Askari et al., J Obes Weight Loss Ther 2013, 3:5
DOI: 10.4172/2165-7904.1000188

Journal of
Obesity & Weight Loss Therapy

Review Article Open Access

A Systematic Review of Community-Based Childhood Obesity Prevention Programs

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Abstract

Background: The problem of overweight and obesity has reached epidemic proportions in the United States as well as globally. School-based interventions, after school interventions, home and family based interventions and community-based interventions have been developed to address the problem of childhood overweight and obesity. Understanding the best approach to impact obesity rates is a necessity for health professionals. Therefore, the purpose of this article was to examine the efficacy of community-based interventions targeting childhood obesity and to further develop a set of recommendations for future interventions.

Methods: A systematic literature review was conducted independently by two authors in four relevant databases. Inclusion criteria were (1) primary research; (2) overweight or obesity prevention interventions; (3) community-based; (4) studies that used a quantitative design and provided outcome data; and (5) were published through September 2012.

Results: A total of 15 interventions met the inclusion criteria, of which six were randomized controlled trials. Eleven interventions were from the United States with one each from Canada, Australia, England and Tonga. Eight interventions utilized a theoretical framework, with Social Cognitive Theory being the most commonly utilized theory.

Discussion: Recommendations for future community based interventions include utilization of multiple settings including schools, use of behavioral theory and its explicit operationalization, use of interactive strategies including social support and involvement of parents and family, along with use of environmental change approaches.

Keywords: Obesity; Overweight; Community; Prevention; Intervention; Program

A Systematic Review of Community-Based Childhood Obesity Prevention Programs

In the past 30 years there has been a substantial rise in childhood obesity rates all over the world [1]. In specific terms the worldwide prevalence of overweight and obesity in childhood has increased from 4.2% in 1990 to 6.7% in 2010 and is expected to reach 9.1% in 2020 [2]. In 2010, 43 million children around the world were estimated to be overweight and obese with an additional 92 million at risk of becoming overweight [2]. In the United States, based on the 2009-2010 National Health and Nutrition Examination Survey (NHANES) data, 16.9% (95% CI, 15.4%-18.4%) of children and adolescents between 2 and 19 years were obese [3] These data imply that the problem of overweight and obesity is more severe in the United States.

Childhood overweight and obesity are associated with several negative consequences. The Bogalusa Heart Study [4] found that childhood obesity is associated with cardiovascular risk factors: of children with a Body Mass Index (BMI) ≥ 95th percentile, 39% had at least two cardiovascular risk factors [5]. Besides impacting cardiovascular risk factors, childhood overweight and obesity also contributes to development of type 2 diabetes, bronchial asthma, sleep apnea, and fatty liver disease [6,7]. Overweight and obesity in childhood is also responsible for several psychological problems such as discrimination, lower self-esteem, depression, body image disturbance, rejection by peers, impaired quality of life, and stigmatization [8-10]. Childhood obesity tends to persist into adulthood. Of children with a BMI ≥ 95th percentile, 65% had an adult BMI ≥ 35 kg/m^2, further warranting the need for childhood obesity prevention efforts [2].

Childhood overweight and obesity are shaped by many factors [11]. According to the Surgeon General's Report, for a large majority of people, overweight and obesity result from consuming too many calories and not getting enough physical activity [12]. However, determinants contributing to obesity are often complex and multi-faceted. Influencing factors have been summarized into the following six categories [11]. The first set of factors are genetics and biological factors that include genes, gender, parental BMI, height, age, and race. The second set of factors comprise of the influences in the first year of life such as weight at birth, growth in the first year, etc. The third set of influence includes the mother's behaviors such as breastfeeding, weight gain, and smoking during pregnancy. The fourth set of influences comprise of family food environment and dietary behaviors such as consumption of fat, preferences for certain types of unhealthy foods, consumption of sweetened beverages, large portion sizes, snacking, and family meal times. The fifth set of influence pertains to participation in physical activity along with total amount of screen time (time spent on computers and television). The final set of influence includes environmental factors, such as environments which hinder or encourage being physically active and access to healthy foods. These factors need to be addressed in a comprehensive manner to see an impact on current childhood obesity rates.

The preventive efforts for combating the problem of overweight and obesity in children have conventionally utilized schools.

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Received August 08, 2013; **Accepted** August 23, 2013; **Published** August 26, 2013

Citation: Ickes MJ, Sharma M (2013) A Systematic Review of Community-Based Childhood Obesity Prevention Programs. J Obes Weight Loss Ther 3: 188. doi:10.4172/2165-7904.1000188

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School-based interventions have a long history, albeit with limited success. Multiple systematic reviews have been published on these interventions, indicating a need for a more comprehensive approach [13,14]. Consequently, in recent years community-based interventions have been introduced. Reviews have been published on after school interventions, prompting a need for further analysis regarding other community-based interventions [15]. Community-based interventions are those which are done in community settings and involve children and/or family members in their activities. There is some evidence that community-based programs are promising [16,17]. However, no systematic analysis assessing the efficacy of such programs has been undertaken. Therefore, the purpose of this article was to examine the efficacy of preventive community-based interventions targeting childhood obesity and develop a set of recommendations for future interventions.

