Preventive Medicine 51 (2010) 103–111

Contents lists available at ScienceDirect

Preventive Medicine

journal homepage: www.elsevier.com/locate/ypmed

Review

Parental involvement in interventions to improve child dietary intake: A systematic review

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ARTICLE INFO

Available online 10 May 2010

Keywords:
Children
Youth
Interventions
Diet
Parents
Obesity prevention

ABSTRACT

Objective. Interventions that aim to improve child dietary quality and reduce disease risk often involve parents. The most effective methods to engage parents remain unclear. A systematic review of interventions designed to change child and adolescent dietary behavior was conducted to answer whether parent involvement enhanced intervention effectiveness, and what type of involvement was most effective in achieving desired outcomes.

Method. In 2008, Pub Med, Medline, Psych Info, and Cochrane Library databases were searched to identify programs designed to change child and adolescent dietary intake that also involved parents. Methods of parental involvement were categorized based on the type and intensity of parental involvement. These methods were compared against intervention design, dietary outcomes, and quality of reporting (evaluated using CONSORT checklist) for each study.

Results. The literature search identified 1774 articles and 24 met review criteria. Four studies systematically evaluated parent involvement with inconsistent results. Indirect methods to engage parents were most commonly used, although direct approaches were more likely to result in positive outcomes. Four studies met >70% of CONSORT items.

Conclusion. Limited conclusions may be drawn regarding the best method to involve parents in changing child diet to promote health. However, direct methods show promise and warrant further research.

Contents

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0091-7435/$ – see front matter
doi:10.1016/j.ypmed.2010.04.014

Introduction

Pediatric obesity continues to be a significant public health issue (Hedley et al., 2004; Ogden et al., 2008). Obesity during childhood is associated with increased disease risk and morbidities during young adulthood, and increased mortality later in life (Must and Strauss, 1999; Reilly et al., 2003). Dietary habits acquired in childhood track to adulthood (Kelder et al., 1994; Li and Wang, 2008; Lien et al., 2001), and changes in diet during childhood are significant predictors of diet quality in adults (Mikkila et al., 2004). Child dietary behavior is determined in part by individual factors (e.g. food preferences) (Capaldi, 1996), socio-cultural factors (e.g. peer norms and parent attitudes/beliefs) (Rozin, 1996) and environmental factors (e.g. availability of healthy food) (French et al., 2001). Parents are instrumental in influencing child diet by providing their child with the ability and opportunity to make healthy or unhealthy choices through the selective use of food parenting practices (i.e. behaviors that parents use to influence children on what and how much to eat) (Hoerr et al., 2009). Since food choices are related to energy intake and obesity risk, parent involvement in child dietary interventions seems crucial to mitigating risk (Rennie et al., 2005). The refractory nature of adult obesity suggests early establishment of healthy eating habits may be a key to prevention (Lobstein et al., 2004).

Reviews of childhood obesity prevention studies have largely focused on school-based programs, many of which did not include a parent component. (Baranowski et al., 2002; Brown and Summerbell, 2008; Sharma et al., 2004; Shaya et al., 2008; Summerbell et al., 2006; Thomas, 2006). A meta-analysis of pediatric obesity prevention programs that included an estimation of a "parent effect" found parental involvement (in 12 of the 46 studies) to be unrelated to larger effect sizes (Stice et al., 2006). A systematic review of studies that aimed to impact young children's weight status, physical activity, diet or sedentary behaviors (Campbell and Hesketh, 2007) concluded parents were "receptive to and capable of some behavioral changes that may promote healthy weight in their young children," but due to the limited number of studies in this age group, the authors were unable to draw any conclusions as to the most effective strategies. As a result, we conducted a systematic review of randomized controlled intervention trials designed to prevent obesity, prevent disease, and/or promote health in children and adolescents through dietary behavior changes that involved parents. We summarized and evaluated the type of parent involvement that had been implemented in each study to answer two questions: 1) whether parent involvement enhanced program effectiveness, and 2) what type of parent involvement, if any, was most effective in achieving dietary change outcomes.

Methods

Following procedures for a systematic review (Lichtenstein et al., 2008), we searched Pub Med, Medline, Psych Info, and Cochrane Library electronic databases to identify individual and population-based obesity/disease prevention and health promotion programs designed to change child and adolescent dietary intake that involved parents. Key terms representing child and adolescent dietary behaviors that were associated with obesity in the literature were used in combination with key terms for parent/family involvement and intervention studies. The following search terms were used: (1) preschool child, preschooler, toddler, child, adolescent, teen; (2) fruit, vegetables, healthy eating, fat, salt; (3) obesity, weight, overweight, prevention, intervention; (4) family, parents, parent education, parenting practices; and (5) childhood obesity, prevention.

Inclusion/exclusion criteria

Study inclusion criteria for this review were i) randomized controlled trials of an obesity prevention, chronic disease prevention, or health promotion intervention that included child dietary intake as a behavior change target and as a measured primary or secondary outcome; ii) published in peer-reviewed, English language journals between January 1st, 1980 and December 31st, 2008; iii) recruited children (2–12 years), or adolescents (13–18 years); and iv) included a parent component. The parent component was defined as an intervention strategy that indirectly or directly engaged parents to support or assist children or adolescents to achieve changes in dietary intake. Exclusion criteria were: i) intervention programs designed solely to treat overweight or obese children (since these parents may have different and stronger motivations), ii) programs that enrolled children with a specific medical problem that could impact diet or weight; ii) studies for which statistics of outcome data were not reported; iii) studies without an intervention component; iv) literature reviews; v) studies with diet as a correlate and not an outcome; vi) qualitative studies; vii) pilot studies; and viii) non-randomized studies. For the current review, a previous definition of a randomized controlled trial (Rothman and Greenland, 1998) was adapted to child dietary interventions.

