently by two reviewers using a checklist developed specifically for this review **(Table S2).** The checklist was informed by the dietary assessment methods checklist of Nelson and colleagues [7] and the EURReca (European Micronutrients Recommendations Aligned) scoring system. [8] The review checklist consisted of six components: methodology validated in similar population, appropriate validation statistics used, data collection quality, reporting of scoring or details of food composition database, and two method specific components (e.g. scale frequency, multiple recall days, seasonality considered). A summary score of the components was calculated. The maximum score was seven and studies were rated as: poor (≤2), acceptable (≤2.5 - ≥3.5), good (≥3.5 - ≤5) or excellent (≥5.0).

For those studies which referenced a validation study for the dietary assessment method, the reference(s) were retrieved and were assessed for study design (validation or reliability study),

appropriateness of the validation study population, their comparative (reference) method and the statistical analysis performed.

Data extraction and analysis

Data were extracted into standardised tables by one investigator and checked for completeness and accuracy by a second. A meta-analysis was not possible, given the heterogeneity of the intervention strategies and outcomes measured. Data synthesis comprised grouping studies by dietary assessment method and comparing in terms of study characteristics and dietary assessment methods reporting quality.

RESULTS

General description of included studies

The search identified 2295 papers of which a total of 31 papers met the review inclusion criteria (**Figure 1**). The most common reason for exclusion was study population (n=125), and 95 studies were excluded as no dietary intake outcomes were reported. The majority of included studies were RCTs (n=27) (**Table 1**) and were published from 2007, with no retrieved papers published prior to 2000. Eighteen studies were conducted in the Americas [11-28], four were conducted in Europe,[29-32], four in Mediterranean and Middle Eastern countries,[33-36] and three in Australia.[37-39] Twelve studies were conducted in a community setting,[11-13, 15, 16, 18, 20-22, 27, 28, 37] seven in hospitals,[14, 17, 29-31, 33, 35] four in universities,[19, 24, 26, 36] and four in primary health care settings.[25, 34, 38, 39] Six studies targeted children less than 10 years of age,[11, 17, 23, 37-39] 13 studies focused on older children,[12-16, 21, 25-28, 31, 40, 41] while 12 studies included both younger and older children (**Table 1**). The number of study participants ranged from 16 to 258, with most studies including between 20 and 50 participants per group (**Table 1**).

Interventions were heterogeneous and included various combinations of the cornerstones of child weight management; diet, physical activity, and behaviour modification (**Figure 2**). The group comparison was diet versus physical activity in nine studies;[12, 13, 16, 17, 19, 26, 37, 41] a comparison of different dietary approaches in seven studies;[14, 21, 27-29, 31, 37] and alternative delivery approaches in five studies.[15, 22, 23, 28, 33] Fourteen studies included a no-intervention control arm.[11-15, 24, 26, 30, 32, 35, 36, 38-40]. Most studies had short-term interventions, mean 13 weeks (range 6 to 25) (**Table 1**). Follow-up was generally limited to the end of the intervention [11-13, 15, 17-19, 27, 28, 36, 40] and varied between eight weeks [18] and two years.[17]

Dietary assessment methods and reporting

Twenty three of the 31 studies reviewed reported energy intake as an outcome measure, and 20 reported macronutrient intakes (**Table 1**). In contrast, only 10 studies reported food group intake outcomes. The most common method for assessing dietary intake was a food diary/record (n=13

studies), with five using 24 hour records/ recalls, four using food frequency questionnaires (FFQ i.e. questionnaires focusing specifically on assessment of frequency of food intake) and four using dietary questionnaires (**Figure 2**). The remaining five studies used multiple dietary assessment or other methods.

The reporting of the dietary assessment methods was rated as 'poor' for 15 of the 31 studies (**Table 1**). A registered dietitian was reported as administering the dietary assessment method in 10 studies, with a further 11 studies reporting use of personnel who had received some training in dietary assessment. The reporting of dietary methods was generally limited by a lack of information on the instrument quality and validity, the qualifications of the person who administered the dietary assessment, and the food composition database that was used to derive energy and nutrient intakes. Of the 31 studies, 11 studies made reference to a dietary validation study for the dietary assessment tool used in the study [16, 17, 20, 25, 27, 28, 32, 33, 35-37]. Of the studies that did not cite a validation reference, 11 used a food record, either weighed or estimated. The four studies using a food record that did reference a validation study all cited the same reference. One validation study was conducted in an adult population, limiting its applicability to the population in which it was used.

Among the referenced validation studies the test dietary intake assessment method was compared with another dietary method, with the exception of three studies which used objective standards. Two studies compared a food diary or a diet history with Doubly Labelled Water (DLW) and a FFQ was compared against biomarkers of fruit and vegetable intake.

The most common statistical approach used to compare two methods was correlation coefficients (n=8 studies). Three studies compared mean intake by the two methods using T-tests. Three studies used Bland-Altman plots to assess the level of agreement between methods, and one used Kappa statistic. Correlation coefficients for FFQs were modest and ranged between 0.26 and 0.63 and between 0.50 and 0.6 for 24 hour recalls. Repeatability was only assessed in three studies, although one was conducted in adults and not the child population where it was applied.

The dietary assessment methods reporting for studies using a food diary/record was generally poor (**Figure 3)**, with only three studies rated as good/ excellent [32, 33, 35]. However seven did report that the food diary/records were administered by a trained person (**Figure 3)**. Most of the studies using 24-hour recalls were rated as good for dietary methods reporting quality and tended to be administered by a registered dietitian (**Figure 3)**. Studies that used multiple dietary intake methods used 24-hour recalls in addition to either a food frequency questionnaire (n=2) or a diet history interview (n=1). Studies using dietary questionnaires were more variable (**Figures 2 and 3**). The validity of the dietary questionnaires was not addressed in any of the studies and none were reported as being administered by trained staff. All the studies utilising dietary questionnaires were rated as poor for dietary methods reporting (**Table 1**).

DISCUSSION

Principal findings

To the authors' knowledge, this is the first systematic review to evaluate the quality of dietary intake methods reporting in intervention studies evaluating childhood obesity interventions that included a dietary component. Studies were only selected for inclusion in the review if their overall study design quality was high. Despite this, there were limitations in the dietary intake methods detail provided in the majority of studies reviewed. The quality of dietary assessment methods reporting was rated as 'poor' in 15/31 studies reviewed and only three were rated as 'excellent'. [20, 29, 37] This is surprising given dietary intake is commonly a key focus of intervention for both treatment and prevention of childhood obesity. Poor dietary intake methods' reporting has implications for a reader's ability to replicate studies, interpret dietary intake findings and consider potential measurement bias.

