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Multidisciplinary approaches interventions in prevention of childhood obesity: targeted systematic review

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Abstract

Among children ages 7–19, about 1 in 3 are overweight and obese (BMI-for-age at or above the 85th percentile of the 2000 CDC growth charts.); 32.1% of all boys and 31.3% of all girls are overweight and obese. Because of the dramatic and alarming increase in childhood obesity and its associated health risks, obesity prevention programs targeting children can and should be developed to promote the health of the public. This study is an overview of different interventions conducted, to guide efforts for an effective management of childhood obesity.
The aim of this review was to assess the literature regarding the prevention of childhood obesity. Databases that were accessed for current literature included Medline, Cochrane and CINAHL. A total of 26 articles were found based on the inclusion criteria for this study. Only 38% of studies required parents' participation, the sample sizes of the studies varied considerably from 201 to 3135 children. 92% of studies used randomized controlled trials and the range of intervention duration ranged from eight weeks to four years. Implications for future research and practice are presented.

Keywords: *Childhood obesity, Body Mass Index, intervention, Overweight, Prevention, Weight gain, Systematic reviews.*

1 Introduction

Childhood obesity and overweight are defined by the Centers for Disease Control and Prevention (CDC) as a body mass index (BMI) greater than or equal to the 95th percentile for children and adolescents of the same age and gender (1, 2). Obesity/overweight has been declared an epidemic and a "public health crisis" among children worldwide (3). The World Health Organization ranked overweight and obesity as the fifth leading global risk for mortality. In addition, 44% of the diabetes burden, 23% of the ischemic heart disease burden and between 7% and 41% of certain cancer burdens are attributable to overweight and obesity (4). Childhood obesity is associated with many health risks; it is the leading cause of pediatric hypertension and associated with type 2 diabetes mellitus, orthopedic complications, increased risk of coronary heart disease, and increased stress on weight-bearing joints (5). As a result, these children are challenged with the negative social consequences of overweight and obesity, as well as the psychosocial problems associated with peer differences and rejection, body image, stigma, social isolation, anxiety and depression, and poor social competence and self-esteem that contribute to decreased quality of life (6,7). In addition, the long-term financial health costs associated with obesity are steadily increasing (8, 9). Moreover, prevalence levels have been rapidly increasing for more than two decades, in parallel with changes in dietary and physical activity patterns, with an unequal distribution across socioeconomic groups (10). The dramatic increase in the prevalence of childhood overweight and its resultant comorbidities are associated with significant health and financial burdens, warranting strong and comprehensive prevention efforts. Prevention is one of the hallmarks of pediatric practice and includes such diverse activities as newborn screenings, immunizations, and promotion of car safety seats and bicycle helmets (1).
Once children (and adults) are obese, it is often difficult for them to lose weight through physical activity and healthy diet. Preventing weight gain from an early age, i.e. in childhood, is therefore recognized as a strategy that will reap health benefits in the long term (4). When developing and implementing childhood obesity prevention intervention, question arise; should we target children as a whole or focus specially on those children at risk? Ells et al. strongly advocated that extremely difficult to confidently identify all children at risk of developing obesity. It is also true to argue that interventions to promote a healthy diet and increased physical activity will benefit all children, irrespective of obesity risk (11).

Obesity prevention is a pressing need as healthcare costs rise in the treatment of its complications. Today, most obesity prevention programs target children who are considered high-risk. For example, those who already qualify as obese or those who have obese parents. Studies on the effectiveness of early intervention programs have concluded that the introduction of healthy changes may decrease or prevent the development of obesity and associated health problems in school-aged children (12). Prevention programs include many interventions, from breastfeeding to nutrition programs. The objective of this review was to assess the literature regarding the prevention of childhood obesity.

1.1 Identification of the problem

The problem of limited evidence to demonstrate the effectiveness of interventions shaped the aim of the review, which was to summaries and analyze strategies used to enhance the prevention of childhood obesity and overweight.

