A Systematic Review of Home-Based Childhood Obesity Prevention Studies

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KEY WORDS

child, obesity, overweight, intervention, home, BMI

ABBREVIATIONS

KQ—key question

PA—physical activity

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abstract

BACKGROUND AND OBJECTIVES: Childhood obesity is a global epidemic. Despite emerging research about the role of the family and home on obesity risk behaviors, the evidence base for the effectiveness of home-based interventions on obesity prevention remains uncertain. The objective was to systematically review the effectiveness of home-based interventions on weight, intermediate (eg, diet and physical activity [PA]), and clinical outcomes.

METHODS: We searched Medline, Embase, PsychInfo, CINAHL, clinicaltrials.gov, and the Cochrane Library from inception through August 11, 2012. We included experimental and natural experimental studies with ≥ 1 -year follow-up reporting weight-related outcomes and targeting children at home. Two independent reviewers screened studies and extracted data. We graded the strength of the evidence supporting interventions targeting diet, PA, or both for obesity prevention.

RESULTS: We identified 6 studies; 3 tested combined interventions (diet and PA), 1 used diet intervention, 1 combined intervention with primary care and consumer health informatics components, and 1 combined intervention with school and community components. Select combined interventions had beneficial effects on fruit/vegetable intake and sedentary behaviors. However, none of the 6 studies reported a significant effect on weight outcomes. Overall, the strength of evidence is low that combined home-based interventions effectively prevent obesity. The evidence is insufficient for conclusions about home-based diet interventions or interventions implemented at home in association with other settings.

CONCLUSIONS: The strength of evidence is low to support the effectiveness of home-based child obesity prevention programs. Additional research is needed to test interventions in the home setting, particularly those incorporating parenting strategies and addressing environmental influences. *Pediatrics* 2013;132:e193–e200

Childhood obesity has become a major public health epidemic.^{1–3} At present, more than one-third of American children and adolescents are overweight or obese, reflecting a nearly threefold increase in obesity prevalence since 1980.^{3,4} The consequences of obesity are numerous. Overweight children are more likely to become obese adults.⁵ Additionally, overweight children are disproportionately affected by adverse physical and psychosocial health outcomes, including hypertension, diabetes, low self-esteem, and increased engagement in high-risk behaviors.^{6,7}

It is widely recognized that the family and home environment significantly influence child diet and physical activity (PA) behaviors.^{8,9} Three recent systematic reviews have highlighted the importance of these influences on child obesity prevention and treatment, mainly for young children.^{10–12} A 2011 review identified studies that supported a small to moderate effect of parenting interventions on weight-related outcomes.¹⁰ Another 2011 review identified studies that reported a favorable effect of key parental variables (eg, parental feeding practices, parental style, etc) on risk behaviors for child obesity in preschool-aged children.¹¹ The third review reported that the majority of studies reported a favorable effect of family and home-based interventions on the treatment of overweight and obesity among young children aged 2 to 7 years.¹²

To additionally examine the evidence base for the effectiveness of home-based prevention programs on child obesity, our team completed an Agency for Healthcare Research and Quality–funded systematic review on childhood obesity prevention studies conducted in high-income countries. The present report represents a component of our larger systematic review of childhood obesity prevention studies.¹³ The larger systematic review addresses 6 key

questions (KQs 1-6) evaluating the effectiveness of obesity prevention programs conducted in various settings for the prevention of obesity or overweight in children. This article describes the results of home-based obesity prevention studies (KQ2). Findings addressing other KQs are available in our full evidence report.

METHODS

We developed and followed a standard protocol for this review following the recommended methods as described in the *Methods Reference Guide for Effectiveness and Comparative Effectiveness Reviews*.¹⁴ Additional details of the protocol are available in our full evidence report.¹⁵

Literature Search Strategy

We searched Medline, Embase, PsychInfo, CINAHL, clinicaltrials.gov, and the Cochrane Library through August 11, 2012, and identified additional studies from reference lists of eligible articles and relevant systematic reviews. Our electronic search strategy included medical subject headings (MeSH) and keywords related to childhood obesity and overweight prevention. We also conducted a gray literature search in clinicaltrials.gov to identify unpublished research that was relevant to our review on July 23, 2012.