Methods

Inclusion/Exclusion criteria

Inclusion criteria for this review were (1) primary research; (2) overweight or obesity prevention interventions; (3) community-based; (4) studies that used a quantitative design and provided outcome data; and (5) were published through September 2012. Exclusion criteria encompassed (1) interventions that included only process evaluation; (2) obesity treatment interventions; (3) obesity interventions conducted solely in school, healthcare and/or home-based settings (i.e., lacking community component); and (4) studies which were not indexed in the included databases.

Study abstraction

An extensive literature search was conducted independently by two researchers to collect studies for inclusion in this review to increase the likelihood that all pertinent articles were retrieved. Searches were performed using the databases Academic Search Premier, CINAHL (Cumulative Index to Nursing & Allied Health), MEDLINE (Medical Literature Analysis and Retrieval System Online), ERIC (Education Resources Information Center). Various combinations of the following keywords were used: [overweight OR obese OR obesity] AND [community] AND [adolescent OR youth OR child] AND [program, prevention, intervention, OR study]. Limits of scholarly journals (peer reviewed) were set. Over 2,800 articles were originally identified using these search criteria. In addition, a thorough assessment of all references cited from the articles identified in the search was conducted to uncover any publications that did not populate during the initial search process. See the PRISMA flow diagram in Figure 1 for a summary of the systematic search results.

Data extraction

Data from the studies were extracted independently by two researchers using a standardized form developed by the authors. Any disagreements were examined and the agreed final data recorded. Extracted data included: lead author, publication year, summary of participants, theoretical framework used to guide intervention design and implementation, research design, outcomes, measures used to obtain collected data, description of intervention, intervention frequency and duration, attrition rates, and main findings.

Results

Included studies

Over 2,800 articles were originally identified using the aforementioned search criteria. Of those, 95 full-text articles were assessed for eligibility, resulting in 15 interventions to be included in this review. See flow diagram in Figure 1 for a summary of the systematic search. The included interventions have been summarized in Table 1, giving a description of the target population, measures used, the intervention and design, as well as key findings. The interventions have been arranged alphabetically by first author's last name.

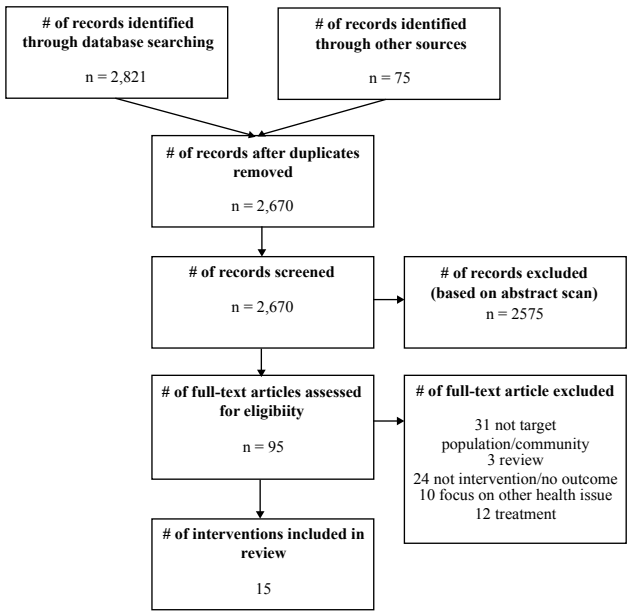

Figure 1: Flow diagram – Summary of search results.

Design and sample

This review was limited to interventions in which a community-based component was included. Considering the design of the studies reported, 40% (n=6) were randomized controlled trials, in which participants were randomly assigned to the intervention or control group [18-23]. Five (33.3%) of the interventions were quasi-experimental, which did not randomly assign the participants, yet still had a control or comparison group [24-28]. A non-experimental design was also used in four of the interventions (26.7%), in which control and/or comparison groups were not delineated [29-32].

Although all of the interventions included a community component to some degree, there was still some variance in setting, with a combination of multiple settings in nine of the interventions. A combination of school-based and community-based was the most frequent setting (n=5) [20,24,27,28,32], with home-based the second most frequent (n=4) [18,19,21,22]. The majority of interventions (n=11, 73.3%) were conducted in the United States [19-21,23,25, 27-32] with Canada, Australia, England and Tonga represented internationally. The demographic makeup of participants within the interventions varied greatly. Ten of the interventions included families [18,20-24,28-31], with five focusing only on children [19,25-27,32]. Although these community-based interventions took a population-based approach, there were still those that reported a high number of obese/overweight participants (n=9, 60%), with reported rates as high as 85% [18-20,22,23,25,27-29].