Identification of relevant studies

Publications with titles and abstracts that met initial screening criteria were retrieved and read by the primary author and a co-author to determine whether these met the inclusion criteria. Discrepancies in retrieved studies between primary author and co-author were resolved through discussions that included all co-authors and were guided by criteria established *a priori*.

Data extraction

Data from the studies were extracted using standardized forms developed by the authors for this purpose. For each publication that met criteria, the following were extracted when available: lead author, year published, geographic location of intervention, sample size (initial and ending), age, sex, ethnicity, and SES of participants, primary intervention location (e.g. school, home, etc.), study design (including intervention arms), theoretical framework used to guide intervention design, primary and secondary outcomes, dietary measurement methods, adiposity measurement methods, description of intervention, intervention frequency and duration, main findings, methods of parental involvement in intervention activities, and any analysis that assessed whether subsequent changes in child or parent behavior could be attributed to this involvement. Recruitment methods and process evaluation measures as they related to parental involvement (e.g. program attendance) or subject participation when reported were also extracted. When studies cited additional published articles that further described their study (e.g. design, outcome evaluation, etc.), the referenced article was also pulled and relevant information extracted (Haerens et al., 2006a,b; Helitzer et al., 1998; Lytle et al., 2004; Nicklas et al., 1998). Thirteen studies included physical activity or physical fitness as an outcome, and while these data were also extracted and summarized (Appendix A, Supplementary data), we did not assess the effect of parental involvement on child physical activity in this review. The extent to which parent involvement in physical activity interventions impacted child physical activity behavior has been summarized and reported elsewhere (O'Connor et al., 2009a,b).

Quality of reporting

The Extended CONSORT checklist for non-pharmacologic randomized controlled trials (Boutron et al., 2008) was used to evaluate consistency and quality of methods and outcomes reporting for each of the twenty-four RCTs included in this review. CONSORT comprises a list of items that are recommended as discussion points in reports of RCTs to facilitate critical

appraisal and interpretation of the trials (Altman et al., 2001). The extended checklist for reporting trials modified and elaborated on the original 22-item CONSORT checklist developed in 1996 (Begg et al., 1996), and is appropriate for evaluating behavior interventions. Each RCT was scored on this 26-item checklist (1–4, 4A–C, 5–10, 11A, 11B, 12, 13, new item, and 14–22) to determine if methodological characteristics may be associated with study outcomes (Table 3).

Results

The initial search yielded 1774 citations. After screening the titles and abstracts of candidate studies, 100 papers were retrieved and the full article reviewed. Of these 100 articles, twenty-four studies met all our criteria and were included in this review.

Methods of parental involvement

Methods of parental involvement used in studies were summarized based on the type and intensity of parental involvement represented, broadly categorized as "indirect" or "direct" strategies (Table 1). Three types of indirect strategies were identified: i) provision of information that did not require a parental response (e.g. newsletters, tip sheets with nutrition information sent to the home through mail, email, or with the child); ii) invitations to parents and children to participate in activities sponsored by the study (e.g. Family Fun Nights/Health Fairs with nutrition topics); and, iii) communications directed at child and/or parent meant to involve parents in intervention activities (e.g. "try this at home"). Two categories of direct strategies were identified: i) parents' presence requested at nutrition education sessions (e.g. didactic or workshop format); and ii) parents' attendance and participation requested for family behavior counseling or parent training sessions.

Study outcomes

Of the twenty-four intervention studies included in this review, ten sought to improve diet as a primary objective (Baranowski et al., 2000, 2003b; Cullen et al., 1997; Haire-Joshu et al., 2008; Lytle et al., 2006; O'Neil and Nicklas, 2002; Perry et al., 1988, 1998; Reynolds et al., 2000; Vandongen et al., 1995); five studies focused on obesity prevention (Caballero et al., 2003; Fitzgibbon et al., 2005, 2006; Foster et al., 2008; Haerens et al., 2006a,b); two studies focused on reducing cardiovascular disease risk factors (Bush et al., 1989; Luepker et al., 1996) one on reducing diabetes risk factors (Trevino et al., 2004); and six studies focused on a combination of diet improvement and increased physical activity and/or fitness (Nader et al., 1989; Neumark-Sztainer et al., 2003; Patrick et al., 2006), or a combination of improved diet and obesity prevention (Epstein et al., 2001; Paineau et al., 2008; Stolley and Fitzgibbon, 1997).