Choice of dietary assessment method did appear to be related to the quality of the dietary assessment methods reporting. The reporting quality of studies that used food frequency questionnaires tended to be rated as 'excellent' or 'good', compared to studies that used 24-hour

recalls or food diaries. These findings may reflect the high degree of structure associated with food frequency questionnaires which may make it easier to report method details appropriately or that FFQs can be quite varied and specific to foods/population groups which require more detail. In comparison, food recalls and diaries are complex and their administration involves a number of detailed steps. This complexity may make it difficult to comprehensively but concisely provide sufficient detail on these methods when word count for the overall article is limited. Twenty-four hour recalls may also have a perception that this approach is a standardised methodology and does not require further detail. The dietary assessment methods reporting of dietary questionnaires was particularly poor. This may reflect that dietary questionnaires themselves are a relatively recent addition to the dietary assessment methods repertoire and lack rigorous testing. There may also be the perception that nutrition experts need not be involved in their development and validation.

The review highlights the limited use or availability of validated tools to assess dietary intake in paediatric populations. Dietary intake assessment is complex and all methods have a number of threats to validity and reliability, including those considered 'gold standard' such as weighed food records and 24 hour recalls.[5] It is important to use methods that are age-appropriate and have been developed, piloted and validated for assessing children's dietary intake. Without adequate piloting in the study population, or use of methods that have been validated in a similar study population, it is not possible to interpret dietary intake findings. For example, were the changes in dietary intake (or lack thereof) observed due to the intervention or measurement error? Choosing existing validated tools or undertaking a validation sub-study needs to be considered when planning a study. It is also important to report or reference the validation details when reporting dietary intake outcomes.

Selection of the most appropriate dietary assessment tool depends on many factors, including type of information needed (i.e. foods, nutrients, or specific dietary behaviours), the level of accuracy required, the research constraints (i.e. money, time, staff and respondent characteristics) and the suitability of that method to the study design.[42] None of the studies provided a rationale for

their choice of dietary assessment method. The most common method for assessing dietary intake was the food diary/record, whereby the respondent (or parent, in case of children) recorded the foods and beverages and the amounts of each consumed over one or more days. Although this method was commonly used and is considered a gold standard its accuracy is questionable [43]. Researchers using food records in child obesity interventions should take particular care to ensure quality use within a study and quality reporting of the method. Only 10 studies reported actual changes in food consumption, with most reporting outcomes such as energy and macronutrients. This lack of food-based outcome data makes development of practical food-based guidelines for obesity interventions for children and adolescents difficult. The use of 24 hour recalls or FFQs appear to provide the most meaningful results in terms of study quality and flexibility for a range of diet outcomes. Technology-assisted versions of these methods may increase the feasibility of incorporating these methods into future child obesity intervention trials by reducing participant and researcher-burden.

The checklist used to rate the quality of the dietary assessment methods reporting was developed for the purposes of the present review. It was informed by the "Checklist for the Methods Section of Dietary Investigations" which was proposed by the UK Nutritional Epidemiology Group [7, 44] in the early 1990s as a guide for reporting on nutrition. Results of this review indicate infrequent application of this checklist or similar principles, and highlights the need for journal editors to set higher standards for studies reporting dietary methods in the context of child obesity interventions. This will encourage authors to fully describe their dietary methods and incorporate meaningful and valid measures of dietary intake. [1, 7, 43]

The majority of studies that did not reference a dietary validation study used food records, perhaps because this is considered the closest to a 'gold standard'. However, given the limitations associated with all dietary assessment methods, the same reporting standards should apply to food records, including transparent reporting of validity properties in a similar population.

The majority of validation studies used correlation statistics which indicate whether two methods are associated. Associations between dietary methods may be an artefact of correlated errors and correlation coefficients of the magnitude observed in this review (around 0.6) suggest that ~40% of individuals would be misclassified by one method compared to the other [45]. C. deMoor et al [46] suggest a correlation coefficient of 0.9 or higher is needed to avoid misclassification bias. We would recommend alternative statistical approaches be reported in validation studies. Techniques such as Bland and Altman plots or methods assessing misclassification (e.g. kappa statistic) provide more useful information on agreement between methods and are more transparent in potential error or bias associated with different dietary assessment methods. Repeatability and sensitivity to detecting change of dietary assessment method was rarely assessed. This is particularly important in the context of child obesity intervention studies and should be considered or evaluated when selecting dietary assessment methods in future studies.

Strengths and limitations

Strengths of this systematic review include an extensive literature search, rigorous adherence to a predefined protocol and use of an evidence-based set of items for reporting in systematic reviews. [9] In addition, this review was conducted using systematic and standardised search methodologies [9] in/among several electronic databases to identify eligible papers. A limitation is that the search strategy only identified studies published in English in the peer-reviewed literature. Studies among children and adolescents reported in other forums, including trade journals, conferences, and committee meetings were not included and pose a possible publication bias. While most of the high quality scientific literature is published in peer-reviewed sources, the poor quality or negative findings associated with dietary intake data raises the potential of publication bias. However, this only reinforces the need to consider carefully the collection and reporting quality when dietary intake is a study outcome.

Implications

This systematic review highlights the need for improvement in the quality of dietary intake assessment methods and reporting in childhood obesity studies. Like many other areas of scientific research, such as the reporting of randomized controlled trials [47] or systematic reviews,[48] results of this review reinforce the need for transparent and comprehensive reporting of dietary methods. Increased quantity and quality of information on the dietary measures, interventions and outcomes used in childhood obesity studies will further knowledge on the dietary treatments that promote weight loss. Further, developing an evidence base for making public health and clinical decisions requires assessing the quality and outcomes of individual studies. However, to make the best use of dietary intake information in quantitative research syntheses requires transparent reporting of the methods and outcomes, with sufficient detail and clarity to allow evaluation of the differences and similarities among studies.[49] As novel dietary assessment methods which utilise new technologies such as the Internet or mobile phones become available [50, 51], this review will need to be updated and compare the studies using these newer methods to the older and see if it changes what can be learnt from the intervention studies about what aspects of diet are amenable to change.

Recommendations

Assessing the diets of children and adolescents presents unique methodological challenges. There are age related limits on what aspects of diet can be reported due to child cognitive abilities or using parent proxies who may or may not know what is consumed by the child for all or part of the day. In addition, dietary outcomes in overweight and obesity studies are often secondary outcomes and may be given less attention and resources. However, adoption of the following recommendations would improve dietary methods and reporting quality in future studies;

- Twenty-four hour recalls or FFQs provide good quality dietary assessments. The choice between methods should be guided by the research question and outcomes of interest and consideration of the inherent strengths and limitations of any dietary assessment method.