The number of participants within each intervention was extremely

varied. To differentiate, interventions were categorized from very small to extra large sample sizes. Two of the interventions were very small (under 50 participants), [22,29] one was small (50-100 participants) [30], four were medium (101-400 participants), [18,19,27,30] three were large (401-800 participants), [20,21,32] and five interventions (33.3%) were considered to have a very large sample size (above 800 participants) [23-26,28].

Theoretical framework

Theories and models were widely incorporated into the interventions, with 53.3% (n=8) reporting the use of at least one theoretical framework/model [18-20,23-25,27,29]. Yet, 46.7% of the interventions (n=7) did not mention using a theoretical framework/model to guide the intervention [21,22,26,28,30-32]. Social Cognitive Theory was the most widely used (n=3) [19,23,27]. Others mentioned included Community Based Participatory Research, Social Ecological Model, and Social Learning Theory. Of the interventions that did use a theory or model, very few explicitly operationalized the constructs of the theory/model (n=3) specific to the intervention [20,25,27]. By explicit operationalization it is meant that the interventions measured the changes in theoretical constructs from before to after the intervention.

Intervention approach

Duration of the interventions ranged from eight days (n=1) to five years (n=1) [28]. The duration of 60% of the interventions lasted less than one year; 1 ½ to 2 months (n=2) [23,30], three to four months (n=3) [27,29,32], 5-6 months (n=2) [18,31], 11 months (n=1) [19]. Five of the interventions ranged from two to five years [20,24-26,28]. Dosage of the intervention also varied, with weekly to monthly sessions.

A variety of strategies were used within the design and implementation of each of the interventions. All of the interventions promoted general education and awareness to some degree. To evoke behavior change, skill building (n=6) [18-20,27,29,30], goal setting (n=5) [18,19,22,23,30], and engaging participants in physical activity (n=5) [19,22,25,29,32] were the most widely used strategies. Two of the interventions mentioned building capacity as an initial planning phase of the intervention [24,30]. Other activities incorporated included use of gardening, community field trips, family fun days, and worksite health screenings. Over ninety percent of the interventions (n=14) reported some degree of parental involvement [18-31]. In addition, environmental changes, including alternate food options at schools, restaurants, and worksites, were incorporated into 46.7% of the interventions (n=7) [18,24-26,28,30,31]. The interventions were implemented by school personnel (n=4), [20,23,24,29] trained staff (n=2) [27,31] community workers and mentors (n=2) [19,31], counselors (n=1) [18], and parents (n=1). Three of the interventions mentioned implementation varied dependent on intervention phase [25,26,28]. Seven of the interventions mentioned the use of incentives throughout recruitment, implementation and/or follow-up phases [18,21-23,25,27,32].

Intervention outcomes and measures

All of the interventions provided outcome data, although the primary outcome varied. BMI was the primary outcome for 60% (n=9) of the interventions [19,20,23-26,28,29,31], while nutrition and/or physical activity behaviors were the primary outcomes for six of the interventions [18,21,22,29,30,32]. Other measures included attitudes (i.e., preferences) toward nutrition choices, general knowledge, theoretical constructs (i.e., readiness, self-efficacy, etc.), and other biometric measures (i.e., blood pressure).

It is important to recognize that 80% (n=12) of the interventions reported positive changes throughout the intervention when comparing the identified primary outcome [18-27,29,32]. Of those measuring BMI as a primary outcome, 88.9% (n=8), indicated an improvement [18-20,23-26,29]. Four of the interventions reported improved nutrition and/or physical activity behaviors or attitudes [21,22,27,32]. Details on intervention outcomes are summarized in Table 1. Out of the 15 interventions, seven conducted follow-up measures beyond post-intervention. Two were within 3-4 months [22,23] and five were within 1-3 years post-intervention [19,20,24,26,31] (Table 2).

Discussion

Childhood obesity is of concern because of the negative impact on the child's physical, psychological, behavioral, and social health. With the large number of children and adolescents affected by overweight and obesity, prevention of childhood obesity has become a national public health priority [33]. The purpose of this review was to examine the efficacy of preventive community-based interventions targeting childhood obesity and develop a set of recommendations for future interventions. Based on a review of the resulting 15 interventions, it is evident community-based interventions are important settings to target, and may have sustainable impact across all populations.

Community-based interventions seem to approach obesity prevention from an ecological perspective, considering the individual, the home, school, neighborhood, as well as surrounding environmental influences and policies [34]. Differences in culture and values within a community are able to be considered and integrated into intervention design [20]. Even though all interventions included a community component, majority were implemented in multiple settings. A third of the interventions included a school component. This makes sense considering the capability of reaching both parents and children, and the potential for a supportive environment to evoke behavior change. When including a school-based component, it may be easier to incorporate an experimental design. While 40% of the interventions reported such a design, the reality is it may be more difficult to include randomization when targeting an entire community. Community-based interventions tend to be larger in size, with most of the interventions targeting over 400 participants. It is recommended that future research determine best practices for research design and implementation for such large-scale studies.