Primary setting of program

The majority of interventions ($n=16$) were delivered in a school setting (Baranowski et al., 2000, 2003b; Bush et al., 1989; Caballero et al., 2003; Fitzgibbon et al., 2005; Foster et al., 2008; Haerens et al., 2006a,b; Luepker et al., 1996; Lytle et al., 2006; Nader et al., 1989; Neumark-Sztainer et al., 2003; O'Neil and Nicklas, 2002; Perry et al., 1988, 1998; Reynolds et al., 2000; Trevino et al., 2004; Vandongen et al., 1995). The remaining eight studies were implemented in community settings, including Girl Scouts meetings (Cullen et al., 1997), an after-school tutoring program (Stolley and Fitzgibbon, 1997), Head start/preschool centers (Fitzgibbon et al., 2005, 2006), clinics (Epstein et al., 2001; Patrick et al., 2006), or at the child's home (Haire-Joshu et al., 2008; Paineau et al., 2008). Three studies took place outside of the United States — in Australia (Vandongen et al., 1995), Belgium (Haerens et al., 2006a,b), and France (Paineau et al., 2008).

Sample size and targeted age

Sample sizes varied from thousands (Baranowski et al., 2000, 2003b; Bush et al., 1989; Caballero et al., 2003; Fitzgibbon et al., 2005; Foster et al., 2008; Haerens et al., 2006a,b; Haire-Joshu et al., 2008; Luepker et al., 1996; Lytle et al., 2006; O'Neil and Nicklas, 2002; Paineau et al., 2008; Perry et al., 1988, 1998; Reynolds et al., 2000; Trevino et al., 2004; Vandongen et al., 1995) to fewer than one hundred participants (Cullen et al., 1997; Epstein et al., 2001; Nader et al., 1989; Neumark-Sztainer et al., 2003; Stolley and Fitzgibbon, 1997). Interventions recruited a wide range of ages, the most common being school age (6–11 years) (Baranowski et al., 2000, 2003b; Bush et al., 1989; Caballero et al., 2003; Cullen et al., 1997; Epstein et al., 2001; Foster et al., 2008; Luepker et al., 1996; Paineau et al., 2008; Perry et al., 1988, 1998; Reynolds et al., 2000; Stolley and Fitzgibbon, 1997; Trevino et al., 2004; Vandongen et al., 1995) followed by early adolescence (12–14 years) (Haerens et al., 2006a,b; Lytle et al., 2006; Nader et al., 1989; Patrick et al., 2006), preschool-age children (Fitzgibbon et al., 2005, 2006; Haire-Joshu et al., 2008) and mid- to late adolescence (15–18 years) (Neumark-Sztainer et al., 2003; O'Neil and Nicklas, 2002).

Use of behavioral theory to inform intervention design

Behavioral theories may inform the design of dietary interventions to provide a rationale for the strategies used to change behavior, thereby increasing the probability that they will be effective (Baranowski et al., 2003a). The most frequently reported behavioral theory was the Social Cognitive Theory (Baranowski et al., 2000, 2003b; Cullen et al., 1997; Fitzgibbon et al., 2005, 2006; Lytle et al., 2006; Neumark-Sztainer et al., 2003; Reynolds et al., 2000) ($n=8$) followed by its predecessor, Social Learning Theory ($n=5$) (Bush et al., 1989; Caballero et al., 2003; Nader et al., 1989; Perry et al., 1988, 1998). The remaining studies used a multi-theoretical approach ($n=5$) (Haerens et al., 2006a,b; Haire-Joshu et al., 2008; O'Neil and Nicklas, 2002; Patrick et al., 2006; Trevino et al., 2004) or did not specify a theory ($n=6$) (Epstein et al., 2001; Foster et al., 2008; Luepker et al., 1996; Paineau et al., 2008; Stolley and Fitzgibbon, 1997; Vandongen et al., 1995).

Measurement of dietary outcomes

Methods to quantify dietary intake included 24-hour food recalls (11 studies, 46%) (Baranowski et al., 2003b; Bush et al., 1989; Fitzgibbon et al., 2005, 2006; Luepker et al., 1996; Lytle et al., 2006; Patrick et al., 2006; Perry et al., 1988, 1998; Reynolds et al., 2000; Trevino et al., 2004); food frequency questionnaires (8 studies, 33%) (Cullen et al., 1997; Epstein et al., 2001; Foster et al., 2008; Haerens et al., 2006a,b; Haire-Joshu et al., 2008; Neumark-Sztainer et al., 2003; O'Neil and Nicklas, 2002; Stolley and Fitzgibbon, 1997); diet records (4 studies, 17%) (Baranowski et al., 2000; Nader et al., 1989; Paineau et al., 2008; Vandongen et al., 1995); and observation by research staff (2 studies) (Caballero et al., 2003; Paineau et al., 2008). In seventeen studies (71%), dietary intake was reported by the child participant (Baranowski et al., 2000, 2003b; Bush et al., 1989; Cullen et al., 1997; Foster et al., 2008; Haerens et al., 2006a,b; Luepker et al., 1996; Lytle et al., 2006; Nader et al., 1989; Neumark-Sztainer et al., 2003; O'Neil and Nicklas, 2002; Patrick et al., 2006; Perry et al., 1998; Reynolds et al., 2000; Stolley and Fitzgibbon, 1997; Trevino et al., 2004; Vandongen et al., 1995); parents reported for their children in four studies (Fitzgibbon et al., 2005, 2006; Haire-Joshu et al., 2008; Paineau et al., 2008); parents assisted their child with reporting in two studies (Epstein et al., 2001; Perry et al., 1988); and in one study, dietary intake was observed and reported by research staff (Caballero et al., 2003).

Table 1
Summary of study characteristics.