Consideration should be given for using FFQs with another method such as 24 hour recall or WFR as a comparative method in at least a population sub sample.

- The validity properties of the method selected should be known in child and adolescent (and preferably overweight/obese) populations. Studies are needed to better understand the validity of WFR, 24hour recalls and dietary questionnaires in the context of obesity interventions in children and adolescents.
- To ensure that study findings are interpretable and replicable, special attention is needed to improve the reporting of dietary method validity details or reference, the qualifications or training of those who administer the dietary assessment, and the food composition database used to derive energy and nutrient intakes.

There are excellent resources readily available to investigators to ensure that the appropriate dietary tool is selected, administered properly and is adequately described in the study methods. These include the Australian Child and Adolescent Obesity Research Network online decision tree which can assist researchers in the selection of appropriate dietary intake methodologies for studies in the context of child obesity,[52] a detailed online interactive decision matrix provided by the Medical Research Council,[53], the checklist by Nelson et al. which is a must for researchers reporting studies that include assessment of dietary intake.[7] and existing publications in measuring dietary intake in children and adolescents in the context of overweight and obesity [1, 5].

CONCLUSION

The goal of the present review was to provide an overview of the state of dietary assessment methods reporting in childhood obesity intervention studies to inform future study design and reporting. Results indicate that authors, reviewers and journal editors need to ensure more transparent and consistent reporting of dietary methods used in childhood obesity trials if the quality of study reporting is to be improved. In particular, reporting of dietary methods can be improved if

investigators provide information on the instrument validity, the qualifications or training of those who administer the dietary assessment, and the food composition database that was used to derive energy and nutrient intakes. Use of the checklist presented in table S2 will help to achieve this.

Table 1: General Study description of included randomized controlled trials

Reference	Country, Setting	Participants			Study quality[2]	Study Arms	Intervention duration and intensity, *Follow up (retention)*	Dietary Reporting Quality[3]	Dietary Measures
		N	Age (years)	Weight status[1]					
Albala et al 2008 [11]	Chilean Community	98	8-10	OW/OB (CDC BMI %tile)	Positive	(1) DP (2) True Control	16 weeks, weekly home visits and milk delivery *16 weeks (end-I, 94%)*	Poor	FFQ baseline and 16 weeks with mothers present
Burrows et al 2008 [37]	Australian Community	165	5-9	OW/OB (IOTF)	Positive	(1) P + FS + HE + NS + DA (parent) (2) PA + NP (child) (3) PA + NP + P + FS + HE + NS + DA (parent & child combined)	6 months, 10x2hour weekly group sessions + 3xmonthly phone calls *6 months (end-I, 70%), 12 months (FU 64%)*	Excellent	135-item semi-quantitative FFQ
Davis et al 2009a[12]	USA Latino Community	54	14-18	>85th BMI %tile	Positive	(1) HE + BT (2) HE + BT + PA (3) True Control	16 weeks,4x motivational interviews + $25 grocery certificate + bi-weekly 60min strength training *16 weeks (end-I, 100%)*	Acceptable	3-day food record with instructions Given measuring cups and rulers to aid in accurate reporting.
Davis et al 2009b[13]	USA Latino Community	50 (girls only)	14-18	>85th BMI %ile	Positive	(1) HE + BT (2) HE + BT + PA (strength) (3) HE + BT + PA (strength & aerobic) (4) True Control	16 weeks,4 x motivational interviewing, 2 x60 min strength training, 2x 60 min aerobic training *16 weeks (end-I, 82%)*	Acceptable	As above
Ebbeling et al 2003[14]	USA Hospital	16	13-21	OB (BMI>95th %ile)	Positive	(1) DP (red GlyLoad) + BT + PA + NP (2) DP (red fat) + BT + PA + NP	6 months, 12 dietary counselling sessions + 2 follow up dietary counselling sessions *12 months (FU, 87.5%)*	Acceptable	7-day food record, Measuring utensils used to educate accurate appraisal of portion sizes.
Ebbeling et al 2006[15]	USA Schools Community	103	13-18	N (53-58%)/ OW	Positive	(1) DP (2) True Control	25 weeks Beverages home delivered weekly *25 weeks (end-I, 100%)*	Poor	2 x 24hr recall
Ellis et al 2010 [16]	USA African American	49	12-17	OB (BMI >95th %ile	Neutral	(1) DP + HE + NS + PA + SB + FS + BT + P +NE	6 months Twice per week (control group weekly) *7 months (end-I, 84%)*	Poor	Questionnaire, Fat and fibre behaviour rated on a 28 item questionnaire (4 point scale

	Community					(2) DP + HE + NS + PA + SB + FS + BT + P + PA + SB + HE (Shapedown Program)			for each).
Epstein et al 2008[17]	USA Hospital	70	4-7	OW/OB (BMI ≥75th %ile)	Positive	(1) P + SB (2) P	24 months, 5 home visits + monthly newsletters *24 months (end-I, 96%)*	Good	85-item FFQ
Ford et al 2010[29]	UK Hospital	106	9-17	OB (BMI > UK 95%ile)	Positive	(1) NS (Mandometer) + HE + DA (2) FS + BT + PA + HE + DA (Std Care)	12 months, 5 training sessions *12 months (86%),18 months (82%)*	Excellent	Total food consumption (g), speed of eating recorded on the Mandometer device.
Garipagaoglu et al 2009[33]	Turkey Hospital	80	6-14	OB (BMI >97%ile, IOTF)	Positive	Two delivery methods (1) FS + DP + HE + NS + DA (group setting) (2) FS + DP + HE + NS + DA (individually)	3 months,7 x fortnightly sessions *3 month (99%),12 months (95%)*	Good	3-day food record
Gillis et al 2007[34]	Israel Primary care	27	7-16	BMI>90 %ile (CDC)	Neutral	(1) HE + PA + P + BT (2) HE+ PA + P	3 months, 12xweekly clinic visit (2) or phone call *6 months (67%)*	Poor	Record contents of food ingested for 1 day of each week.
Goldfield et al 2006 [18]	Canada Community	30	8-12	OW/OB (BMI>85th %ile	Neutral	(1) BT + PA + SB (2) BT	8 weeks Biweekly meetings with research staff *8-wks (end- I, 100%)*	Acceptable	3-day food record (2 weekdays and 1 weekend day pre and post, 30 minutes instruction on food recording provided measuring utensils for estimating portion sizes.
Gutin et al 2002 [19]	USA University	80	13-16	OB (>85th %ile)	Positive	(1) BT + HE + PA (LSE) (2) LSE + PA (Moderate) (3) LSE + PA (High Int)	8 months ,1 hr LSE biweekly; PA 5d/wk biweekly – alternate wk LSE *8 months (51%)*	Acceptable	2 x 24hr recall, 2 consecutive days.
Janicke et al 2008 [20]	USA Community	93	8-14	OW (>85th %ile)	Positive	(1) FS + BT + HE + PA (Parent & Child sessions) (2) FS + BT + HE +	16 weeks,90 minute group sessions. Weekly x 8 weeks, fortnightly 8 weeks.	Excellent	Youth Adolescent FFQ