Study Selection

We identified studies conducted in high-income countries that reported the effects of interventions to prevent obesity in children and adolescents aged 2 to 18 years old. We included randomized controlled trials, quasi-experimental studies, and natural experimental studies with at least 1-year follow-up that targeted children in their homes or included significant family involvement. Interventions of interest involved a modification of diet, PA, sedentary behaviors, or a combination

of these. Additionally, the study was required to report the effect(s) of the intervention on weight-related outcomes. We excluded studies that targeted only overweight or obese children or children with preexisting medical conditions such as diabetes or heart disease.

Data Extraction and Quality (Risk of Bias) Assessment

Two reviewers independently screened first the abstract and then the full article for eligibility (Fig 1). One reviewer abstracted data from included articles and a second reviewer checked the abstracted data for accuracy. We abstracted information on study characteristics, study participants, eligibility criteria, interventions, outcome measures, the method of ascertainment, and the outcomes. We assessed the quality of included studies by using the Downs & Black instrument.¹⁵ We categorized the studies as having low, moderate, or high risk of bias. We rated a study as having a low risk of bias only when it had met all of the following requirements:

1. stated the objective clearly;
2. described the main outcomes;
3. described the characteristics of the enrolled subjects;
4. described the intervention clearly;
5. described the main findings;
6. randomly assigned the subjects to the intervention group; and
7. concealed the intervention assignment until recruitment was complete.

Additionally, the study had to have at least partially described the distributions of (potential) principal confounders in each treatment group.

Outcome Variables

We compared the effects of interventions on weight- or body composition–related outcomes (eg, BMI, BMI z score, weight),

FIGURE 1

Results of the literature search on home-based childhood obesity prevention studies in high-income countries. ^a Sum of excluded abstracts exceeds 5600 because reviewers were not required to agree on reasons for exclusion. ^b Sum of excluded articles exceeds 470 because reviewers were not required to agree on reasons for exclusion. KQ, key question.

obesity-related clinical outcomes (eg, blood pressure, lipids), intermediate outcomes (dietary intake, PA), and ad-

verse effects of interventions. Body composition-related outcomes were our primary focus. Outcomes were ei-

ther compared between 2 groups, both of which received an intervention, or 2 groups, 1 of which received the

intervention and the other usual care or no intervention.

Data Synthesis and Analysis

We created a set of detailed evidence tables containing all information abstracted from eligible studies. Results were first organized by setting or combination of settings where the intervention took place (eg, home, school settings or home, community settings, etc) and then by intervention. We described the interventions on the basis of their focus (eg, change in dietary intake or PA) and the modality of intervention delivery (eg, education, environment modification, or self-management technique). We reviewed studies for outcomes of relevant subgroups (eg, age, gender, race), and reported them separately by subgroup.

We present qualitative summaries of included studies in this review. Due to intervention and outcome heterogeneity, meta-analyses could not be conducted.

Strength of the Evidence

We graded the quantity, quality, and consistency of the best available results or evidence by adapting an evidence-grading scheme recommended in the *Methods Reference Guide for Effectiveness and Comparative Effectiveness Reviews*.¹⁴ We classified evidence into 4 categories:

1. “high” grade (indicating high confidence that the evidence reflects the true effect and that additional research is very unlikely to change our confidence in the estimate of the effect);
2. “moderate” grade (indicating moderate confidence that the evidence reflects the true effect and that additional research may change our confidence in the estimate of the effect and may change the estimate);
3. “low” grade (indicating low confidence that the evidence reflects the true effect and that additional research is likely to change the estimate); and
4. “insufficient” grade (indicating evidence is unavailable; there was only 1 study and it had moderate to high risk of bias, or a conclusion could not be drawn on the basis of data).