	Primary author and publication year	Number of studies
Methods of parental involvement used in studies		
I1: provision of information with no requirement of parental response (e.g. newsletters, tip sheets with nutrition information sent to the home through mail, email, or with the child)	Bush et al., (1989); Neumark-Sztainer et al. (2003); O'Neil and Nicklas (2002)	3
I2: invitations to parents and children to participate in activities sponsored by the study (e.g. Family Fun Nights/Health Fairs with nutrition topics)	Caballero et al. (2003)*; Foster et al. (2008)*; Trevino et al. (2004)	3
I3: prompts or "assignments" directed at child and/or parent meant to involve parents in intervention activities (e.g. "try this at home" activities)	Baranowski et al. (2000)*; Baranowski et al. (2003a,b)*; Cullen et al. (1997)*; Fitzgibbon et al. (2005)*; Fitzgibbon et al. (2006)*; Haerens et al. (2006a,b)*; Luepker et al. (1996)*; Lytle et al. (2006)*; Patrick et al. (2006)*; Perry et al. (1988); Perry et al. (1998); Reynolds et al. (2000)*; Vandongen et al. (1995)	13
D1: parent attendance requested at nutrition education sessions (e.g. didactic or workshop format)	Nader et al. (1989); Stolley and Fitzgibbon (1997), Paineau et al. (2008)*	3
D2: parent attendance and participation requested for family behavior counseling or parent training sessions (e.g. tailored counseling sessions or home/clinic visits)	Epstein et al. (2001)*; Haire-Joshu et al. (2008)	2
Primary study objectives		
Improved diet quality (optimization of kcal/fat intake)	Baranowski et al. (2000); Baranowski et al., 2003a,b; Cullen et al. (1997); Haire-Joshu et al. (2008); Lytle et al. (2006); O'Neil and Nicklas (2002); Perry et al. (1988); Perry et al. (1998); Reynolds et al. (2000); Vandongen et al. (1995)	10
Improved diet and increased physical activity/fitness	Nader et al. (1989); Patrick et al. (2006);	2
Improved diet and obesity prevention	Paineau et al. (2008); Stolley and Fitzgibbon (1997); Epstein et al. (2001)	3
Improved diet; increased physical activity/fitness; and obesity prevention	Neumark-Sztainer et al. (2003)	1
Obesity prevention	Caballero et al. (2003); Fitzgibbon et al. (2005); Fitzgibbon et al. (2006); Foster et al. (2008); Haerens et al. (2006a,b);	5
Cardiovascular disease prevention	Bush et al. (1989); Luepker et al. (1996);	2
Diabetes prevention	Trevino et al. (2004)	1
Dietary outcomes		
Increased fruit and juice, vegetable consumption	Baranowski et al. (2000); Baranowski et al. (2003b)	2
Increased fruit and vegetable consumption	Cullen et al. (1997); O'Neil and Nicklas (2002); Perry et al. (1998); Reynolds et al. (2000); Haire-Joshu et al. (2008); Epstein et al. (2001); Lytle et al. (2006); Patrick et al. (2006)	8
Decreased consumption of high fat and high sodium foods	Luepker et al. (1996); Nader et al. (1989)	2
Healthier eating patterns	Neumark-Sztainer et al. (2003); Paineau et al. (2008); Bush et al., (1989)	3
Decreased total fat and saturated fat	Stolley and Fitzgibbon (1997); Fitzgibbon et al. (2006)	2
Increased whole grains and FV, decrease fatty, sugar and/or salty foods	Perry et al. (1988); Vandongen et al. (1995); Caballero et al. (2003); Fitzgibbon et al. (2005); Foster et al. (2008); Haerens et al. (2006a,b); Trevino et al. (2004)	7
Primary setting of program		
School	Baranowski et al. (2000); Baranowski et al. (2003b); Luepker et al. (1996); Lytle et al. (2006); Neumark-Sztainer et al. (2003); O'Neil and Nicklas (2002); Perry et al. (1988); Perry et al. (1998); Reynolds et al. (2000); Vandongen et al. (1995); Nader et al. (1989); Haerens et al. (2006a,b); Bush et al. (1989); Trevino et al. (2004); Foster et al. (2008); Caballero et al. (2003)	16
Head start center/preschool	Fitzgibbon et al. (2005); Fitzgibbon et al. (2006)	2
Community	Cullen et al. (1997); Stolley and Fitzgibbon (1997)	2
Home	Haire-Joshu et al. (2008); Paineau et al. (2008)	2
Outpatient clinic	Epstein et al. (2001); Patrick et al. (2006)	2
Sample size (starting)		
>1000	Baranowski et al. (2000); Baranowski et al. (2003b); Luepker et al. (1996); Lytle et al. (2006); O'Neil and Nicklas (2002); Perry et al. (1988); Perry et al. (1998); Reynolds et al. (2000); Vandongen et al. (1995); Haire-Joshu et al. (2008); Paineau et al. (2008); Haerens et al. (2006a,b); Fitzgibbon et al. (2005); Bush et al. (1989); Trevino et al. (2004); Foster et al. (2008); Caballero et al. (2003)	17
500–1000	Patrick et al. (2006)	1
100–500	Cullen et al. (1997); Neumark-Sztainer et al. (2003); Nader et al. (1989); Fitzgibbon et al. (2006)	4
50–100	Stolley and Fitzgibbon (1997)	1
<50	Epstein et al. (2001)	1
Targeted age		
Preschool child (2–5 years)	Haire-Joshu et al. (2008); Fitzgibbon et al. (2005); Fitzgibbon et al. (2006)	3
School age child (6–11 yrs)	Baranowski et al. (2000); Baranowski et al. (2003b); Cullen et al. (1997); Luepker et al. (1996); Perry et al. (1988); Perry et al. (1998); Reynolds et al. (2000); Vandongen et al. (1995); Epstein et al. (2001); Paineau et al. (2008); Stolley and Fitzgibbon (1997); Trevino et al. (2004); Caballero et al. (2003); Bush et al. (1989); Foster et al. (2008)	15
Early adolescence (12–14 yrs)	Lytle et al. (2006); Nader et al. (1989); Haerens et al. (2006a,b); Patrick et al. (2006	4
Late adolescence (15–18 yrs)	Neumark-Sztainer et al. (2003); O'Neil and Nicklas (2002)	2