2 Methods

2.1 Search strategy and Inclusion criteria

A comprehensive search of the available English language literature from June 2001 to October 2011 was conducted utilizing the Medline, Cochrane and CINAHL (Cumulative Index to Nursing & Allied Health) databases. In order to maximize the yield of the search, several keyword identifiers were utilized (Table 1). In addition, reference lists were screened to identify additional relevant articles; similar strategies were run in the other databases. Full texts of all reviews identified as potentially eligible were obtained and further screened against the eligibility criteria. Disagreement between reviewers regarding eligibility was resolved via discussion with independent third reviewer.
Studies were selected based on meeting the following criteria: (a) Studies only in English language (b) an obesity-related intervention, (c) Studies that used subjective measures as the exposure (e.g., using questionnaires only) were excluded as these are more likely to be biased than studies using objective measures (e.g., as physical activity), (d) an age criterion where subjects are between 7 and 19 years. No specific conditions were set for controlled studies. Therefore, excluded all studies whose primary aim was not to intervene on obesity or related health and fitness measures (ie, interventions for the prevention of cardiovascular disease, type II diabetes, etc). In addition, sample sizes less than 100 participants would have limited statistical power to find an effect; thus, four studies were excluded from the review.

2.2 Data extraction

One reviewer extracted data from identified studies, which met the inclusion criteria. To describe the characteristics of included studies, the following information was extracted: Author; year of publication, age group, description of intervention, the setting and outcomes.

Table 1: Search strategy in Medline

1	Obesity [Mesh]
2	Overweight OR over weight
3	Weight gain [Mesh]
4	Body Mass Index OR BMI
5	1 OR 2 OR 3 OR 4
6	Child OR children OR pediatr*
7	5 AND 6
8	Obesity intervention
9	Physical activity
10	Obesity prevention
11	preventive measures
12	Nutrition program
13	Review [Mesh]
14	Exercise
15	Life Style

3 Results

The searches initially yielded 2100 references and preliminary sift was conducted to remove the obviously irrelevant papers. Duplicate publications were excluded and in all cases of duplicates the first publication was selected for inclusion. This left 1050 records for further screening, which were then imported into an Endnote bibliographic database and following a process of electronic and manual elimination of duplicates; 950 records were treatment program or had a target population outside the selected age group, this lifted 100 potentially eligible papers. After full-text articles appraisal 74 were excluded and 26 papers were included in this review (Figure1). Selected articles related to prevention are listed in Table 2. Lobstein et al. (3) expressed eloquently that prevention of obesity in childhood is the only feasible option and prevention of overweight is more effective than interventions that target the correction of obesity because of the recalcitrant nature of obesity.

3.1 The studies characteristics

A summary of study characteristics is provided in Table 2. All 26 articles on which this systematic review is based were published in peer review journals and are in the English language and no conflict of interest was declared. Of 26 studies, fourteen were conducted in the USA, eight in Western Europe (Belgium, Sweden, Netherlands, two in France and two UK), two in South America (Chile and Brazil), one in Australia, and one in China. One in Intervention durations ranged from eight weeks to four years. One of the interventions reviewed included only girls and 25 interventions included both girls and boys participants. The sample sizes of the studies varied considerably, from 201 children in the study by Neumark-Sztainer et al. (13) to 3135 children in the study by Marcus et al. (14). Regarding the parents participation, sixteen interventions did not include parents and ten required parents' participation. Of the 26 interventions that examined prevention, 24 (92%) used randomized controlled trials, one (4%) (15) tested the intervention using a pretest–posttest evaluation design with no control group and (4%) (16) used a community-based participatory research design.

