

UC Berkeley

UC Berkeley Previously Published Works

Title

Community-engaged interventions on diet, activity, and weight outcomes in U.S. schools: a systematic review.

Permalink

<https://escholarship.org/uc/item/3xm89005>

Journal

American journal of preventive medicine, 43(1)

ISSN

0749-3797

Authors

Krishnaswami, Janani
Martinson, Marty
Wakimoto, Patricia
et al.

Publication Date

2012-07-01

DOI

10.1016/j.amepre.2012.02.031

Peer reviewed

Community-Engaged Interventions on Diet, Activity, and Weight Outcomes in U.S. Schools

A Systematic Review

Janani Krishnaswami, MD, MPH, Marty Martinson, DrPH,
Patricia Wakimoto, DrPH, RD, Andrew Anglemeyer, PhD, MPH

Context: Community engagement literature suggests that capacity-building approaches and community partnership in health intervention design, delivery, and analysis improve outcomes. School communities influence childhood diet and activity patterns affecting lifelong obesity risk. This systematic review's purpose is to assess whether incorporating community engagement principles in school-based interventions influences weight-related outcomes.

Evidence acquisition: Obesity-prevention interventions (published January 2000–2011) in diverse U.S. schools, meeting a minimum threshold of community engagement and targeting weight-, diet- or activity-related outcomes were identified in MEDLINE, PsycINFO, and CINAHL (December 2010–March 2011). Two reviewers scored community engagement performance on 24 metrics of capacity building and partner involvement along four research stages. Outcome performance was calculated as percentage of targeted primary and/or secondary outcomes achieved.

Evidence synthesis: Sixteen studies were included, targeting anthropometric ($n = 12$); dietary ($n = 13$); and activity ($n = 10$) outcomes in schoolchildren (mean age = 10.7 years). Studies averaged 46% of targeted outcomes (95% CI = 0.33, 0.60) and met 60% of community engagement metrics. Positive correlations existed between community engagement performance and all-outcome performance ($r = 0.66$, 95% CI = 0.25, 0.87) and secondary-outcome performance ($r = 0.67$, 95% CI = 0.22, 0.89), but not primary-outcome performance ($r = 0.26$, 95% CI = -0.27, 0.67). Number of outcomes met was not correlated with number of outcomes targeted, number of partners, or study size. Specific qualitative and quantitative trends suggested that capacity-building efforts, engagement in needs assessments and results dissemination, and durable partnerships positively influence outcomes.

Conclusions: Results suggest that meaningful partnership of diverse school communities within obesity prevention interventions can improve health outcomes.

(Am J Prev Med 2012;43(1):81–91) © 2012 American Journal of Preventive Medicine

Context

More than one third of schoolchildren in the U.S. are currently overweight or obese. Incidence of childhood obesity outpaces that of national obesity, with the sharpest rise in low-income and minority populations: Obesity prevalence rose 120% for

African-American and Hispanic children between 1986 and 1998, versus 50% for non-Hispanic whites.^{1–4} Distribution of community-level factors, such as food availability, walkability, and school/home environment, may play a role by fostering disparate development of obesity-related risk factors.^{5–9}

In particular, school environments shape childhood diet and activity behaviors associated with lifelong obesity risk.^{2,10} Children partake of 25%–33% of their daily food intake and 20%–30% of their daily physical activity in schools; a diverse, representative cohort of children including minority and low-income groups are regularly exposed to this environment.^{11–13} Schools thus represent natural settings for interventions preventing obesity and related disparities.

From the Department of Preventive Medicine (Krishnaswami), Institute for Global Health (Anglemeyer), University of California San Francisco, the Department of Internal Medicine (Krishnaswami), Kaiser Permanente, the Department of Health Education, San Francisco State University (Martinson), San Francisco, the School of Public Health (Krishnaswami, Wakimoto), University of California Berkeley, Berkeley, California; and Kaplan Test Preparations, Inc. (Krishnaswami), New York, New York

Address correspondence to: Janani Krishnaswami, MD, MPH, 555 4th Street #404, San Francisco CA 94107. E-mail: jkswami@gmail.com.

0749-3797/\$36.00

<http://dx.doi.org/10.1016/j.amepre.2012.02.031>

Cognizant of the environment–behavior link, intervention researchers offer the *community engagement* continuum, in order to provide an equitable, potentially effective framework for school-based obesity prevention interventions. Community engagement research^{14–16} suggests that interventions can achieve better health outcomes by promoting community “ownership” along the research process. At the high end of the community engagement continuum is community-based participatory research (CBPR), calling for *partnership* and *participatory* involvement of community members throughout all stages of research: prioritization of intervention objectives and needs assessments, design, delivery, and results dissemination/analysis. CBPR also emphasizes creating structures for community partnership, autonomy, and capacity, through mechanisms such as school–university partnerships, community-led focus groups, leadership and “systems” training, funding and personnel networks, policy change, and grassroots advocacy.^{14,17} CBPR has been promoted as a means to recruit disadvantaged populations in health research, narrow disparities, ensure relevance to community context, and enable communities to independently sustain intervention effects beyond limited grant windows.^{18–23}