Table 1 *(continued)*

	Primary author and publication year	Number of studies
Behavioral theory used to inform intervention		
Social cognitive theory	Baranowski et al. (2000); Cullen et al. (1997); Neumark-Sztainer et al. (2003); Reynolds et al. (2000); Baranowski et al. (2003b); Lytle et al. (2006); Fitzgibbon et al. (2005); Fitzgibbon et al. (2006)	8
Knowledge Attitudes Behavior	O'Neil and Nicklas (2002)	1
Social Learning Theory	Perry et al. (1988); Perry et al. (1998); Nader et al. (1989); Bush et al. (1989); Caballero et al. (2003)	5
Multiple theories	Haire-Joshu et al. (2008); Haerens et al. (2006a,b); Trevino et al. (2004); Patrick et al. (2006)	4
Not specified	Luepker et al. (1996); Vandongen et al. (1995); Epstein et al. (2001); Paineau et al. (2008); Stolley and Fitzgibbon (1997); Foster et al. (2008)	6
Measurement of dietary outcome		
24-h recall		
1 day	Reynolds et al. (2000); Perry et al. (1988); Luepker et al. (1996); Perry et al. (1998), Lytle et al. (2006); Fitzgibbon et al. (2005); Bush et al. (1989); Fitzgibbon et al. (2006)	8
3 days	Trevino et al. (2004), Patrick et al. (2006)	2
4 days	Baranowski et al. (2003a, 2003b)	1
Diet record		
2 days	Vandongen et al. (1995)	1
3 days	Nader et al. (1989)	1
7 days	Baranowski et al. (2000)	1
Not reported	Paineau et al. (2008)	1
Food frequency questionnaire	O'Neil and Nicklas (2002); Cullen et al. (1997); Stolley and Fitzgibbon (1997); Epstein et al. (2001); Haire-Joshu et al. (2008); Neumark-Sztainer et al. (2003); Haerens et al. (2006a,b); Foster et al. (2008)	8
Observation by research staff	Caballero et al. (2003)	1
Report of diet		
Child report	Baranowski et al. (2003b); Reynolds et al. (2000); Cullen et al. (1997); Perry et al. (1998), Luepker et al. (1996), Vandongen et al. (1995); Nader et al. (1989); Baranowski et al. (2000); O'Neil and Nicklas (2002); Neumark-Sztainer et al. (2003); Stolley and Fitzgibbon (1997); Lytle et al. (2006); Haerens et al. (2006a,b); Bush et al. (1989); Trevino et al. (2004); Foster et al. (2008); Patrick et al. (2006)	17
Parent report	Haire-Joshu et al. (2008); Paineau et al. (2008); Fitzgibbon et al. (2005); Fitzgibbon et al. (2006)	4
Child assisted by parent	Perry et al. (1988); Epstein et al. (2001)	2
Observation by research staff	Caballero et al. (2003)	1

*Multiple methods of parental involvement used in study.
I = indirect and D = direct.

Effect of parent involvement on child dietary outcomes

To determine whether parent involvement enhanced program effectiveness and what type of parent involvement was the most effective, studies were categorized based on dietary outcomes (positive, mixed, and no effect) and cross-tabulated with the method of parental involvement (Table 2). "Positive" indicated dietary changes that occurred in the desired or hypothesized direction; "mixed" indicated changes that occurred for some subgroups but not others (e.g. girls only), or for some but not all outcomes (e.g. fat intake decreased, but no change in fiber); and "no effect" meant that there were no reported changes in child diet (Table 2). There were no negative findings reported (i.e. intervention had opposite, or detrimental effect on diet).