						PA (Parent only sessions) (3) WL Control	*16 weeks (end-I, 87%),10 months (f'up 76%)*		
Krebs et al 2010[21]	USA Community	46	12-18	OB (≥175% IDW)	Positive	(1) DP (High Pro, Low CHO) + NP +PA (2) DP (Low Fat) + NP + PA	13 weeks , Fortnightly clinic visits *13 wks (end-I, 72%),24 wk (FU 1, 59%), 36 wks (FU 2, 48%)*	Poor	3-day food record, multiple occasions (3-14 days recoded for each subject, average 8.1 days)
McCallum et al 2007 [38]	Australia Primary Care	163	5-9	OW/OB (IOTF)	Positive	(1) BT + FS + NP (2) True Control	12 weeks Parents attended 4 consultations over a 12-week period *9 months (FU, 93%),12 months (FU, 90%)*	Poor	4-day food record, listed 14 foods, parent reported consumption as none, once or twice or more.
Nemet et al 2005 [35]	Israel Hospital	54	6-16	OB	Positive	(1) FS + DA + NP + HE + NS + NE + PA (2) Control	3 months(1) I group: 6 consults over 3 mths, 30-45 mins each, parents involved; 2 x 1fr exercise training sessions/wk C group: 1 nutritional consultation with PA advice *3-months (end-I, 80%), 12-months (FU 67%)*	Good	2-day food record
Nemet et al 2006 [36]	Israel Hospital	24	6-16	OB (BMI >95th %ile)	Neutral	(1) FS + DA + NP + HE + NS + NE + PA (2) Control	3 months14 weekly meetings (8 with parent only bi weekly) 60-90mins, 12 sessions with children + 6 with parents. 2x per week 1hour exercise training + 1 x 45 min movement therapy session *3 months (end-I, 100%)*	Poor	2 x 24hr recall, One weekday and one weekend day at baseline and not clear at follow up.
Park et al 2007[40]	Korea School	44	13-15	OB (BMI >95th %ile)	Positive	(1) PA + BT (2) True Control	12 weeks PA (walking) - 6 days/week supervised sessions, DL & BT -once per week *12 weeks (end-I, 91%)*	Poor	3-day food record, 2 weekdays and 1 weekend day. Several practice sessions on measuring cup, spoon, and

									ruled paper.
Raynor et al 2002 [22]	USA Community	31	8-12	OW (20-100% >50th BMI %ile)	Positive	Two delivery methods (1) PA + FS + DP + HE + BT (Grp & Indvid Sessions) (2) PA + FS + DP + HE + BT (Grp Sessions Only)	20 weeks, 1 hr weekly meetings for 2 months, bimonthly meetings for 2 months, and 1 monthly meeting. *20 weeks (end-I, 83%, 69% for diet data)*	Good	3 x 24-hour recall
Reinehr et al. 2010 [30]	Germany Hospital	66	Mean 11.5	OW (BMI >90th ≤97th %ile)	Neutral	(1) FS + BT + PA + HE (2) WL Control	6 months, Not stated *6 months (end-I, I group 97%, C group 86%)*	Poor	3-day food record, weighed food data collected.
Resnick et al 2009 [23]	USA School	46	grade K – 5	OW/OB (BMI ≥85th %ile)	Neutral	Two delivery methods (1) FS + PA + SB + NP + NS (Education materials mailed) (2) FS + PA + SB + NP + NS (Education materials received through personal encounters with CHW's)	I group: 18 wks (average 3.4 home visits or phone calls, 5.5wks apart). C group: 30 wks 6 mailing contacts over 30 weeks. intervals) *4 weeks (end-I, 91%)*	Poor	Serves of fruit and vegetable
Rodearmel et al 2007 [24]	USA University	218	7-14	OW/OB (BMI>85th %ile)	Neutral	(1) FS + PA + DP + NS + HE (2) True Control	6 months, Not stated *6 months (end-I, 84%)*	Poor	'Sweets survey'.
Rolland-Cachera et al 2004 [31]	France Boarding school at medical centre	121	11-16	OB (BMI>97th French %ile)	Neutral	(1) DP (Protein 15%, CHO 54%) + PA + SB (2) DP (Protein 19%, CHO 50%) + PA + SB	9 months Live in at boarding school *9 months (end-I, 82%), 2 years (FU, 60%)*	Poor	Diet provided.
Saelens et al 2002 [25]	USA Primary care	44	12-16	OW/OB (BMI>20-100% over median)	Positive	(1) BT + PA + SB + HE + NE + P (2) PA + HE	16 weeks, I group: weekly (8) and biweekly (3) phone sessions +mail C group: 1 session with GP *4 months (FU, 88%),7-*	Poor	2 x 24hr recall

							mths (FU, 84%), were paid $25 at each time point*		
Sung et al 2002 [41]	Hong Kong School	82	8-11	OB (>120% of median wt for ht)	Neutral	(1) DP + PA (2) DP	6 weeks , Bi-weekly *Not reported*	Acceptable	3-day food record, recorded by child with help of parent.
Ventura et al 2009 [26]	USA University	66	Mean age (SD): 15.5 (±1)	OW/OB (≥85th CDC %ile)	Positive	(1) HE (2) HE + PA (3) True Control	16 weeks weekly *16 weeks (end-I, 82%)*	Poor	3-day food record, short lesson on estimating portion sizes and provided with measuring equipment.
Wake et al 2009 [39]	Australia Primary Care	258	5-10	OW/OB (IOTF)	Positive	(1) BT + FS + NP (2) True Control	12 weeks,4 visits to GP *6 months (end-I, 97%),12 months (FU, 94%)*	Poor	4-day food record, parents reported child's consumption of 10 food and drink items for 2 weekdays and 2 weekend days (fruit, vegetables, water; fatty/sugary foods and non-diet sweet drinks).
Waling, et al 2010 [32]	Sweden University	92	8-12	OW/OB (IOTF)	Positive	(1) FS + PA + HE + NP + DA (2) True Control	12 months once or twice per month *12 months (end-I 63%)*	Good	1)1x diet history interview previous 2 weeks 2) 3x2-day food records (weekdays and weekend days and different seasons). 3) Portion sizes translated from digital camera photos
Williams et al 2007 [27]	USA Community	38	11-15	OB (BMI>95th %ile)	Neutral	(1) DP (1500kcal/day + free snack) + FS + HE + PA (2) DP (1500kcal/day + restricted snack) + FS + HE + PA	12 weeks Fortnightly Ax & Monitoring. Dietary counselling *12 weeks (end-I, 84%)*	Good	1) 3x24hr food diary records 2) Willett Youth FFQ
Williamson et al 2005 [28]	USA Community	57	11-15	OW/OB (BMI>85th %ile)	Neutral	(1) FS + BT + PA + HE (2) DA + HE	6 months unlimited website access *6-mths (end I, 88%)*	Good	1) 3x24hr food recalls 2) Block FFQ