RESULTS

Search Results

We identified 34 545 unique citations. During the title screening, we excluded 28 344 citations, and excluded an additional 5600 during abstract screening. During article screening, we excluded an additional 470 articles. Six studies reporting on home-based interventions (KQ2) were included in this review: 3 home-based combined (diet and PA) intervention studies,^{16–18} 1 home-based diet intervention study,¹⁹ 1 combined home-based study with primary care and consumer health informatics components,²⁰ and 1 combined home-based study with school and community components (Fig 1).²¹ The results of the gray literature search did not yield studies eligible for inclusion in this review.

Description of Included Studies

Study characteristics are summarized in Table 1. All studies were randomized controlled trials conducted in the United States.^{16–21} The majority of included studies were conducted exclusively in the home setting ($n = 4$).^{16–19} The sample size of included studies ranged from 26 to 1323 participants. Intervention length varied between 14 and 104 weeks, and participant follow-up ranged from 52 to 104 weeks. One study specifically targeted girls,¹⁹ and 2 other studies targeted preschool-¹⁸ and adolescent-aged participants (Table 1).²⁰

Overall Findings on the Effectiveness of Home-Based Interventions

The results of home-based obesity interventions on weight-related and intermediate outcomes are summarized in Tables 1 and 2, respectively. None of the 6 studies reported a significant intervention effect on weight-related outcomes, whereas 3 reported statistically significant effects of a combined intervention on fruit/vegetable intake^{17,21} or sedentary behaviors.²⁰ No studies reported on clinical outcomes or adverse effects of the interventions.

Effectiveness of Home-Based Interventions by Setting(s) and Intervention Type

Home-Based Diet and PA Interventions

Three randomized controlled trials tested such interventions over a 52-week study period.^{16–18} These studies enrolled a total of 262 participants aged 4 to 17 years. One reported on the effect of 2 educational diet and PA interventions, each targeting a different dietary behavior (increased fruit and vegetable intake versus decreased intake of high-fat/high-sugar foods).¹⁶ The second study evaluated the effect of the intervention on television viewing, snack/sweet intake, eating out, and PA among entire households.¹⁷ The third study assessed the effect of the intervention on dietary fat, fruit and vegetable intake, television viewing, and PA among preschool-aged children.¹⁸

None of these studies reported significant beneficial intervention effects on BMI, BMI z score, weight, or prevalence of obesity/overweight.^{16–18}

With regard to intermediate outcomes, in 2 studies there were no differences between the intervention and control groups in minutes per day of PA, television viewing, or general screen time.^{17,18} All 3 studies^{16–18} reported a favorable intervention effect on fruit and vegetable intake, but only 1 study reported

TABLE 1 Summary of the Results of Home-Based Childhood Obesity Prevention Studies Conducted in High-Income Countries on Weight-Related Outcomes

Study, Design	N	Intervention		Age range, y	Girls, %	Follow-up, wk	BMI z Score	BMI	Body Fat, %	Prevalence Obesity/Overweight	Weight, kg
		Type	Description								
Epstein et al (16), RCT	26	D, PA	26-week parent-focused behavioral intervention to reduce high-fat/high-sugar intake or increase fruit/vegetable intake; increase access to PA; reduce access to sedentary behaviors	8.6–8.8	65	52	—	—	—	NS ^c	—
Fitzgibbon et al (18), RCT	146	D, PA	14-week family-based intervention (parent-child dyads) to increase fruit/vegetable intake, decrease fat intake, reduce television viewing, and increase PA	3–5	50	52	0.03 (95% CI, −0.28 to 0.34)	0.17 (95% CI, −0.45 to 0.80)	—	—	0.57 (95% CI, −0.55 to 1.68)
French et al (17), RCT	90 ^a	D, PA	52-week behavioral and environmental intervention to prevent weight gain among entire households	5–17	—	52	0.06 (<i>P</i> = .53)	—	—	—	—
Lappe et al (19), RCT	59	D	104-week calcium-rich dietary intervention designed to assess effect on weight gain	9	100	104	—	NS ^c	NS ^c	—	NS ^c
Patrick et al (20), RCT	878	D, PA	52-week PACE+ computer-supported behavioral intervention to modify total intake of fat, fruit/vegetable intake, PA, and sedentary behaviors	11–15	49.9	52	−(<i>P</i> ≥ .05 for normal and overweight participants)	—	—	—	—
Gentile et al (21), RCT	1323	D, PA	30-week “Switch” behavioral intervention to modify nutrition, television viewing/screen time and PA	9.6 ^b	53.0	61	—	−(<i>P</i> ≥ .05 overall sample, <i>P</i> < .05 boys)	—	—	—