Four of twenty-four studies were designed to assess whether parent involvement enhanced the effectiveness of interventions that aimed to change child dietary intake (Haerens et al., 2006a,b; Luepker et al., 1996; Perry et al., 1988; Vandongen et al., 1995). The effect of parent involvement was estimated by including "parent-only" and/or "parent-plus" comparison arms. Of those four studies, one achieved significant changes in the primary dietary outcome (reduced intake of total fat and increased intake of complex carbohydrates) for children enrolled in the home-based (parent) arm of the study compared to the control group (Perry et al., 1988). Two other studies reported changes in dietary outcomes that differed by gender. A study conducted in Belgium demonstrated reduced fat intake and percent of energy from fat 2 years post-intervention in girls (but not boys) who were enrolled in the intervention condition plus parent support group compared to the control group (Haerens et al., 2006a,b). The same girls were also found to have significantly lower BMI and BMI *z*-scores compared to the control boys and girls and girls in the intervention without parent support (Haerens et al., 2006a,b). In a study conducted in Australia, girls in a home nutrition group, and girls in the school plus parent intervention group both reported significantly greater decreases in total fat intake compared to boys in the parent group and control girls (Vandongen et al., 1995). In this same study, boys but not girls in the fitness, fitness plus school nutrition, and school plus home groups significantly reduced sugar intake. Finally, in a multi-center school intervention trial based in part on a previous study conducted by Perry et al. (Luepker, et al., 1996), participants in the school plus parent intervention arm demonstrated greater positive changes in dietary knowledge (a secondary outcome), but not in dietary intake or serum cholesterol (primary outcomes), when compared to the participants in the school-only condition.

Parental involvement strategies and dietary and adiposity outcomes

Nineteen studies used indirect methods to engage parents in intervention activities, while five used direct methods. Of the nineteen studies using indirect methods to engage parents, seven (37%) reported achieving statistically significant changes in the desired directions (Baranowski et al., 2003b; Caballero et al., 2003; Cullen et al., 1997; Fitzgibbon et al., 2005; O'Neil and Nicklas, 2002; Perry et al., 1988; Reynolds et al., 2000), seven (37%) reported mixed intervention outcomes (Baranowski et al., 2000; Haerens et al., 2006a,b; Luepker et al., 1996; Patrick et al., 2006; Perry et al., 1998; Trevino et al., 2004; Vandongen et al., 1995), and five (26%) reported no significant intervention effects (Bush et al., 1989; Fitzgibbon et al., 2006; Foster

Table 2
Dietary outcomes by methods to involve parents.

Method used to involve parents (# studies)	Dietary outcomes		
	Positive	Mixed	No effect
Indirect strategies (n = 19)			
I1 — information only — e.g. newsletters, tip sheets with nutrition information sent through mail, email, or with the child (n = 4)	1 CR-O'Neil and Nicklas, (2002)	1 ↓SFA consumption, girls only, CR-RE Patrick et al. (2006)	2 CR-FFQ Neumark-Sztainer et al. (2003) CR-RE Bush et al. (1989)
I2 — invitation to participate in optional intervention activities sponsored by the study — e.g. Family Fun Nights/Health Fairs with nutrition topics (n = 2)	0	1 ↑ Fiber but not fat, CR- Trevino et al. (2004)[c]	1 CR- Foster et al. (2008)
I3 — Child or study staff involves parents in intervention activities and expects a response — e.g. "try this at home" activities (n = 13)	6	5	2
	CR- Baranowski et al. (2003a,b) OBS Caballero et al. (2003) CR-FFQ Cullen et al. (1997) PA- Perry et al. (1988)[b] CR- Reynolds et al. (2000) PR- Fitzgibbon et al. (2005)	↑ F/V in lowest 2 quintiles, CR-DR Baranowski et al. (2000) ↓ Fat only, CR-RE Luepker et al. (1996)[b,c] ↑ F, but not FV CR-RE; ↑ lunch FV, ↑ lunch V girls only, OBS Perry et al. (1998) ↓ Fat, girls; ↓sugar, boys, CR- Vandongen et al. (1995),b ↓ Fat, girls only CR- Haerens et al. (2006a,b)[b]	CR-RE Lytle et al. (2006) PR- Fitzgibbon et al. (2006)
Direct strategies (n = 5)			
D1 — parent attendance requested at nutrition education sessions - e.g. didactic or workshop format (n = 2)	0	2 ↓ Sodium, fat, white only, CR-DR Nader et al. (1989) ↓ Fat intake, energy intake, +/− sugars/complex CHO PR-DR Paineau et al. (2008)[a,c]	0
D2 — Parent attendance/participation requested at family behavior counseling or parent training sessions — e.g. counseling sessions or home/clinic visits involving parent training (n = 3)	2	1	0
	PA- Epstein et al. (2001)[d] PR- Haire-Joshu et al. (2008)[c,d]	↓ % Fat calories, no effect SFA or dietary cholesterol, CR-FFQ Stolley and Fitzgibbon (1997)	
Total	N = 9	N = 10	N = 5

PR = parent reported; CR = child reported; PA = parent assisted; OBS = observer; FFQ = food frequency questionnaire; and DR = diet record.
RE = dietary recall; WR = weighed record; and CL = checklist.
[a] Used combination of indirect and direct strategies.
[b] Included parent-only or parent-plus comparison groups to test "parent effect".
[c] Met at least 70% of CONSORT criteria.
[d] Included only parent groups (no child-alone or school-alone).

et al., 2008; Lytle et al., 2006; Neumark-Sztainer et al., 2003) (Table 2). Of the five studies using direct methods to involve parents in the intervention, two reported positive outcomes (Epstein et al., 2001; Haire-Joshu et al., 2008) and the remaining three mixed effects (Nader et al., 1989; Paineau et al., 2008; Stolley and Fitzgibbon, 1997). Thus, a greater proportion (100%) of studies using direct methods achieved at least some dietary change (positive or mixed), while only 64% of studies using indirect methods achieved changes in dietary outcomes. There were no discernible patterns when outcomes were distributed across methods of dietary measurement and sample size (data not shown).