[1.] OW overweight; OB obese; CDC Centre for Disease Control; IOTF International Obesity Task Force; %ile Percentile; [2.] Overall methodological study quality was assessed using the American Dietetic Association critical appraisal tool [103.] Assessed with modified version of the EURECA tool. I -Intervention, FU– Follow up, DP– Dietary pamphlet, DA- Dietary advice, LSE lifestyle education, DL-Diet and lifestyle, BT-Behaviour therapy, P-Parenting, PA Physical activity, FS – family support SB sedentary behaviour, BMI – Body Mass index, DP-Dietary Prescription, HE-Healthy Eating-, NS Nutrition skills, NE Nutrition environment , NP Nutrition pamphlet, DA- Dietary advice, NO Nutrition other

FIGURE 1

Title: Flow diagram of article identification, retrieval and inclusion for systematic review.

FIGURE 2

Title: Intervention details for randomized controlled trials included in the systematic review.

Legend: Horizontal bars represent the number of studies within each descriptive category. The sections of the horizontal bars starting from left to right by type of dietary instrument used and are represented by the following abbreviations: FD: food diary/record; 24-HR: 24 hour recall; FFQ: food frequency questionnaire; Q: questionnaire; MM: multiple methods; and Other.

FIGURE 3

Title: Study and dietary methodology and reporting quality in studies included in the systematic review.

Legend: Horizontal bars represent the number of studies within each descriptive category. The sections of the horizontal bars starting from left to right by type of dietary instrument used and are represented by the following abbreviations: FD: food diary/record; 24-HR: 24 hour recall; FFQ: food frequency questionnaire; Q: questionnaire; MM: multiple methods; and Other.

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Figure 1
Flow diagram of article identification, retrieval and inclusion for the systematic review

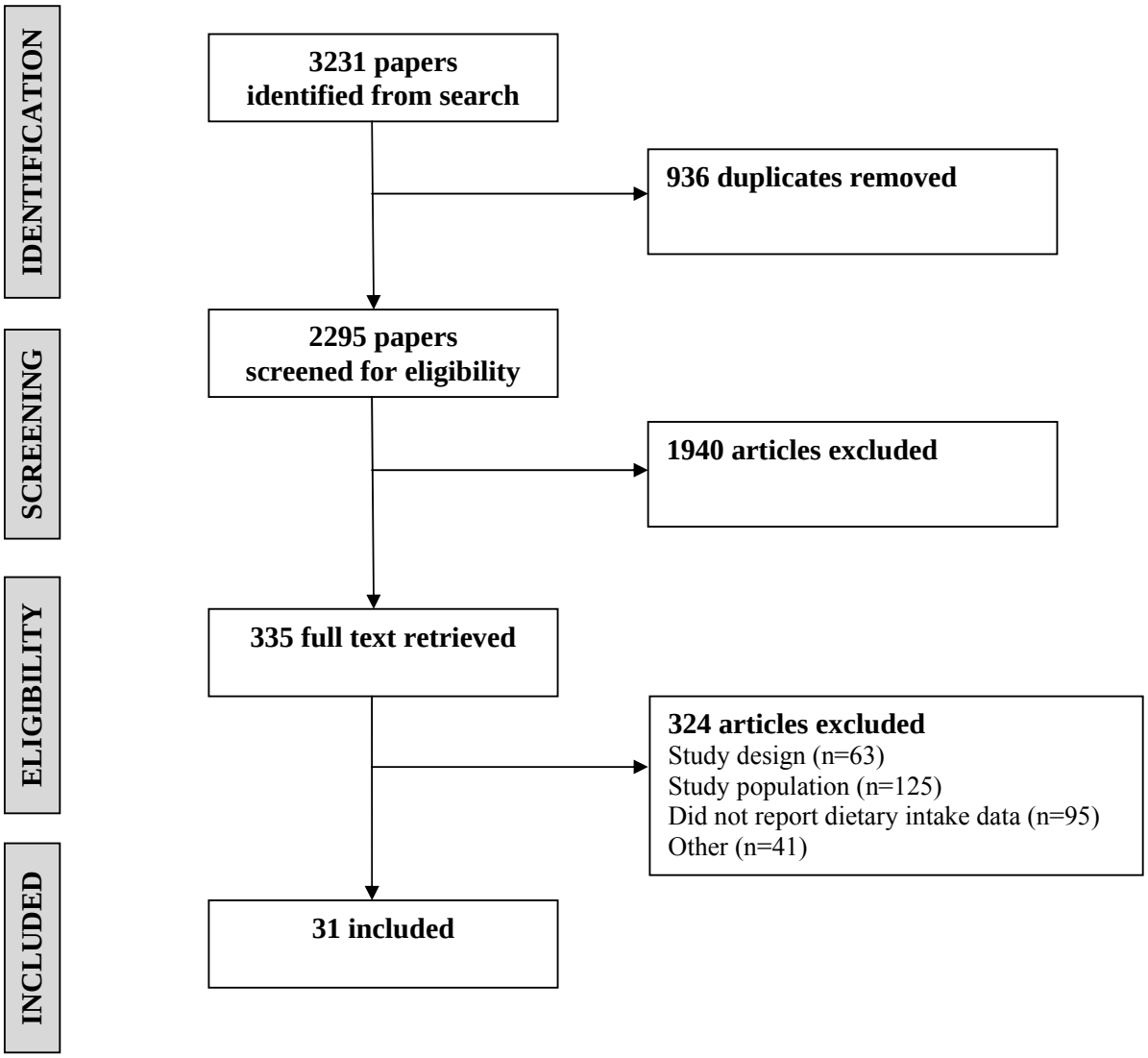
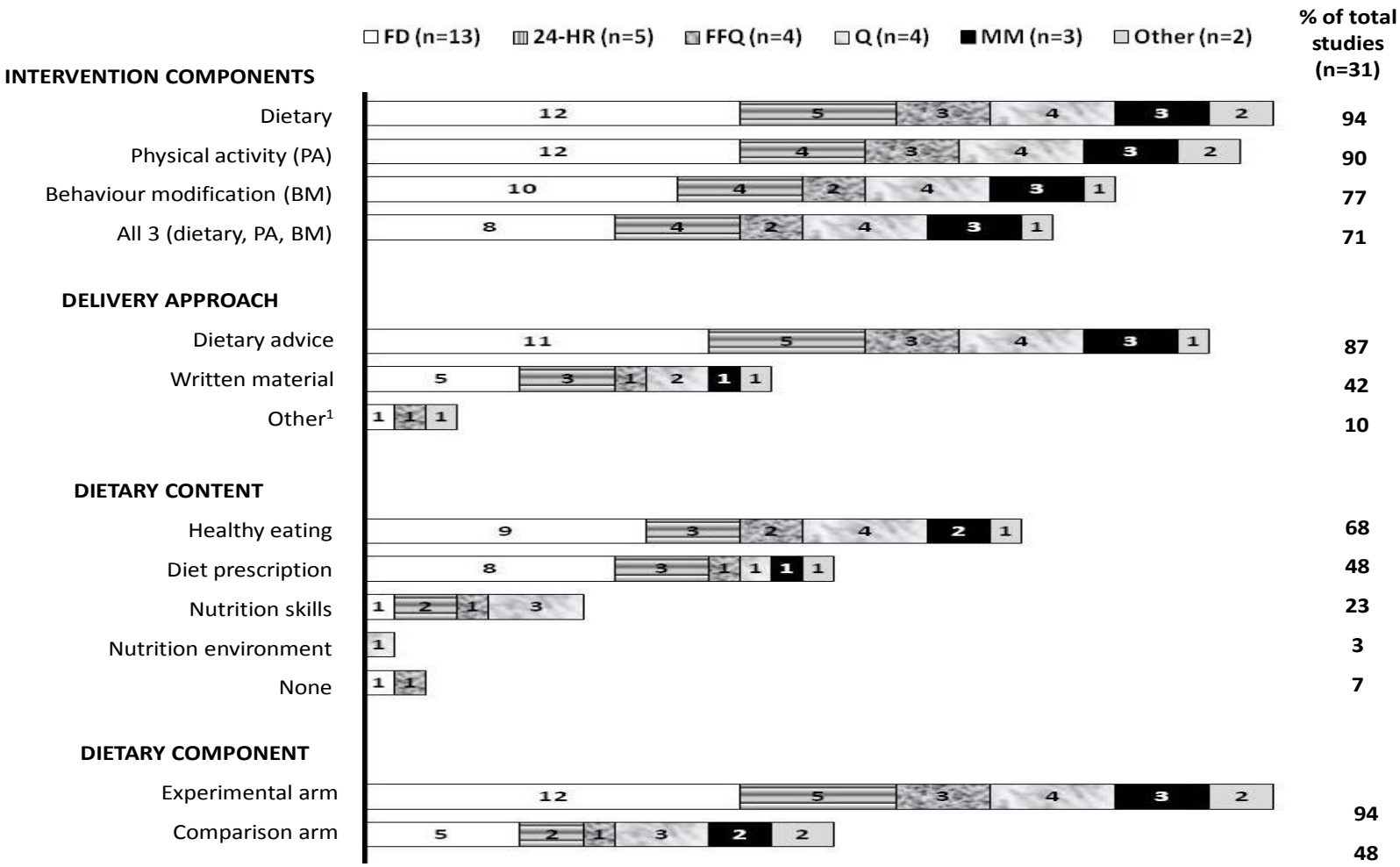