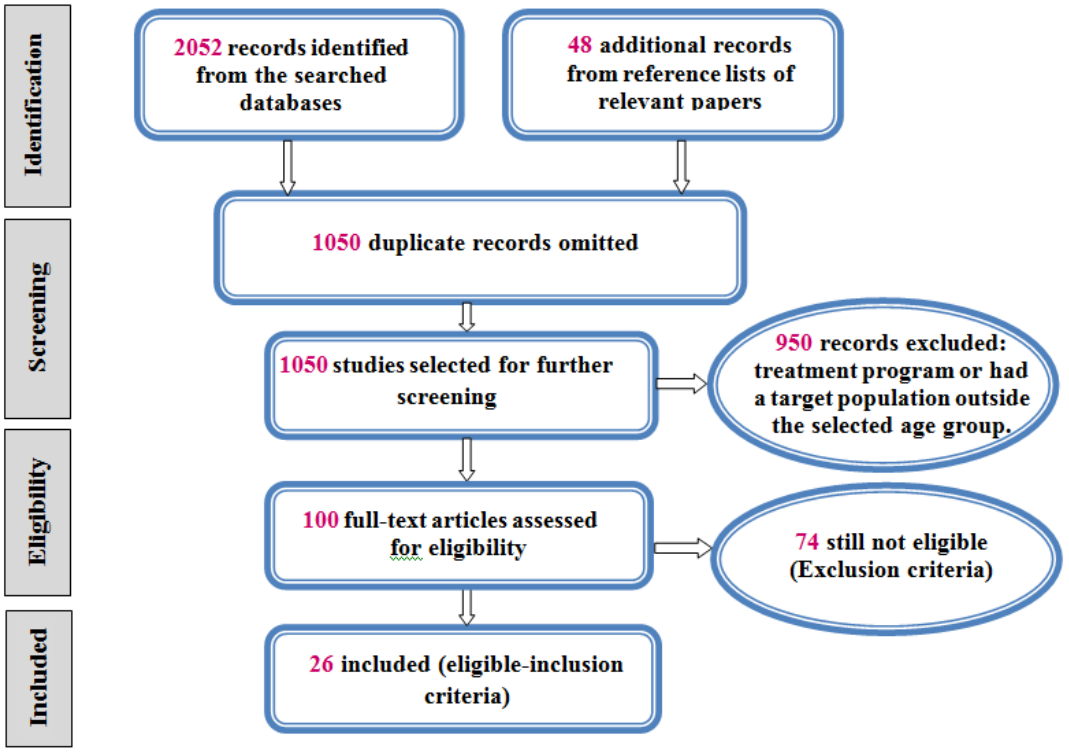

Figure 1: Flowchart for selecting studies

Table 2: Interventions included in the review

Author(s)	Target group	Location of study	Intervention	Setting & intervention duration	Main findings
Data from (17) Black et al. (2010)	235 black adolescents, 11–16 years	USA	Challenge! program for adolescents including: PA sessions, PA education Nutrition education, Peer mentoring	Community based, 11 months	the intervention reduced total percentage of body fat and fat mass and increased fat-free mass at delayed follow-up and increased play-equivalent physical activity at post intervention .
Data from (16) Bruss et al. (2010)	primary caregivers of 3rd grade children (n=407)	Northern Mariana Islands USA	The intervention, entitled Project Familia Giya Marianas (PFGM) including eight different 90-min sessions focused on : promoting physical activity, reducing sedentary activities, preserving self-esteem, weight normalcy and healthy eating environment,	School-2 yrs	children whose caregivers completed 5–8 lessons experienced a significant change in BMI z-score as compared to those with 0 lessons
Data from (18) Caballero et al. (2003)	1704 children, 8-10 years old	Arizona, New Mexico, and South Dakota, USA	Three 30-minute physical education sessions per week during school time; two 10-minute exercise breaks performed inside or outside of the classroom; two 45-minute sessions delivered by teachers each week for 12 wks in 3rd and 4th grade and 8 wks during 5th grade; family involvement program.	School-3yrs	No statistically significant difference in anthropometric variables at baseline and follow-up between the control and intervention groups. Knowledge increased significantly in the intervention group compared with control group; self efficacy to be physically active higher in the intervention group; self efficacy to choose healthy foods no difference between groups.
Data from (15) Contento et al.(2007)	278 children	New York, USA	The intervention program called Choice, Control, and Change (C3), that is designed to foster healthful eating and physical activity and a healthy weight through enhancing agency and competence. C3 curriculum including 24 lessons daily x8 weeks.	School based, 8 weeks	Increase in PA: decreased sedentary activities, improved dietary behaviors: increased F/V intake; decreased frequency of sweetened drinks, snacks, fast food; ate and drank smaller portions, increased outcome beliefs and self-efficacy, no change in attitude

Table 2 Interventions included in the review (continued)