All of the included interventions focused on primary obesity prevention. Primary prevention strives to prevent obesity from occurring, thereby reducing both the incidence and prevalence, and associated healthcare costs [34]. However, considering at least 60% of the intervention populations included high rates of obesity, this may not be the most appropriate approach, particularly in high-risk populations. It is important for future research to consider tertiary (i.e., treatment) versus prevention approaches, and/or a combination of the two, depending on targeted community.

Theory-based health behavior change programs are thought to be more effective compared to those that do not use theory [34]. Of the included interventions, slightly over half incorporated the use of behavioral theory, with Social Cognitive Theory used most frequently. Social Cognitive Theory tends to be widely used in obesity prevention interventions [14]. Understanding the influence of the individual, environment and behavior on related choices is important to promote lifestyle changes. Regardless of the theory used, theory-based interventions aid in the development of measurable program outcomes, help in the initial design of the interventions, provide a

Author/ Year	Population	Overweight/ Obesity at Baseline	Research Design	Intervention	Theory-based	Primary Outcome	Measures	Attrition	Salient Findings
Anand et al. [18]	Candada; Aboriginal households (i.e., families); Adult *M*=41.3 (Tx), 37.2 (Cnt) Tx=88; Cnt=86	*Mean* BMI Adults: Tx=34.3, Cnt=32.7. Teens: Tx=25.6, Cnt=23.9. Children: Tx=22.3, Cnt=20.6.	RCT; Household	SHARE-AP ACTION: Counselors made home visits to assist families in setting dietary and PA goals. Water cooler/ bottles provided. Food preparation classes. After school activity program. Duration = 6-months	Protection Motivation Theory, Social Learning Theory, Theories of Persuasion	Chage in kcal per day and PA	Nutrition & PA: 24-hour recall	At 6-months: Tx=4%, Cnt=18%	Sig dietary changes (p<.05): trans fats (g/day); fats, oils, sweets; bottled or distilled water; soda pop/juice.
Black et al. [19]	U.S.; Urban, African American (Tx=97.5%, Cnt=96.5%) adolescents; *M*=13.3; Tx=121; Cnt=114	Adolescents: Tx=44.6%, Cnt=32%. Caregivers: Tx=767%, Cnt=76.1%	RCT; Individual	Challenge!: Mentors delivered the intervention in the adolescents' homes and accompanied on field trips to various community sites. Included challenges, personal goal setting, made/tasted healthy snacks, engaged in PA with mentor. Duration = 11-months (12-sessions)	Social Cognitive Theory	Body mass, body fat	Body mass: DEXA; PA: accelerometers; Nutrition: FFQ	At 11-months: 22%; At 24-months: 24%	Overweight/obese status declined 5% among Tx group and increased 11% amont Cnt group. Among overweight/obese, intervention reduced body fat, fat mass; increased PA. Tx group declined sig. more in snack/dessert consumption at both follow-ups (p<.05).
Bruss et al. [20]	Primary caregivers of 3rd graders in a U.S. Commonwealth in western Pacific; Child *M*=8.55, Parent *M*=38.23; N=407; Year 1=228, Year 2=179	47% ≥ 85 percentile at baseline with 32% > 95 percentile	Year 1 - RCT-School; Year 2- Quasi-experimental	Project Familia Giya Marianas (PFGM): Targeted primary caregivers of 3rd graders. Curriculum focused on physiological and sociocultural, psychosocial, dietary, and activity. Facilitators used hands-on activities, role playing, etc. to apply information. Duration = 2 years, 2-semesters each (3 x 90-minute sessions)	CBPR	BMI z-score	Height/Weight	34% did not participate in any lesson; 38% considered "completers" with 5-8 lessons	There was a difference in BMI for children whose caregivers attended 5-8 lessons compared to 0 lessons (p<.0001).
deSilva-Sanigorski et al. [24]	Children ages 0-5 and their families; Austrailia; Child *M*=2.1 (Tx, Cnt), *M*=3.6 (Tx, Cnt); 2-y-old sample: Tx=1587, Cnt=17,732. 3-y-old sample: Tx=1191, Cnt=14,647	Overweight/ Obese: Tx=17.1%, Cnt=13.2%	Quasi-experimental	Romp & Chomp: Focus on building community capacity and developing sustainable changes in areas of policy, socicultural and physical environments. Professional development opportunities, change in food choices, resource folders to families, collaboration. Duration = 4 years	Socio-ecologic Framework	Anthropometric (BMI, weight status)	Height/Weight	Varied - difficult to determine	Sig. lower mean weight, BMI in 3.5 year-old subsample and a sig. lower prevalence of overweight/obesity in the 2- and 3.5 year-olds (by 2.5 and 3.4 percentage points), p<.05. Sig. lower intake of packaged snacks, fruit juice in Tx. compared to Cont., p<.05.
Echevarria and Pacqulao [29]	U.S.; Caregivers and their school-aged children (pre-K - 5th); Hispanic community; N = 14 aregivers & their children (N =14)	Overweight/ Obese Children = 42.9%, Caregivers = 85.7%	Non-experimental	Developed based on community needs assessment - respect Hispanic preferences and beliefs; Educational intervention divided into two parts - promoting healthy diet and lifestyles behavior and low-impact aerobic activity for the family. Duration = 10-weeks (1 session, 2.5 hours/week)	Health Promotion Model; Culture Care Diversity and Universality Theory	Nutrition, PA, Clinical Measures (BP, BMI)	HealthPromoting Lifestyle Profile II; Height, weight, BP	Not Mentioned	Children: Sig. lower mean BMI (p<.05), systolic BP (p<.05). Caregivers: Sig. higher nutrition and PA mean scores (p <.05).
Economos et al. [25]	U.S.; Children grades 1-3 in urban communities: *M*=7.92 (Tx), 7.34 (Cnt1), 7.8 (Cnt2); N=1178; Tx=385, Cnt1=561, Cnt2=232	Overweight/ Obese Children: Tx=44.4%, Cnt1=36.4%, Cnt2=43.1%	Quasi-experimental	Shape Up Sommerville (SUS): Eat Smart, Play Hard: Specific changes before-, during-, and after-school; home-based parental education; family events; community advisory council; community restuaruant and PA initiatives. Duration = 3 years	CBPR	BMI z-score	Height/Weight	40% Tx, 25.5% Cnt	Sig change in BMI z-score in Tx group compared to Cnt (p=.02)