Quality of reporting

Publications varied widely with regard to reporting quality. Four publications reported ≥70% of the items on the CONSORT checklist (Haire-Joshu et al., 2008; Luepker et al., 1996; Paineau et al., 2008; Trevino et al., 2004). Item 4C (details on how adherence to protocol was assessed), item 7 (sample size determination), items 8–10 (randomization methods), 11A and 11B (blinding), item 13 (flow of participants through the study), and item 19 (adverse events) were the information most commonly omitted from the publications (Table 3).

Discussion

There were not enough studies that compared dietary interventions for children with and without parental components to adequately answer whether parent involvement enhanced program effectiveness (Research Question 1). Despite variability in the quality of reporting of the RCTs reviewed to address Research Question 2 (What type of parent involvement was most effective in achieving dietary outcomes?), interesting patterns emerged. Studies that used direct methods to engage parents were more likely to report positive or mixed results compared with those studies that used more indirect methods. Further, those studies that used indirect methods to involve parents but required children engage their parent in an activity were also more likely to report positive or mixed results, suggesting an intensity level that is adequate to result in significant change in children's dietary intake.

When dietary outcomes were cross-tabulated with methodological characteristics, there was no apparent pattern. It was unclear whether 'direct' interventions attracted those most interested in change (i.e. more motivated participants), or the intensity of the contact was sufficient to break through barriers preventing behavior

Table 3
Summary of CONSORT checklist results by study and dietary outcome.

CONSORT items*	1	2	3	4A	4B	4C	5	6	7	8	9	10	11A	11B	12	13	NI	14	15	16	17	18	19	20	21	22	% Met	Dietary outcome**
Author, year																												
Baranowski et al., (2000)	x	x	x	x	x		x	x	x						x		x	x			x	x		x	x	x	**62%**	Mixed
Baranowski et al. (2003a,b)	x	x	x	x	x		x	x	x	x					x				x		x	x		x	x	x	**65%**	Positive
Bush et al. (1989)	x	x		x	x	x	x	x		x					x		x	x	x	x	x	x		x		x	**65%**	No effect
Caballero et al. (2003)		x	x	x	x	x	x	x		x					x	x	x		x	x	x	x		x		x	**65%**	Positive
Cullen et al. (1997)	x	x	x	x	x	x	x	x							x		x		x	x	x	x		x	x	x	**65%**	Positive
Epstein et al. (2001)	x	x	x	x	x		x	x							x		x		x	x	x	x		x	x	x	**62%**	Positive
Fitzgibbon et al. (2005)	x	x	x	x			x	x	x	x			x		x		x	x	x	x	x	x		x		x	**69%**	Positive
Fitzgibbon et al. (2006)	x	x	x	x			x	x	x				x		x	x	x	x	x	x	x	x		x		x	**69%**	No effect
Foster et al. (2008)	x	x		x			x	x		x					x	x	x		x	x	x	x		x		x	**58%**	No effect
Haerens et al. (2006a,b)	x	x		x			x	x	x						x	x	x	x	x	x	x			x		x	**58%**	Mixed
Haire-Joshu et al. (2008)	x	x	x	x	x	x	x	x	x	x	x	x	x			x	x	x	x			x		x	x	x	**81%**	Positive
Luepker et al. (1996)	x	x	x	x	x	x	x	x							x	x	x	x	x	x	x	x	x	x	x	x	**77%**	Mixed
Lytle et al. (2006)		x	x	x	x	x	x	x							x		x	x						x	x	x	**50%**	No effect
Nader et al. (1989)	x	x	x	x	x	x	x	x					x		x		x	x				x		x	x	x	**62%**	Mixed
Neumark-Sztainer et al. (2003)	x	x	x	x	x	x	x								x		x	x	x					x	x	x	**54%**	No effect
O'Neil and Nicklas (2002)	x	x	x	x			x	x							x		x	x	x					x	x		**46%**	Positive
Paineau et al. (2008)	x	x	x	x	x		x	x		x	x				x	x	x	x	x	x	x	x		x	x	x	**77%**	Mixed
Patrick et al. (2006)	x	x		x	x		x	x							x	x	x	x	x	x	x	x		x	x	x	**65%**	Mixed
Perry et al. (1988)		x	x	x		x									x			x			x	x		x	x	x	**42%**	Positive
Perry et al. (1998)	x	x	x	x		x	x	x							x		x	x			x	x		x	x	x	**58%**	Mixed
Reynolds et al. (2000)	x	x	x	x	x	x	x								x	x	x	x	x		x	x		x	x	x	**65%**	Positive
Stolley and Fitzgibbon (1997)	x	x	x	x			x									x	x		x	x	x	x		x	x	x	**54%**	Mixed
Trevino et al. (2004)	x	x	x	x	x		x	x		x					x	x	x	x	x	x	x	x		x	x	x	**73%**	Mixed
Vandongen et al. (1995)	x	x		x	x		x	x	x						x		x		x		x	x		x	x	x	**58%**	Mixed
Total	21	24	19	24	16	11	23	20	7	8	2	1	4	0	22	11	22	17	19	13	19	20	1	24	18	23		

*Defined by the Extended CONSORT Checklist for non-pharmacologic randomized controlled trials, Boutron et al. (2008).
**Positive indicates dietary changes occurring in the desired or hypothesized direction; mixed indicates change occurred for some subgroups but not others, or for some but not all outcomes; and no effect indicates that there were no reported changes in the child diet.

changes (an intervention design factor). Similar trends were recently reported among interventions with family components intended to promote physical activity in children (O'Connor et al., 2009a,b), suggesting that direct involvement of parents in interventions targeting child dietary behavior need to be further evaluated via well-designed, adequately powered, randomized controlled trials.