Figure 2



[1] Other represents studies that did not have a dietary component, such as Goldfield, 2006 and Epstein, 2008 which aimed to reduce sedentary behaviour and increase physical activity and the study by Reinehr, 2010 that reported approaches varied by treatment center.

Figure 3

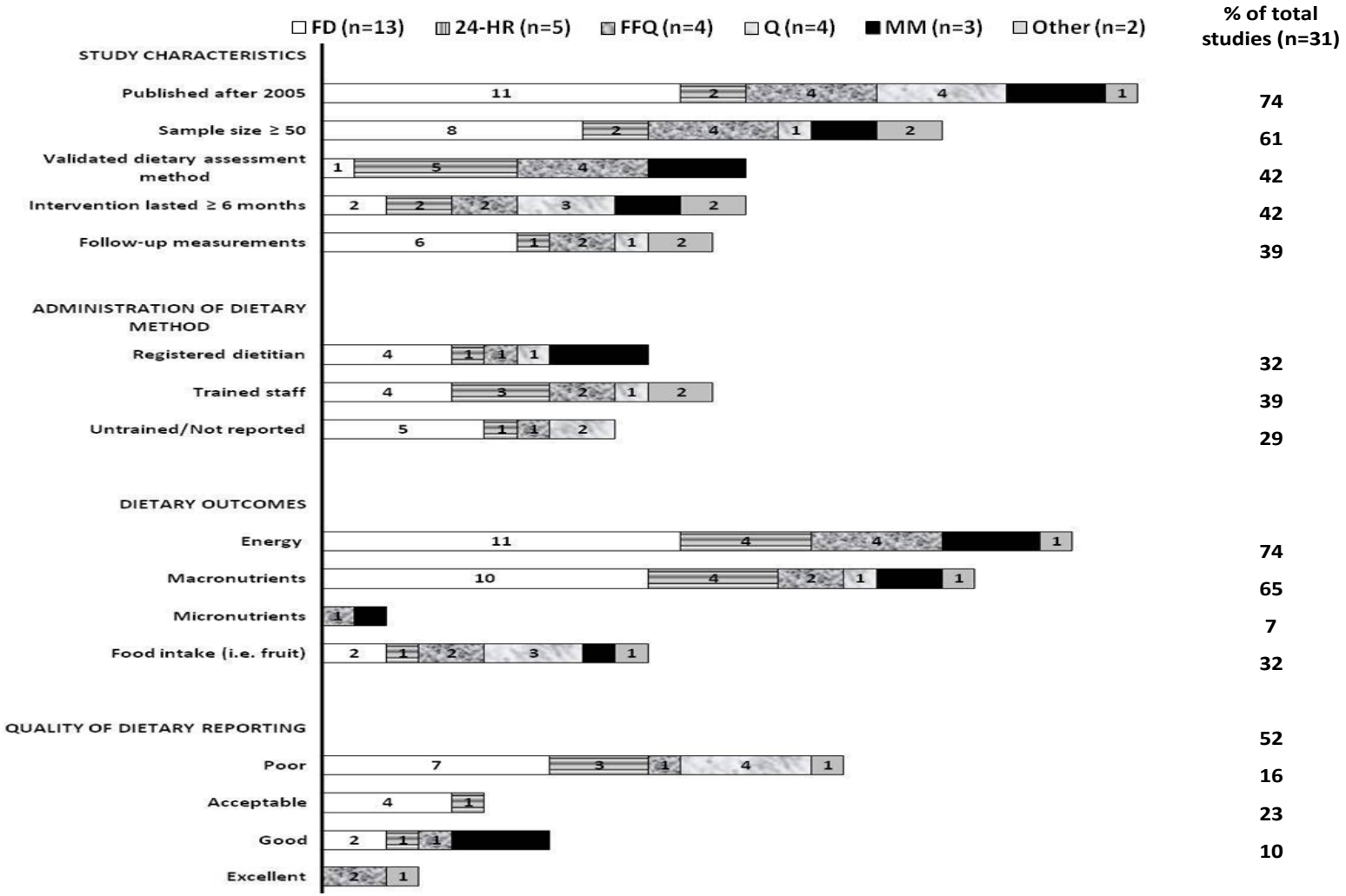

FD (n=13)
24-HR (n=5)
FFQ (n=4)
Q (n=4)
MM (n=3)
Other (n=2)
% of total studies (n=31)
STUDY CHARACTERISTICS
Published after 2005
11
2
4
4
1
74
Sample size ≥ 50
8
2
4
1
2
61
Validated dietary assessment method
1
5
4
42
Intervention lasted ≥ 6 months
2
2
2
3
2
42
Follow-up measurements
6
1
2
1
2
39
ADMINISTRATION OF DIETARY METHOD
Registered dietitian
4
1
1
1
32
Trained staff
4
3
2
1
2
39
Untrained/Not reported
5
1
1
2
29
DIETARY OUTCOMES
Energy
11
4
4
1
74
Macronutrients
10
4
2
1
1
65
Micronutrients
1
7
Food intake (i.e. fruit)
2
1
2
3
1
32
QUALITY OF DIETARY REPORTING
52
Poor
7
3
1
4
1
16
Acceptable
4
1
23
Good
2
1
1
10
Excellent
2
1

Table S1: Full search Strategy for The quality of dietary intake methodology and reporting in child and adolescent obesity intervention trials: a systematic review.

Set No.	Search terms	MEDLINE Results	CINAHL Results	EMBASE Results	MEDLINE In process	PsycINFO Results
1	dietetic*.mp.	8172	3307	12,144	131	335
2	diet.mp.	241482	47190	280,797	5324	11969
3	nutrition.mp.	118362	47024	1,183	3538	9226
4	healthy eating.mp.	118362	1205	2,164	112	720
5	dietary intervention*.mp.	2688	792	695	143	284
6	**1 or 2 or 3 or 4 or 5**	**342064**	**84760**	**1,227,043**	**8672**	**20432**
7	paediatric*.mp.	28147	7067	120,978	1564	1792
8	pediatric*.mp.	161296	52346	566,058	1564	1792
9	child*.mp.	1590971	303446	1,288,904	23079	466018
10	adolescent*.mp.	1388461	43047	559,159	4597	132729
11	family.mp.	561866	104645	675,294	14987	199344
12	families.mp.	127595	29846	107,715	4528	81218
13	parent*.mp.	279039	63957	275,855	9360	168525
14	school*.mp.	175456	68860	2,163,246	6022	279945
15	**7 or 8 or 9 or 10 or 11 or 12 or 13 or 14**	**2976411**	**461805**	**3,899,441**	**50814**	**827648**
16	overweight.mp.	23171	6751	22,543	1477	5450
17	obesity.mp.	131109	33961	158,206	4470	14367
18	weight control*.mp.	3435	5025	4,020	176	3939
19	weight management.mp.	1396	1001	1,552	123	730
20	weight loss.mp.	44918	11375	39,007	0	5725
21	healthy weight.mp.	581	666	529	54	250