Evans et al. [21]	U.S.; Caregivers of children aged 3-7 in urban communities (44.1% African American, 42.4% Hispanic); *M*=35; N=524	Not collected	RCT; Individual	5-4-3-2-1 Go! Tx: Received brief in-home counseling session Included receipt of educational and promotional items plus potential to be exposed to community campaign; Cnt: Exposed to community campaign (PSAs, community outreach, etc.). Duration not mentioned.	Not mentioned	Five targeted nutrition and PA behaviors	Community Healthy Living Awareness Survey (interview)	51.9% did not participate in follow-up interviews	Overall - Sig. increase in vegetables from baseline to follow-up (p<.0001); dairy consumption increased (p<.0001); days of vigorous PA (p<.0001). Brief counseling (Tx) had sig. effect on parents' FV consumption (p=.049). No sig. effects on child behaviors observed.
Fotu et al. [26]	Tongan adolescents 11-19 years; *M*=14.4 (Tx), *M*=15.2 (Cnt); Tx=815; Cnt=897	Overweight/ Obese: Tx=15.6%, Cnt=14.0%	Quasi-experimental	Ma'alahi Youth Project (MYP): Aimed to build capacity of communities and schools to create their own solutions to healthy eating, PA and healthy weight. Used social marketing and grassroots activities (i.e., media promotions, printed materials, fruit distribution, school food policies, community events). Duration = 2 years.	Not mentioned	Weight, BMI, Body fat percentag	Height/Weight	Tx = 25%; Cnt=34%	Sig. decrease in body fat percentage in Tx group among both males and females (*p*<.001). Few positive effects on targeted nutrition and PA behaviors.
Gatto et al. [27]	U.S.; Predominantly Latino (Tx=85.3%, Cnt=90%) youth; *M*=9.7 (Tx), *M*=9.9 (Cnt); N=104; Tx=40, Cnt=77	BMI Percentile: Tx=77.3, Cnt=81.1	Quasi-experimental	LA Sprouts: Interactive cooking and nutrition education lesson. Students worked in small teams to prepare recipes that emphasized FV. Consumed in a 'family syle' manner. Interactive gardening lessons taught by bilingual master gardner. Visits to local farmers' markets. Follow-up workshops offerred to as delayed intervention after intervention was completed. Duration = 12-weeks (90 mins. session/week).	Social Cognitive Theory	School engagement; perceptions/ preferences for FV; self-efficacy	Questionnaire	Tx = 15%, Cnt = 9.1%	Among overweight/ obese (p=.009) and females (p=.05) in Tx group, sig. increase in preference for vegetables. Tx group had greater change in perception that "cooking is easy" (p=.01) and "gardening is easy (p=.05)
Gombosi et al. [28]	U.S.; K-8th (5-14 years) and their families in rural community; N = 4241 +/- 200 students each year	At baseline - 1st graders: 26.2% overweight, 12.8% obesity	Quasi-experimental	Tioga County Fit for Life: Highlight healthier choices on community restaurant menus; worksite initiatives including health screenings, healthy foods, health fairs; community festivals and family fun days. Duration = 5 years.	Not mentioned	Overweight/ Obesity	Varied	Not Mentioned	Overweight and obesity increased throughout the years - 52.5% overweight and 29.7% obese.
Hardman et al. [22]	England; Preadolescent girls and their families; Child *M* = 10.6 years; Parent *M* = 41 years; N = 32; Tx = 14; Cnt = 18	At baseline - Tx child = 50%, Tx parent = 54%; Cnt child = 53%, Cnt parent = 67%	RCT; School	Fit 'n' Fun Dudes: Home-based program implemented by parents; Focused on making physical activity fun; Used pedometers, encouragement,and awards system; Maintenance phase included pedometer/ step goals. Duration = 8-days.	Not mentioned	Physical Activity	Pedometer/Steps	Not Mentioned	Tx group children during intervention were more active (*p*=.006), but there was no significant difference between follow-up and baseline. Tx parents were more active at follow-up (*p*=.008).