CI, confidence interval; D, diet; NR, not reported; NS, not significant; RCT, randomized controlled trial. —, results not reported.

^a *N* = 90 households.^b PACE+, Patient-centered Assessment and Counseling for Exercise +Nutrition.^c Only mean age reported.^d 95% CI or *P* value not reported.

a statistically significant intervention effect on fruit and vegetable intake ($P = .05$).¹⁷ In 1 study there was no difference in sugar-sweetened beverage intake between the intervention and control groups.¹⁷ Similarly, another study reported no difference between the intervention and control groups in energy intake.¹⁸

The strength of evidence is low to conclude that combined diet and PA interventions in a home setting prevent child obesity. We graded the strength of evidence as low because it included 3 moderate to high risk of bias studies that were inconsistent (1 reported a favorable but not statistically significant effect, 2 reported a negative effect) and imprecise (Table 3).

Home-Based Diet Intervention

One randomized controlled trial reported on an educational diet intervention that randomly assigned 59 girls to intervention and control groups.¹⁹ This study included only 9-year-old girls with a BMI <85th percentile. The study evaluated the effect of a calcium-rich diet on weight gain over a 104-week study period.

There was no reported difference in BMI at 104 weeks between the intervention and control arms.¹⁹ Similarly, there was no reported difference in fat mass or weight at 104 weeks between the intervention and control arms and no difference in reported hours of PA. At 104 weeks, the intervention group had a higher total energy intake compared with the control group. However, this between-group difference was not significant.¹⁹

Home-, Primary Care-, and Consumer Health Informatics–Based Diet and PA Intervention

A single study enrolled 878 participants aged 11 to 15 years. The intervention targeted diet and PA behaviors by using several modalities: computer-supported assessment, provider counseling, monthly mail and telephone counseling, and family participation.

TABLE 2 Summary of the Results of Home-Based Childhood Obesity Prevention Studies Conducted in High-Income Countries on Intermediate Outcomes

Study, Design	N	Intervention Type	Follow-up, wk	Fruit and Vegetable Intake	Energy Intake, kcal	PA	Sedentary Behavior
Epstein et al (16), RCT	26	D, PA	52	$P = .12$	—	—	NS ^c
Fitzgibbon et al (18), RCT	146	D, PA	52	Vegetable intake: -0.18 servings/d (95% CI, -1.35 to 0.99)	-26.3 (95% CI, -0.96 to 43.5)	9 min/d MVPA (95% CI, -35.1 to 53.2)	0.26 h/d screen time ^d (95% CI, -0.58 to 1.10)
				Fruit intake: 0.28 servings/d (95% CI, -0.36 to 0.92)			
French et al (17), RCT	90 ^a	D, PA	52	0.47 portions/d ($P = .05$)	—	24.3 min/d MVPA ($P = .39$)	0.11 h/d television viewing ($P = .79$)
Lappe et al (19), RCT	59	D	104	—	NS ^c	NS ^c	—
Patrick et al (20), RCT	878	D, PA	52	$-(P = .49$ for boys, $P = .07$ for girls)	—	$-(P = .17$ for boys, $P = .90$ for girls)	$-(P = .001$ for boys and girls)
Gentile et al (21), RCT	1323	D, PA	61	$-(P < .05)$	—	$-(P > .05)$	$-(P > .05)$

CI, confidence interval; D, diet; MVPA, moderate-to-vigorous PA; NR, not reported; NS, not significant; RCT, randomized controlled trial; —, results not reported.