Author(s)	Target group	Location of study	Intervention	Setting & intervention duration	Main findings
Data from (19) Donnelly et al. (2009)	1527 children 2nd-5th grade	Kansas, USA	programme promoted 90 min/wk of moderate-to-vigorous physically active academic lessons delivered to children intermittently throughout school day. This is in addition to the existing 60 min/wk PE which would result in a total of 150 min of PA/wk	School-3 years	No significant differences for change in BMI or BMI percentile (baseline to year three) for intervention vs. control and this finding was not influenced by gender.
Data from (20) Foster et al. (2008)	1349 children 4th-6th grade	Philadelphia, USA	SNPI-School Nutrition Policy Initiative - 5 components: school self-assessment, nutrition education, nutrition policy, social marketing, and parent outreach	School-2 years	• The prevalence of overweight was lower in the intervention schools. • No differences were observed in the incidence or prevalence of obesity or in the remission of overweight or obesity at 2 years.
Data from (21) Gentile et al. (2009)	1323 children in 3rd - 5th grade and their parents	Lakeville, Cedar Rapids, USA	The Switch programme promoted healthy active lifestyles by encouraging Students to 'Switch what you Do, Chew, and View'. The specific DO, VIEW, and CHEW goals were to be active for 60 minutes or more per day, to limit total screen time to 2 hours or less per day, and to eat five fruits/vegetables or more per day.	School-One academic year	• At the 6-month follow-up, parent-reported screen time was significantly lower, and parent and child-reported fruit and vegetable consumption was significantly increased. • No significant effects on pedometer measures of physical activity or body mass index in the intervention group.
Data from (22) Gutin et al. (2008)	206 children in 3rd grade	Georgia, USA	Two hours after-school intervention sessions were offered 5 days/wk on school days for 3 school years, the intervention included 40 min of academic enrichment activities, during which healthy snacks were provided, and 80 min of moderate-to-vigorous PA (MVPA)	School-3 years	• Children in intervention schools improved in fitness and %BF during the school years and returned to levels similar to those in control schools during the summers. • Over the six measurement points, the intervention group increased more than the control group in bone density, fat-free soft tissue, weight, height, and body mass index

Table 2 Interventions included in the review (continued)

Author(s)	Target group	Location of study	Intervention	Setting & intervention duration	Main findings
Data from (23) Haerens et al. (2006)	2840 children	West Flanders, Belgium	Computer-tailored diet/PA program for healthy eating, parents attended meetings on healthy food and PA-received publication three times/year and computer-tailored intervention for child	School- two academic years	• Significant positive intervention effects on physical activity in both genders and on fat intake in girls. • Parental involvement did not increase intervention effects
Data from (24) James et al. 2004)	644 children, their age ranged from7-11	Southern UK	Educational sessions aimed at reducing carbonated beverage consumption and increasing water consumption.	School- 3 sessions; one per term	• At 12 months the percentage of overweight and obese children • increased in the control group by 7.5%, compared with a decrease in the intervention group of 0.2%.
Data from (25) Jiang et al.(2007)	2425 children (Grades 1-4) & their parents	Beijing, China	School-based program in China: PA education Nutrition education Additional meetings for overweight and obese children Lessons on modifying home activities for participants' parents	School- 3 years	• the prevalence of overweight and obesity were significantly lower in the intervention schools than in the control schools. There was also significant difference in body mass index between intervention and control schools.
Data from (26) Kain et al. (2004)	3086 children from 1st to 8th grade	Santiago, Curico and Casablanca Chile	Educational programmes on diet and physical activity, encouraging school kiosks to sell healthy foods, meetings with parents, 90 min of additional physical activity (PA) weekly.	School- 6 months	• Positive effect on adiposity indices (except TSF) was observed in boys, while both physical fitness parameters increased significantly in both boys and girls.
Data from (27) Kipping et al. (2008)	679 children in grade 5 (age 9-10)	Gloucesters hire England	Sixteen lessons on healthy eating, physical activity and reducing TV viewing were taught over 5 months by teachers.	School- 5 months	• Primary outcome: reduction in time spent doing screen-based activities. • Other outcomes: there was no difference in mean body mass index or the odds of obesity.

Table 2 Interventions included in the review (continued)