Hawley et al. [30]	U.S.; Students and families; 100% white; 11-12 years; rural; N = 65 (students/ classroom); N = 25 (student families)	Not mentioned	Non-experimental: cohort repeated measures	Included school, family and community components. Phase 1 built awarenss and capacity, forming a community-based referral network. Phase 2, provided education and practice in skills, goal-setting, self-efficacy, enhancing readiness for change. Family fun night. Duration = 6-weeks (5 sessions, 40 mins.each).	Not mentioned	PA/Nutrition knowledge, behavior, readiness	Self-report survey	14 completed post-measures (56% attrition)	No sig. changes in knowledge/ attitudes in students. Families did see sig. improvements in: goal-setting ($p<.05$), PA ($p<.01$), knowledge ($p<.001$). Also progressed in readiness.
Karanja et al. [31]	U.S.; Expectant mothers and their families; American Indian; *Parent M* = 25; Tx = 178; N Comp = 205	Average birth BMI	Separate sample pre-/ post	Toddler overweight and tooth decay prevention study (TOTS): Community-wide interventions used: raising awareness, providing health education, facilitating individual behavior change, augmenting public health practice, modifying environments and/or policies related to breastfeeding, sweetened beverages. Family component: received one-one-one counseling via home visits. Duration = 6-months (7-21 visits family component).	Not mentioned	Changes in z-scores (for age) of BMI from birth to 24 months	Height/Weight; Breastfeeding status; Confidence	14% completed all measures	Breastfeeding initiation and 6-month rates were 14 -15% higher; all interventions except breastfeeding were given a score of four or higher by 60% of the participants, indicating confidence in the usefulness of TOTS in implementing target behaviors; BMI z-scores increased in all tribes but increase was less in family, plus community interventions.
McDermott et al. [32]	Youth 8-12 years; N = 522 (participants)	Not mentioned	Non-experimental	VERB: Community-based physical activity promoted. Youth filled out score card and received prizes as they reached certain PA levels. Duration = 3-months.	Not mentioned	Vigorous PA	Self-report	Not mentioned	Youth in the participant group were 1.73 times more likely to report high physical activity than were students in the unexposed (i.e., reference) group
Weber Cullen et al. [23]	U.S.; Parents/ Caregivers; *M*= 35; N = 1,006; Int=582, Cnt= 424	BMI Pre (Int) = 31.4; Pre (Cnt) = 31.7	RCT; City	Building Healthy Families: Step by Step: The components included the intervention video and discussion guide with supporting materials (goal setting, problem solving, goal review, handouts, and session-specific recipes. Duration = 6-weeks (1 session/week).	Social Cognitive Theory	BMI	Height/weight	Time 1 = 26%; Time 2 = 45%	There was a significant BMI decrease at post compared to baseline for the intervention group only. This change was not maintained at the follow-up.

Table 1: Summary of interventions.

framework for effective programming strategies, and increase the likelihood of successful replication [34]. Of the interventions that did use theory, very few explicitly operationalized the constructs of the theory and measured changes in the related constructs from pre- to post-intervention. This is important as it provides an understanding of which components are working, which are not, and also helps improve the theoretical application. Thus, when designing future interventions, theory should be used as a framework, but associated constructs must also be adequately measured with validated instruments [14].