^a $N = 90$ households.

^b 95% CI or P value not reported.

^c Time spent watching television, DVDs, or videos; playing video games; or using a computer.

TABLE 3 Summary of the Strength of Evidence for Weight-Related Outcomes in Studies Taking Place in the Home

Setting	Intervention, No. of Studies	Year of Publication	Enrolled Participants, N	Number of Studies with Low/Moderate/High Risk of Bias	Percentage With Favorable Outcome		Risk of Bias ^a	Consistency ^b	Precision ^c	Strength of Evidence ^d
					$P < .05$	$P < .05$ Not Necessary				
Home	D, 1	2004	59	0/1/0	0	0	Moderate	NA	Imprecise	Insufficient
	C, 3	2001–2012	262	0/2/1	0	33	Moderate	Inconsistent	Imprecise	Low
Home, PC, CHI	C, 1	2006	878	1/0/0	0	0	Low	NA	Imprecise	Insufficient
Home, school, community	C, 1	2009	1323	0/0/1	0	0	High	NA	Imprecise	Insufficient

C, combination of diet and PA interventions; D, diet; CHI, consumer health informatics; NA, not applicable; PC, primary care.

^a The Downs & Black instrument¹⁵ was used to assess the risk of bias in the included studies.

^b The body of evidence was considered as consistent in direction if $\geq 70\%$ of the studies had an effect in the same direction.

^c We considered the body of evidence precise if $\geq 70\%$ of the studies reported statistically significant results ($P < .05$) or had narrow confidence intervals that excluded the null.

^d We considered the 4 recommended domains: (1) risk of bias in the included studies, (2) directness of the evidence, (3) consistency across studies, and (4) precision of the pooled estimate or the individual study estimates. We identified all studies as providing direct evidence because all of the studied interventions directly affected one of our primary outcomes of interest.

The study did not find a significant difference in BMI z score at 52 weeks between the intervention and control arms among all participants or among participants with a BMI ≥ 95 th percentile.²⁰ It also did not find significant differences in minutes per week of moderate plus vigorous PA, percentage of calories from fat, or fruit and vegetable intake between the intervention and control groups. However, the intervention resulted in a significant decrease in hours per day of sedentary behaviors among boys and girls ($P = .001$).

Home-, School-, and Community-Based Diet and PA Intervention

One randomized controlled trial evaluated such an intervention on weight and intermediate outcomes at 34 and 61

weeks.²¹ This study was conducted in the United States and enrolled 1323 participants with a mean age of 9.6 years. The intervention targeted 3 behaviors at the family, school, and community levels: increase in fruit and vegetable intake, increase in PA, and decrease in screen time. There was no overall difference in BMI between the control and intervention groups at the 34- or 61-week follow-up. However, when analyzed by gender, boys had significantly lowered BMI due to the intervention ($P < .05$).²¹

There was no statistically significant difference in PA or screen time between the intervention and control groups at either follow-up time period.²¹ However, children in the intervention group reported significantly more fruit and vegetable

consumption compared with the control group at 61 weeks ($P < .05$).²¹

DISCUSSION

We identified 6 childhood home-based obesity prevention studies conducted in high-income countries. The majority of them ($n = 4$) were conducted exclusively in the home setting. The remaining studies included intervention components implemented in other settings such as the school and local community. Overall, none of the home-based interventions revealed a statistically significant desirable effect on weight-related outcomes such as BMI and prevalence of overweight/obesity. However, 3 studies assessed and reported significant desirable intervention effects on diet or PA