22	**16 or 17 or 18 or 19 or 20 or 21 or 22**	**169560**	**45431**	**188,244**	**5261**	**20822**
23	**intervention*.mp.**	**383208**	**126899**	**147,761**	**18483**	**167377**
24	randomized controlled trial.pt.	299648	16671	206,899	411	4334
25	controlled clinical trial.pt.	82502	82055	294,392	21	660
26	randomized.ab.	206014	35450	79,525	8235	23257
27	placebo.ab.	122093	16107	30,342	3378	23595
28	randomly.ab.	149770	22961	41,377	8502	38440
29	trial.ab.	212881	35197	66,369	8682	44223
30	groups.ab.	997303	104934	238,861	47929	284143
31	**24 or 25 or 26 or 27 or 28 or 29 or 30**	**1463100**	**211252**	**597,540**	**63093**	**366197**
32	**6 and 15 and 22 and 23 and 31**	**732**	**233**	**983**	**48**	**151**
33	**limit 32 to yr="1985 - Current"**	**722**	**233**	**983**	**48**	**150**

Cochrane Library

(dietetic*:ab or diet:ab or nutrition:ab or healthy eating:ab or dietary intervention*:ab) and (paediatric*:ab or pediatric:ab or child*:ab or adolescent*:ab or family:ab or families:ab or parent*:ab or school*:ab) and (overweight:ab or obesity:ab or weight control*:ab or weight management:ab or weight loss:ab or healthy weight:ab) and (randomised control trial:ab or randomized control trial:ab or controlled clinical trial or (placebo:ab) or (randomly.ab) or (trial.ab) or (groups.ab)) and intervention*:ab

Web of Science – 274

Topic=(dietetic* or diet or nutrition or healthy eating or dietary intervention*) AND Topic=(paediatric* or pediatric* or child* or adolescent* or family or families or parent* or school*) AND Topic=(overweight or obesity or weight control* or weight management or weight loss or healthy weight) AND Topic=(randomized control trial or randomised control trial or controlled clinicial trial or randomized or placebo or randomly or trial or groups) AND Title=(intervention*)

SCOPUS - 676

ABS((dietetic* OR diet OR nutrition OR "healthy eating" OR "dietary intervention*") AND (paediatric* OR pediatric OR child* OR adolescent* OR family OR families OR parent* OR school*) AND (overweight OR obesity OR "weight control*" OR "weight management" OR "weight loss" OR "healthy weight") AND ("randomised control trial" OR "randomized control trial" OR "controlled clinical trial" OR (placebo) OR (randomly) OR (trial) OR (groups)) AND intervention*)