A variety of strategies were used within the design and implementation of each of the interventions. All of the interventions included a focus on increased knowledge and awareness, particularly related to nutrition and physical activity behaviors. Although a change in knowledge is integral to the foundation of many interventions, it does not necessarily evoke behavior change [30]. Focus should be on implementing health education that provides individuals with the knowledge, attitudes, skills, and experiences needed for healthy living. Individuals must learn to build relevant skills to successfully make behavior changes that will foster maintaining health behavior change. Recommended strategies include the use of developmentally appropriate materials, incorporating strategies that are interactive, engage all participants, and are relevant to the individual's daily life and experiences [35]. It is also recommended programs focus on participation in positive behaviors rather than limiting negative behaviors, which may increase participant buy-in and long-term success. Only one third of the interventions incorporated physical activity into the intervention. Providing the opportunity for physical activity may help to build self-efficacy for future participation.

Author/ Year	Design	Allocation (randomization)	Blinding	Similarities at Baseline	Explanation of Attrition/ Withdrawals	Description of Eligibility Requirements	Follow-up ≥ 1 year	Theory-Based	Statistically Significant Results (Primary Outcome)
Anand et al., 2007	RCT	Household	Not mentioned	Given but no analysis	Yes	Yes	No - 6 months	Yes, Not Op.	No (not in primary outcome)
Black et al., 2010	RCT	Individual	Not mentioned	Yes	Yes	Yes	Yes - 24 months	Yes, Not Op.	Yes (at delayed follow up)
Bruss et al., 2010	RCT	School	Not mentioned	Yes	Yes	Yes	Yes-2 years	Yes	Yes (sig difference for those participating 5-8 lessons)
deSilva-Sanigorski et al., 2010	Quasi-experimental	N/A	Not mentioned	Yes	Yes	Yes	Yes - 3 years	Yes, Not Op.	Yes
Echevarria et al., 2008	Non-experimental	N/A	N/A	N/A	No	Yes	No - 10 weeks	Yes, Not Op.	Yes (children BMI, BP; Caregiver nutrition, PA)
Economos et al., 2007	Quasi-experimental	N/A	Not mentioned	Yes	Yes	Yes	No-8 months	Yes	Yes (children BMI z-score)
Evans et al., 2011	RCT	Individual	Not mentioned	No	Yes	Yes	Not mentioned	No	Yes (FV)
Fotu et al., 2011ab	Quasi-experimental	N/A	Not mentioned	Yes	Yes	Yes	Yes-1-3 years	No	Yes (% body fat)
Gatto et al., 2012	Quasi-experimental	N/A	Not mentioned	Yes	Yes	Yes	No - 13 weeks	Yes	Yes (preferences for veg)
Gombosi et al., 2007	Quasi-experimental	N/A	Not mentioned	No	No	Yes	Yes - 5 years	No	No
Hardman et al., 2009	RCT	School	Not mentioned	Yes	No	Yes	No - 12-weeks	No	Yes (PA/steps parents & children)
Hawley et al., 2006	Non-experimental	N/A	N/A	N/A	Yes	Yes	No-6-weeks	No	Yes (Family goal-setting, PA, knowledge)
Karanja et al., 2010	Non-experimental	N/A	N/A	N/A	Yes	Yes	Yes-2 years	No	Yes (Breastfeeding initiation)
McDermott et al., 2010	Non-experimental	N/A	N/A	N/A	No	Yes	No-9-months	No	Yes (PA levels)
Weber Cullen et al., 2009	RCT	City	No	Yes	Yes	Yes	No-4-months	Yes, Not operationalized	Yes (BMI)

Table 2: Quality summary of included interventions.

To maximize potential for behavior change, appropriate strategy selection is essential. Intervention strategies which evoked the most promise in this review were comprehensive in nature. They implemented multiple components, included hands-on activities, skill-building and knowledge activities, and incorporated environmental changes along with a social support component. School personnel were used to facilitate and/or disseminate close to 30% of the interventions. Typically, school personnel already have high levels of rapport with parents and children [20]. This is an important point considering efforts to promote sustainability of such intervention approaches. Regardless who is in charge of program facilitation it becomes critical to include training opportunities before, during and after the intervention.

Parents were involved in over 90% of the interventions. Family plays a critical factor in the majority of nutrition and physical activity behaviors of children. The family can shape students' behaviors in a variety of ways, including availability and access, expression of attitudes related to obesity-related behaviors, and being recognized as role models for healthy behaviors. Interventions should encourage communication among parents and motivate families to promote long-term adoption of healthy behaviors [35]. Further research should explore how adoption of healthy behaviors leading to parental behavior change can be leveraged to result in child behavior change [21].

Beyond an individual level approach, almost half of the

S.no	
1	Utilization of multiple settings
2	Inclusion of school component
3	Use of behavioral theory
4	Explicit operationalization of the behavioral theory
5	Use of interactive strategies that change attitudes and skills
6	Greater emphasis on physical activity promotion
7	Incorporation of social support component
8	Involvement of parents and family
9	Incorporation of environmental changes

Table 3: Recommendations for future community-based interventions in the area of childhood obesity.

interventions incorporated environmental changes. Such changes included menu labeling at community restaurants, school nutrition policies, worksite initiatives, and improving policies promoting breastfeeding. "The complex nature of the etiology of obesity demands far-reaching interventions that penetrate every aspect of a child's world." [25]. Environmental and policy influences may potentially be the most powerful, but currently least well understood, strategies for addressing child obesity [33]. Recommendations continue to incorporate strategies which affect environmental change, including providing access to healthy foods and opportunities for physical activity, along with promoting a culture which encourages healthy behaviors throughout the community [35]. Although more interventions are including environmental changes, there is still a need to fully understand feasible and effective strategies, particularly when dealing with larger communities.