outcomes.^{17,20,21} There were several characteristics of these 3 studies that may have contributed to their beneficial effect on intermediate outcomes. Two of these studies included significantly larger sample sizes ($N = 878$, $N = 1323$) of participants in comparison with the other home-based interventions.^{20,21} These same studies also tested the effect of intervention components implemented in other settings (eg, school, community, primary care settings), which may enhance their effectiveness on behavior change by virtue of their greater reach to targeted participants. Finally, one of the studies targeted entire families in households.¹⁷ Hence, the intervention's effect on child dietary intake may have been facilitated through direct modification of the physical home environment and emphasis on family involvement.

Despite demonstration of favorable effects on intermediate outcomes, none of the 6 studies included in our review reported a significant overall effect on weight-related outcomes. This finding suggests that longer intervention duration and/or greater intensity of intervention dose may be necessary to fully realize the impact of the interventions on weight-related outcomes. Second, many of the included studies targeted individual behavior change without concurrent modifications to the child's food environment (eg, increased availability of healthful foods) or PA environment (eg, increased access to neighborhood recreational space, neighborhood walkability). It is widely recognized that environmental factors such as these may influence child obesity risk.^{22–24} Therefore, without systematically addressing physical environmental factors and their potential influence on individual-level behaviors, the impact of interventions on obesity-risk behaviors and resultant obesity may be attenuated. Finally, the inclusion of studies with small sample sizes and studies that did

not primarily aim to prevent obesity may have also contributed to the lack of treatment effect observed.

This review has several key strengths. We used a systematic and rigorous review process to identify the relevant literature, as standardized by the Agency for Healthcare Research and Quality. Additionally, we evaluated the effects of the interventions on multiple outcomes including weight-related outcomes and behavioral outcomes and used a widely accepted grading scheme to grade study quality and strength of evidence.

Several factors also limited our review. We identified only 6 studies, and due to the considerable heterogeneity in populations, approaches, outcomes, and measurement tools among studies, we were unable to conduct a quantitative synthesis of the literature. Additionally, we limited our review to diet and PA intervention studies with at least 1 year of follow-up and only included those from high-income countries. Hence, we excluded some studies with potentially useful interventions (eg, parenting interventions). However, many of these studies have been included in other, more general, systematic reviews.^{10,11,25} Finally, we excluded interventions that were primarily conducted in other settings but included components conducted in the home setting (eg, school- and home-based interventions), because these interventions may differ from those included in this review and hence limit the ability to collectively examine their effectiveness on child obesity prevention. Details of the findings from these other studies are available in our full evidence report.

Our study contributes valuable information to the existing literature on home-based obesity interventions. In comparison with other recent systematic reviews that examined the effect of parenting or treatment interventions mainly among young children,^{10–12} this

review systematically assessed the impact of diet or diet and PA interventions on prevention of obesity among children and adolescents. On the basis of the paucity of the evidence, however, it is clear that more research is needed to evaluate the impact of home- and family-based interventions on child obesity. Specifically, additional research is needed to test home-based interventions with larger sample sizes, greater intervention duration and intensity, and adequate participant follow-up to improve statistical power of studies. Given the important role parenting plays on child behaviors and the demonstrated effectiveness of parenting intervention components on weight-related outcomes and obesity risk,^{11,26} widespread integration of parenting strategies in home-based interventions should also be considered and additionally evaluated. Finally, implementing and testing the effectiveness of home-based interventions that address important physical environmental influences on obesity-risk behaviors should be a priority of the child obesity research agenda.

CONCLUSIONS

Only a small number of studies examined childhood obesity prevention programs in the home setting. The strength of evidence is low, at best, to support the effectiveness of home-based programs on childhood obesity prevention. Additional research is needed to test interventions in the home setting, particularly those integrating parenting and addressing important environmental sources of influence.

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