Author(s)	Target group	Location of study	Intervention	Setting & intervention duration	Main findings
Data from (14) Marcus et al. (2009)	3135 children in grades 1-4	Sweden	Daily physical activity (30 min per child) was integrated into regular school curriculum. Classroom teachers encouraged healthy eating, eating less sweetened foods, and to choose healthy items for school lunch. Awareness raising activities included STOPP newsletter to parents and schools twice a year. School nurses were also trained in obesity-related problems.	School-4 years	• The prevalence of overweight and obesity decreased by 3.2% in intervention schools compared with an increase of 2.8% in control schools. • PA did not differ between intervention and control schools after cluster adjustment. • Eating habits at home were found to be healthier among families with children in intervention schools at the end of the intervention.
Data from (28) Mauriello et al. (2010)	1800 9th to 11th graders	USA	Interactive computer program aimed to multi-media intervention for physical activity, fruit and vegetable consumption, and limited TV viewing between 2006 and 2007.	School-14-month	• The intervention group reported greater numbers of days doing at least 60 minutes of physical activity • The intervention group reported eating fruit and vegetable significantly more than the control group . • The difference between groups on reported average hours of TV was not significant.
Data from (29) McMurray et al. (2002)	1140 youth aged 11 to 14 years	North Carolina, USA	The study involved a control and three intervention groups: exercise only, education only, and combined exercise and education	School-2 months	• The BMI did not change significantly, but the sum of skin folds increased less in subjects in the exercise intervention groups than the education only or control groups.

Table 2 Interventions included in the review (continued)

Author(s)	Target group	Location of study	Intervention	Setting & intervention duration	Main findings
Data from (13) Neumark-Sztainer et al. (2003)	201children (9th-12th grade)	USA	New Movies was offered as a girls-only alternative physical education program that high-school girls took for credit Social Cognitive theory. physical activity offered four times a week, and nutrition and social support sessions that offered every other week on alternating weeks. Each student received an attractive student manual with sections for each of these three components.	School-4 months	• The feasibility of implementing New Moves was high, as indicated by strong satisfaction among participants, parents, and school staff. Girls in the intervention significantly progressed in their stage of behavioural change for physical activity from baseline to follow-up. However, for the majority of outcome variables, differences between intervention and control schools at post intervention and follow-up were not statistically significant.
Data from (30) Paineau et al. (2008)	1013 children, 7- 9 years old& their parents	Paris, France	Family-based program for school children to encourage low fat, high complex carbohydrate diets: Nutrition education; Personal telephone nutrition counselling for participants' families.	School 8 months	• Intervention groups achieved their nutritional targets for fat intake and to a smaller extent for sugar and complex carbohydrate intake, leading to a decrease in energy intake. • Mean changes in body mass index were similar among children in intervention and control group.
Data from (31) Rodearmel et al. (2006)	105 Families with at least one 8-12 year old child (n= 259)	Colorado, USA	Families asked to maintain their usual eating and step patterns for the first week of the study to establish baseline, then asked to make two small lifestyle changes consisting of: increasing their daily walking by 2000 steps/day above baseline levels and consuming 2 servings/day of ready-to-eat cereal.	Home-13 weeks	• The intervention was successful in increasing walking (steps) and cereal consumption. The intervention had positive, significant effects on percentage BMI-for-age and percentage body fat for target children and weight, BMI, and percentage body fat for parents

Table 2 Interventions included in the review (continued)

Author(s)	Target group	Location of study	Intervention	Setting & intervention duration	Main findings
Data from (32) Sahota et al.(2001)	634 children aged 7-11 years	Leeds, UK	Program consisted of teacher training, modification of school meals, and the development and implementation of school action plans designed to promote healthy eating and physical activity over one academic year.	School-12 month	Intervention children showed a higher score for knowledge, attitudes, and self reported behavior for healthy eating and physical activity. Not effective by BMI weighted mean difference
Data from (33) Sallis et al. (2003)	1484children, their age ranged from 11-14	San Diego, USA	Intervention group: increased physical activity before, during and after school. Reduced fat in school diet. Control group: No special interventions	School-2yrs	Boys: Statistically Significant reduction in BMI between intervention and control group. Girls: no statistically Significant deference in BMI between intervention and control group.
Data from (34) Salmon et al. (2008)	311children aged10 to12 years and their parents	Melbourne, Australia	Three intervention groups: - *Behavior Modification (BM) group:* physical education and sports classes, - *Fundamental Motor Skills (FMS) group:* Lessons focused on mastery of six fundamental movement skills (run, throw, dodge, strike, vertical jump, and kick). - BM/FMS group: children in this group received both BM and FMS lessons	School-6 months	there was a significant intervention effect from baseline to post intervention on age- and sex-adjusted BMI in the BM/FMS group compared with controls. Children in the BM/FMS group were less likely than controls to be overweight/ obese between baseline and post intervention.
Data from (35) Sichieri et al. (2009)	1140, 9-12-year-old fourth grader students	Niteroi,Rio de Janeiro, Brazil	Focus on the reduction in consumption of sugar-sweetened carbonated beverages by students: Healthy lifestyle education program, social marketing. 10x 1 hr sessions of activities facilitated by 4 trained researchers who were assigned for each class. Encouraging water drinking. Printed materials provided to intervention group to facilitate sessions dietary interventions versus control	School 7 months	A statistically significant decrease in the daily consumption of carbonated drinks in the intervention compared to control; followed by a non-significant overall reduction in BMI. However, among those students overweight at baseline, the intervention group showed greater BMI reduction.