The potential impact of community-based obesity prevention interventions is reinforced by the reported success of these included interventions. With the varying research design, duration, and primary outcome measures, only limited comparisons can be made across studies; however, it is important to recognize that 80% of the interventions reported a positive impact on the primary outcome. Typically, those interventions lasting six months or less reported improvements in attitudes, knowledge, and behaviors related to nutrition and physical activity [18,22,27,30-32]. For example, Hawley and colleagues did not report changes in behavior, but did report improved readiness to change [30].

There were eight interventions reporting a significant decrease in BMI, which is promising considering the correlation between a decreased BMI and risk for morbidity and mortality [33]. The majority of interventions reporting improvements in BMI and/or overweight and obesity prevalence were longer in duration, 11 months to 4 years. However, there were two interventions with duration of 6-10 weeks which also reported decreased BMI. Weber et al. [23] did report significant decrease in BMI at six weeks post-intervention; however, this was not maintained at the four month follow-up. Echevarria and Pacqulao [29] also reported decreased BMI at 10-weeks post-intervention. Results may have been impacted due to the thorough planning process of the researchers, highlighted by the inclusion of a needs assessment among the targeted population. This may well have contributed to the motivation and readiness to change among intervention participants. Very few of the interventions conducted a long-term follow-up measure. Sustainability of behavior change and BMI surveillance needs to be considered. For example, according to Black et al., it was not until delayed follow-up that the intervention effects on BMI and body composition were observed [19]. Therefore, recommendations on duration of intervention need to be further explored.

More intensive and environmental interventions may be required to maintain dietary and PA changes. A change in BMI follows significant behavior changes, including maintenance of dietary and physical activity changes. Therefore, more intensive interventions may be required to sustain such behavior changes, and ultimately lead to significant improvements in BMI. There is a need to continue community support once the intervention is complete. The longer the intervention, the more likely attrition rates tend to increase. Included interventions reported 4-56% attrition. Future research needs to consider the impact of intrinsic and extrinsic motivation within community-based interventions in hopes to decrease attrition throughout the intervention. Karanja et al. mentioned the impact strong community collaboration in the development phase can have on decreased attrition rates [31].

With the continued promise of community-based interventions, there needs to be an effort to use existing evidence-based guidelines as the foundation for developing, implementing and evaluating such obesity prevention interventions. Most communities might not able to implement all recommendations at once, but it is possible to build in selected strategies, and consider a long-term plan. Table 3 summarizes key recommendations for future community-based interventions in the area of childhood obesity.

Limitations

It is important to note the limitations of this review. This is a qualitative review and not a quantitative meta analysis. The purpose of the review was to summarize community-based interventions designed to prevent childhood obesity. Further, the interventions included were limited to those in the English language, published through September 2012. This precluded interventions not published in the English language, those not including a community-based component, those not reporting outcome results, and those studies published after September 2012.

It is also necessary to mention publication bias as a limitation to any systematic review, due to the major threat to validity. Only a small number of intervention studies reach publication in an indexed journal and are in turn easily found through systematic database searches. Typically, statistically significant, positive results indicating optimal outcomes are more likely to be published, particularly in high impact journals. Similarly, studies with more robust design and large sample sizes tend to be published more frequently. This systematic review included all studies that were indexed in the relevant databases, however, it is understood that other non-peer reviewed studies may be available. The systematic nature of this review and explicit search criteria provide rationale for inclusion/exclusion of all studies. As this is a narrative review, comparisons can be made between intervention strategies, target population, and reported outcomes. However, future meta-analysis should aim to include grey literature along with the peer-reviewed studies since statistical comparisons can then be made.

Conclusion

With 43 million children around the world considered overweight or obese and an additional 92 million at risk of becoming overweight [2] targeting childhood obesity worldwide has become a national priority. Community-based interventions are important in combating childhood obesity, since it will take the combined efforts and collective strength of schools, families, and communities to reverse obesity trends. The potential impact was evident considering of these 15 interventions, over 80% achieved success. The use of multi-component interventions

that address multiple influences on health behavior such as family and community norms, enhanced knowledge, skill-building, accessibility of healthful food options and opportunities for physical activity, is crucial for effective approaches. Continuing to implement evidence-based obesity prevention interventions will hopefully lead toward a decline in these staggering obesity rates.

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