Although CBPR is considered the “gold standard” of community involvement in intervention research and practice, partner engagement on a smaller scale may play important roles.^{14,24} Community engagement in only one or two stages of research, such as providing input on proposed data-collection instruments or helping design a locally appropriate and culturally sensitive intervention, can increase response rates and enhance the intervention’s acceptability, contextual relevance and ultimate likelihood of success.^{24–26}

Schools are defined as “communities” in community engagement literature.^{14,17} Based on community engagement theory, participatory school-based interventions that engage partners such as students, teachers, parents, and administrators in multiple research stages are more likely to achieve desired health outcomes in challenging settings.^{14,27} If such outcomes are sustained, community-engaged interventions potentially could improve adult health and narrow future health disparities in diverse populations. On the other hand, multiple partners and emphasis on community autonomy theoretically also could undermine results, by rendering community-engaged interventions vulnerable to practical problems such as inconsistent implementation and inefficiency.

Although prior systematic reviews^{28–33} have addressed definition, qualitative impact, and dissemination of results in CBPR-based interventions, no review has assessed quantitative health outcomes of CBPR- or community engagement–focused interventions in the U.S.

Moreover, although prior reviews have examined effectiveness of school-based dietary and physical activity interventions, none have assessed whether incorporating specific community engagement elements influences health outcomes, or whether highly engaging interventions are more likely than less-participatory approaches to achieve desired outcomes.^{34–39}

The present review responds to this evidence gap. The purpose of this systematic review is to assess whether community engagement in obesity-prevention interventions influences health outcomes in diverse U.S. school populations. In considering interventions along the community engagement continuum, this review assesses the following primary and secondary objectives: (1) whether a relationship exists between level of community engagement and achievement of quantitative, study-defined health outcomes and (2) whether certain elements of engagement, such as capacity-building approaches, community-partner type, and community participation in specific research stages, are linked to outcomes. This review’s scope covers peer-reviewed publication; interventions in diverse or low-income U.S. school populations; and quantitative weight, physical activity, and diet-related outcomes.

Evidence Acquisition

Community Engagement Inclusion Criteria

Criteria were developed for community engagement in conjunction with comprehensive literature review (including interdisciplinary journals, reviews, and reference texts) and consultation of academic experts.^{20,21,24,25,28} In lieu of selecting only highly participatory CBPR interventions, criteria established a minimum “participatory involvement” threshold to facilitate including a broader spectrum of interventions and enable outcome comparisons between approaches with high versus low levels of community engagement. Inclusion criteria were evidence of (1) either formal or informal structures of partnership or empowerment AND (2) minimum participatory features: at least one school–community partner (students, parents, teachers/staff, administrators, local policy-makers, academic/community-based agencies) involved in at least one research stage (prioritizing need, intervention design, delivery, data analysis/results dissemination).

Other Inclusion Criteria

Other criteria included preventive orientation; child/adolescent population in the U.S. with at least 30% minority/low-income status; and statistical reporting and analysis of quantitative nutrition, weight, or physical activity outcomes. RCTs, matched-control experiments, and observational and quasi-experimental (nested cross-section, pre–post) designs published in peer-reviewed journals between January 2000 and 2011 were considered. Studies were required to assess outcomes relative to a control group or, for observational studies, to have a sample size >50 and control for confounders.

Search Strategy and Data Sources

Past reviews^{28,40–42} have commented on inherent challenges to systematic review of CBPR—community engagement research, including inconsistent indexing and categorization. Thus, critical examination was made of first-generation literature, reference texts, and prior reviews; experts were consulted; and a search was conducted of the NCBI MeSH database to generate accurate search strategies and terms.^{24–29,33–39,42} A structured search of MEDLINE, CINAHL, and PsycINFO was conducted from December 2010 to March 2011 using 60 search terms on “community-based,” “school health intervention,” or “obesity prevention” in “AND-” combination with eligible study design, date, and location terms. Manual review of included studies’ citations and librarian-assisted citation and related-article searches also were conducted in PubMed and Web of Science.

Data Extraction

Outcome scores and performance. Study objectives (i.e., “promote healthy weight” or “increase physical activity”) and targeted quantitative health outcomes (i.e., BMI, minutes of exercise) were identified from the publication text. Outcomes were classified as primary and secondary, and by type (“physical activity,” “nutrition,” or “weight–anthropometric”). “Achieved” or “positive” outcome is defined as a significant result directionally consistent with study aims. Each outcome that was achieved received 1 point if consistent across study population and duration and 0.5 points if associated with qualification (i.e., objective met in specific subgroup or in one period of time). *Combined outcome performance* was calculated as outcomes achieved over total number of primary and secondary outcomes targeted. Outcome performance was calculated separately also for primary and secondary outcomes. When reported by a study, outcomes relating to process and implementation (measuring intervention delivery, environmental changes and attendance) also were recorded.

Community engagement scores and performance.