Dissertations and Theses

145 documents found for: *(dietetic* OR diet OR nutrition OR "healthy eating" OR "dietary intervention*") AND (paediatric* OR pediatric OR child* OR adolescent* OR family OR families OR parent* OR school*) AND (overweight OR obesity OR "weight control*" OR "weight management" OR "weight loss" OR "healthy weight") AND ABS("randomised control trial" OR "randomized control trial" OR "controlled clinical trial" OR (placebo) OR (randomly) OR (trial) OR (groups)) AND (intervention*)*

ADT - 0

((dietetic OR diet OR nutrition OR "healthy eating" OR "dietary intervention*") AND (paediatric* OR pediatric OR child* OR adolescent* OR family OR families OR parent* OR school*) AND (overweight OR obesity OR "weight control*" OR "weight management" OR "weight loss" OR "healthy weight") AND ("randomised control trial" OR "randomized control trial" OR "controlled clinical trial" OR (placebo) OR (randomly) OR (trial) OR (groups)) AND (intervention*))*

Table S2: Dietary intake methodology reporting checklist developed for review

All Methods	
Document dietary assessment method	ie diet recall, diet history, food frequency questionnaire, dietary questionnaire, (weighed) food record, biomarker (list), other (describe)
Is there a referenced or reported validation study?	If yes, use to complete question 1-2.
Document dietary assessment method validated against	ie diet recall, diet history, food frequency questionnaire,, dietary questionnaire, (weighed) food record, biomarker (list), other (describe)
1. Validation study sample & sample size (max 1 point):	0.0 method not validated; 0.5 if validated in same population as for intervention study; **PLUS** 0.5 if n≥100 or n≥50 if biomarkers used.
2. Statistics to assess validity (max 3 points)	1.0 if compare/test mean or median or difference or face validity (expert review); **PLUS** [choose highest value of: 0.5 correlation OR 1.0 adjusted correlations/ unweighted Kappa/ Cronbach alpha OR 1.5 deattenuated/ interclass correlations/ weighted Kappa]; **PLUS** 0.5 classification or Bland & Altman plot).
3. Data collection (max 1 point)	0.5 if researcher administered (ie supervised, face to face or phone interview); **plus** 0.5 if conducted or reviewed/checked by a trained person
4. Scoring Method (max 1 point)	1.0 For questionnaires - weighting of items or subscales reported; 1.0 For nutrient calculations -relevant nutrient databases reported
FOOD FREQUENCY QUESTIONNAIRE[1]	
5. Frequency scale (max 1 point)	0.5 if considered; 0.5 robust portion size estimation methodology
6. Seasonality (max 0.5 points)	0.5 if considered
FOOD RECORD/RECALL METHOD	
5. Number of days recall (max 1 point)	0.5 for multiple days of recall: 0.5 for consideration of all days of the week (i.e. all days covered at group level or weighting applied to adjust for weekday/ weekend day)
6. Use of multiple pass and aids/ prompts (additional 0.5 points)	(0.25 if multiple pass protocol used: 0.25 if aids/ prompts used for portion size estimation)
DIET HISTORY	
5. Time-scale (max 0.5 point)	0.5 if time-scale appropriate to capture usual intake
6. Use of 24-h recall and aids/ prompts (max 1 point)	0.5 if included 24-h recall: 0.5 if aids/ prompts used for portion size estimation
DIETARY QUESTIONNAIRE[1]	
5. Details provided (max 1 point)	1.0 point if provided as an appendix OR 0.5 point if summary of items reported.
6. Factor analysis (max 0.5 point)	0.5 if undertaken
Total Score (max 7 points)	≥ 5 points (very good/excellent); or 3.5 ≤ score < 5 points (good); 2.5 ≤ score < 3.5 points (acceptable/reasonable); ≤ 2.0 points (poor)

[1] The term food frequency questionnaire was reserved for questionnaires focusing on assessment of frequency of food intake.

Table S3: Dietary intake methodology reporting checklist developed for review

All Methods	
Document dietary assessment method	ie diet recall, diet history, food frequency questionnaire, dietary questionnaire, (weighed) food record, biomarker (list), other (describe)
Is there a referenced or reported validation study?	If yes, use to complete question 1-2.
Document dietary assessment method validated against	ie diet recall, diet history, food frequency questionnaire,, dietary questionnaire, (weighed) food record, biomarker (list), other (describe)
1. Validation study sample & sample size (max 1 point):	0.0 method not validated; 0.5 if validated in same population as for intervention study; **PLUS** 0.5 if n≥100 or n≥50 if biomarkers used.
2. Statistics to assess validity (max 3 points)	1.0 if compare/test mean or median or difference or face validity (expert review); **PLUS** [choose highest value of: 0.5 correlation OR 1.0 adjusted correlations/ unweighted Kappa/ Cronbach alpha OR 1.5 deattenuated/ interclass correlations/ weighted Kappa]; **PLUS** 0.5 classification or Bland & Altman plot).
3. Data collection (max 1 point)	0.5 if researcher administered (ie supervised, face to face or phone interview); **plus** 0.5 if conducted or reviewed/checked by a trained person
4. Scoring Method (max 1 point)	1.0 For questionnaires - weighting of items or subscales reported; 1.0 For nutrient calculations -relevant nutrient databases reported
FOOD FREQUENCY QUESTIONNAIRE[1]	
5. Frequency scale (max 1 point)	0.5 if considered; 0.5 robust portion size estimation methodology
6. Seasonality (max 0.5 points)	0.5 if considered
FOOD RECORD/RECALL METHOD	
5. Number of days recall (max 1 point)	0.5 for multiple days of recall: 0.5 for consideration of all days of the week (i.e. all days covered at group level or weighting applied to adjust for weekday/ weekend day)
6. Use of multiple pass and aids/ prompts (additional 0.5 points)	(0.25 if multiple pass protocol used: 0.25 if aids/ prompts used for portion size estimation)
DIET HISTORY	
5. Time-scale (max 0.5 point)	0.5 if time-scale appropriate to capture usual intake
6. Use of 24-h recall and aids/ prompts (max 1 point)	0.5 if included 24-h recall: 0.5 if aids/ prompts used for portion size estimation
DIETARY QUESTIONNAIRE[1]	
5. Details provided (max 1 point)	1.0 point if provided as an appendix OR 0.5 point if summary of items reported.
6. Factor analysis (max 0.5 point)	0.5 if undertaken
Total Score (max 7 points)	≥ 5 points (very good/excellent); or 3.5 ≤ score < 5 points (good); 2.5 ≤ score < 3.5 points (acceptable/reasonable); ≤ 2.0 points (poor)

[1] The term food frequency questionnaire was reserved for questionnaires focusing on assessment of frequency of food intake.