Table 2 Interventions included in the review (continued)

Author(s)	Target group	Location of study	Intervention	Setting & intervention duration	Main findings
Data from (36) Simon et al.(2008)	954 – 12-year-old six-graders.	Eastern France	Program began during first school year and ran until end of fourth school year. Educational component focusing on physical activity and sedentary behaviors. New opportunities for PA offered in lunchtime, breaks and after school hours. Activities organized by formal physical educators, no competitive aspect	School 4 years	• Intervention students had a lower increase in BMI and age- and gender-adjusted BMI over time than controls. • The intervention had a significant effect throughout the study in initially non-overweight adolescents for adjusted BMI at 4 years.
Data from (37) Singh et al. (2007)	978 adolescents	Netherlands	The Program increase awareness and induce behavioral changes: Reduction in consumption of sugar-sweetened beverages Reduction in consumption of high-sugar, high-fat-content snacks Reduction in sedentary behavior increase in active transport behavior maintenance of level of sports participation. Educational program covering 11 biology and physical education lessons.	School 8 months	• Significant differences in changes after the 8-month intervention period in favor of the intervention group with regard to hip circumference and sum of skin folds among girls. • In boys, the intervention resulted in a significant difference in waist circumference. • No significant intervention effects were found related to aerobic fitness
Data from (38) Spiegel & Foulk (2006)	1013 students in fourth and fifth grades	Colorado USA	The WAY intervention program was integrated throughout the school year with activities ranging in engagement time from 20 minutes to more extensive activities that require 1 hour or more. Students were engaged in multidisciplinary activities in language arts, mathematics, science, while developing their health attitudes and behavioral intent.	School 6 months	Analysis of post-data shows significant positive shifts ($p = 0.01$) in BMI in the intervention group compared with the comparison group. Notable increases in the consumption of fruits and vegetables and increased physical activity levels were reported in the intervention group.

3.2 Intervention type

The 26 studies utilized a variety of obesity-related interventions in children (Table 2). Of these interventions, 6 only utilized an implementation or a modification of an existing physical activity program or an in-school physical education class (18, 19, 34, 36, 37, 38). Another 10 intervention protocols only used health and fitness educational models, dietary regimens, or physical activity behavior modification strategies (13, 16, 17, 20, 23, 24, 25 26, 27, 30). The remaining 10 intervention studies utilized combinations of physical activity programs, health/fitness educational models, and/or dietary/ nutritional regimens (14, 15, 21, 22, 28, 29, 31, 32, 33, 35). Prevention strategies focused on building healthy habits related to nutrition and activity has more stable Long-term results as compared with strategies focused on limiting behaviors. For example, children who were encouraged to increase their fruit and vegetable intake were more likely to demonstrate significant decreases in percentage of overweight than the children who were encouraged to decrease their fat and sugar intake (30, 37, 38)**.**

4 Discussion

In a recent Cochrane review and meta-analysis by Waters et al. although levels of parent participation were not considered in the Cochrane review, Waters et al. conclude that the greater effectiveness seen in non-school settings is likely related to level of parental engagement (39). In addition, a wealth of literature supports the importance of parental involvement in childhood obesity prevention (40, 41,42, 43). In the current review, Haerens and colleagues found that parents provided greater support after receiving the same computer-tailored intervention as their children. After 1 year, girls had a decreased fat intake and higher levels of physical activity, yet after 2 years, there were no differences with or without parental support. The authors suggested that one weakness of the study was the lack of evaluation of parental involvement. While some interventions emphasized the importance of parent involvement, only 38% of the reviewed studies required the parent participation. It may be due to that the most of these studies were conducted in school setting or the target population was school age children and adolescents rather than young children (23).