Of concern was the lack of comprehensive and transparent reporting among the published interventions — only four of the reported studies met at least 70% of the CONSORT criteria for non-pharmacologic randomized controlled trials (Boutron et al., 2008). Empirical evidence suggests that omitting information captured by the CONSORT checklist is associated with biased estimates of treatment effect, making it difficult to determine the reliability or relevance of findings (Altman et al., 2001). We were unable to ascertain whether this was an issue in our review because of the limited number of publications meeting a majority of the reporting criteria.

There is a great need for development of more valid and reliable approaches for assessing dietary intake among children of all ages. Lack of uniformity in measurement of child dietary intake was also a troubling pattern that emerged from this review. While four commonly used methods of assessing dietary intake were used by the studies reviewed here (24-hour recalls, food frequency questionnaires, diet records, and staff observation), each varied slightly in methods, resulting in almost as many different measures of dietary outcome as studies reported. Different measurement methods yield different results (Stevens et al., 2007). The selection of a method for obtaining food intake data should be based on the research question, study design, and additional criteria regarding potential sources of error and problems that may occur due to socio-cultural characteristics of the participant population. For example, the food frequency questionnaire was designed to measure typical patterns of food intake and not necessarily intended to provide accurate quantitative measures of energy and nutrient intakes on an individual basis (Thompson and Byers, 1994). Further, while parents can report somewhat accurately on their child's behalf (Linneman et al., 2004), they report less accurately when children eat in settings outside the home (e.g. at school or in childcare settings) (Baranowski et al., 1991).

Interventions designed to impact child diet have largely taken place in school settings, which allow for large numbers of children to be reached, but with limited effects (Thomas, 2006). Strategies are needed that reach and impact a majority of children at a substantial and meaningful level. This review suggests that such strategies should aim to directly engage parents in ways to help support their child have more healthy dietary consumption patterns. Designing an effective nutrition intervention requires an understanding of psychosocial or environmental determinants of diet (Baranowski et al., 1997). Parents remain attractive targets for nutrition intervention programs because they act as nutrition "gatekeepers," providing their children with ability and opportunity to make healthy food choices.

A potential barrier to implementing an effective parent-focused dietary intervention is a lack of theory-driven research that systematically evaluates the effects of specific parenting strategies (and in what context they are used) on child dietary behavior and weight. Research has begun to explore "effective food parenting" (O'Connor et al., in press) with an emphasis on feeding styles (Hughes et al., 2005) and parenting practices (Hendy et al., 2009; Musher-Eizenman and Holub, 2007) and linking these strategies to child intake (O'Connor et al., 2009a,b). Improving our understanding of this could inform policy and guide public health efforts.

This review has several limitations. Only published articles were reviewed which may bias the selection to more favorable outcomes, since interventions with null findings are less likely to be published than those with a positive effect (Doak et al., 2006). Only studies published in the English language were included, limiting the number of studies included outside of English-speaking countries. The CONSORT criteria allow for review of the quality of reporting, and are not a direct assessment of the study design and analysis. Using this checklist to assess quality of reporting is also somewhat subjective given the possibility that users may interpret the criteria differently (despite definitions provided by CONSORT statement authors). Since

the method of parental involvement that was reported in the publications only specified intensity of contact, intervention targets and intervention content must also be considered. It was impossible to ascertain either of these factors from the majority of studies in this review because of a lack of detailed reporting, often the result of word limits set by many medical and public health journals.

Summary and conclusions

Currently, limited conclusions may be drawn regarding the best method to involve parents in changing child diet to prevent obesity and improve health. Indirect methods remain the most commonly used strategies to engage parents, however, direct methods of engagement show more promise and therefore, warrant further research.

Future research should specifically test a "parent effect" by designing methodologically rigorous studies with appropriate comparison groups. Different intensities of parental involvement should be investigated, and parent participation rates in intervention activities reported. Based on the CONSORT criteria, quality of reporting was generally inadequate and needs to be improved. A gold standard diet assessment method in children remains a significant methodology issue. Innovative ways to measure diet in real time should be developed to capture a more accurate representation of children's dietary intake. Finally, investigators should strive to use similar methods of dietary and adiposity measurement, making comparisons across studies possible and advancing this critical field of research.

Conflict of interest statement
The authors declare there is no conflict of interest.

Acknowledgments

This research was funded by a National Institute of Child Health and Human Development Training Grant 5T32HD007445, "Research Training in Maternal, Infant & Child Nutrition." This work is also a publication of the United States Department of Agriculture (USDA/ARS) Children's Nutrition Research Center, Department of Pediatrics, Baylor College of Medicine, Houston, Texas, and has been funded in part with federal funds from the USDA/ARS under Cooperative Agreement no. 58-6250-6001. The contents of this publication do not necessarily reflect the views or policies of the USDA nor does mention of trade names, commercial products, or organizations imply endorsement from the U.S. government.

Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at doi:10.1016/j.ypmed.2010.04.014.

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