The setting of most intervention described in the included studies (92%) focused on the schools and only 8% were conducted in community settings. Nielsen et al., declare that the rationale for working in community settings as the future focus for addressing the childhood obesity epidemic is strong. Adolescents obtain more than 90% of their total calories from outside the school setting, the majority from within their homes (60.5%) or from restaurants (19.3%) (44). The authors argue that new directions beyond the central focus on schools must be explored in order to effectively combat the burgeoning obesity among children. Specially that the mixed and modest results of school-centered trials to date argue that this approach alone is not effective in making a real dent in childhood obesity prevention (45). On the other hand, school-based programs have had limited success in engaging parents to change household behavior, and thereby reducing the obesigenic environment at home, with some exceptions (46).

While some of the interventions were long term, there were eight interventions (30%) had a duration of 6 months or less, which appears to be an inadequate duration to achieve significant changes in BMI. This conclusion is supported by Kain et al. (26), whose study duration was 6 months. They stated that the finding of decreased adiposity in the male participants in the intervention group was most likely a result of better adherence to the physical activity portion of the intervention and greater intensity of activity, but this observation needs to be evaluated over a longer duration to obtain a more definitive answer.

Most of the reviewed studies included multiple areas of intervention, this integrative review of available current literature points to no specific intervention or combination of interventions as the most beneficial. This observation is supported by Stevens (47) which arise the question is the failure or modest success of the intervention was because of a problem in the content of the intervention approach or with its implementation?

There is strong evidence linking physical inactivity (sedentary behavior) with obesity in children and adolescents (48). In the present review, reduction of sedentary activities was included as a main element in obesity prevention program in three of the reviewed studies (15, 16, 37). These studies measured the outcomes in term of increasing the reduction of sedentary activities, which adds to the growing evidence that sedentary lifestyles are a concern for all children.

Table 3: Interventions utilized in childhood obesity prevention

Subjects	Intervention: dietary	Intervention: physical activity	Intervention: parental involvement	Intervention: healthy lifestyle education
Black et al. (2010)	Yes	Yes	Yes	Yes
Bruss et al. (2009)	No	Yes	Yes	Yes
Caballero et al. (2003)	No	Yes	Yes	No
Contento et al. (2007)	Yes	Yes	No	No
Donnelly et al. (2009)	No	Yes	No	No
Foster et al. (2008)	Yes	No	No	Yes
Gentile et al. (2009)	Yes	Yes	No	Yes
Gutinet al. (2008)	Yes	Yes	Yes	Yes
Haerens et al. (2006)	Yes	Yes	Yes	No
James et al. (2004)	Yes	No	No	Yes
Jiang et al.(2007)	Yes	Yes	Yes	No
Kain et al. (2004)	Yes	Yes	Yes	No
Kipping et al. (2008)	Yes	Yes	No	No
Marcus et al. (2009)	Yes	Yes	No	No
Mauriello et al. (2010)	Yes	Yes	No	No
McMurray et al. (2002)	No	Yes	No	Yes
Neumark-Sztainer et al. (2003)	Yes	Yes	No	No
Paineau et al. (2008)	Yes	No	Yes	No
Rodearmel et al. (2006)	Yes	Yes	Yes	Yes
Sahota et al. (2001)	Yes	Yes	Yes	No
Sallis et al. (2003)	Yes	Yes	No	No
Salmon et al. (2008)	No	Yes	No	Yes
Sichieri et al. (2009)	Yes	Yes	No	No
Simon et al. (2008)	No	Yes	No	Yes
Singh et al. (2007)	Yes	Yes	No	No
Spiegel & Foulk (2006)	No	Yes	No	No

5 Limitations

Despite comprehensive efforts to identify all relevant studies, it is possible that some may have been missed. Because studies considered for inclusion were in English language only, further data might have been revealed from including non-English language studies. In addition, the studies included in this review were conducted in a variety of countries with a diversity of cultures and the degree of their generalizability is uncertain.

6 Conclusion

The purpose of this systematic review was to identify the current state of the evidence related to the prevention of overweight and obesity in children and adolescents. The results indicate three areas of emphasis in the literature: community settings as the future focus for addressing the childhood obesity epidemic is strong, prevention as the best option; crucial parental involvement; and no specific intervention or combination of interventions as the most beneficial approach. Health care practitioners must be involved in developing and implementing well-constructed implementation and evaluation studies that build on the limited base of current evidence.

7 Conflict of Interest Statement

The authors declare that there are no conflicts of interest.

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