Community-engaged approach was scored independently by two reviewers on 24 metrics assessing capacity-building components (10 metrics) and level/depth of partner involvement across four research stages (14 metrics). Capacity-building components included targeting long-term impact, removing environmental barriers to participation or behavior, building leadership, promoting self-esteem and empowerment, establishing channels for funding or equipment, and addressing system-level and/or policy components. Studies received points for each community engagement feature as follows: 1 if fully present, 0.5 if partially present, and 0 if absent. A study earning the maximum 24 points represents a highly participatory, CBPR-level intervention. *Community engagement performance* represents each study’s percentage of this “gold standard” score, calculated by dividing earned community engagement score (range 0–24) by 24.

A standardized data abstraction sheet was prepared. Pairwise correlation between raters and other quantitative analyses were performed by a researcher not involved in data abstraction or study review/selection. The relationship between outcome performance and community engagement performance was analyzed qualitatively and quantitatively, along with community engagement–outcome relationships for groups of studies stratified by research stage and partner type. When appropriate, pooled, weighted outcome scores were performed using a random effects DerSimonian-

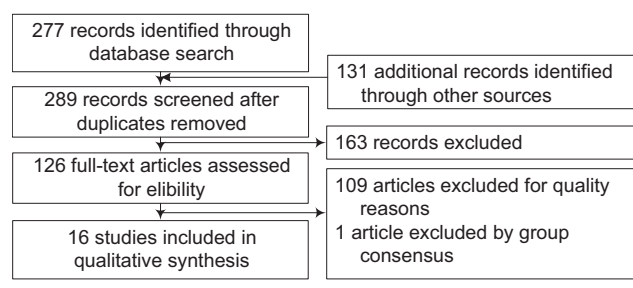


Figure 1. Overview of systematic search process

Laird model. Analyses were performed in R 2.14 (R Development Core Team; www.R-project.org/). Trends in community engagement features and outcomes were analyzed separately via qualitative review. Finally, studies also were assessed on 23 measures of quality using a modified version of the scoring system employed by Viswanathan and colleagues.²⁸

Evidence Synthesis

Study Selection

Twenty-three distinct searches and review of outside sources yielded 289 potentially relevant, distinct studies. Title and abstract review excluded 163 articles without outcomes and/or fulfillment of minimum community engagement elements. Full-text review of 126 remaining articles excluded 109 studies, most commonly for reasons of quality (i.e., no statistical analysis or objective outcomes, purely qualitative description, pre–post comparison only); target population (not disadvantaged or diverse); and lack of sufficient engagement-oriented approach. The remaining 17 studies were reviewed fully. Group consensus eliminated one study, leaving 16 studies for final scoring. Scores demonstrated high inter-rater correlation ($r = 0.92$, 95% CI = 0.79, 0.97; Figure 1). All data and analysis presented here are based on averaged rater scores.

Descriptive Characteristics of Included Studies

Targeted outcomes, study population, and duration. Interventions lasted an average of 24 months and involved diverse groups (African-American, Hispanic, Native American, rural, urban, and low-income) of mean age 10.7 years. Studies targeted multiple primary and secondary outcomes (mean number of total outcomes=8.6, range=1–39). Anthropometric outcomes were most commonly primary or secondary targets, followed by dietary and physical activity measures.

Outcome performance. Across all studies, the weighted, pooled summary proportion of combined outcomes met was 0.46 (95% CI=0.33, 0.60). The weighted, pooled summary proportions outcomes met for primary and secondary outcomes considered separately was 0.57 (95% CI=0.42, 70) and 0.43 (95% CI=0.28, 0.58), respectively (Table 1).

Table 1. Included studies presented by quartiles of community engagement performance

Intervention	Community engagement performance ^a	Outcome performance ^a			Outcome type ^b			Diverse group ^c					Quartile	
		All	Primary	Secondary	Weight	Diet	PA	AA	AI	LI	H	R		F
Healthy Living Cambridge Kids ⁴³	0.97	0.83	0.83	0.83	x		x				x			1
Shape up Somerville ²⁷	0.89	1.00	1.00	N/A	x			x		x	x			1
SNaX ⁴⁴	0.76	0.75	0.50	1.00		x		x			x			1
CATCH BP ⁴⁵	0.76	0.80	1.00	0.67	x	x	x	x		x	x			1
School Nutrition Policy Initiative ⁴⁶	0.74	0.35	0.50	0.31	x	x	x	x			x			2
M-SPAN ¹⁰	0.65	0.33	0.33	0.33	x	x	x	x			x			2
HYP ⁴⁷	0.63	0.57	0.67	0.50		x	x	x		x	x			2
Fruit and Vegetable Promotion in Kindergarten ⁴⁸	0.61	0.75	0.50	0.33		x		x						2
CATCH El Paso ⁴⁹	0.58	0.21	0.50	0.17	x	x					x			3
Pathways ⁵⁰	0.56	0.50	0.00	0.58	x	x	x		x					3
Health Knowledge Mississippi ⁵¹	0.53	0.24	1.00	0.20	x	x		x			x	x		3
HOP'N ⁵²	0.44	0.20	0.17	0.25	x	x	x	x			x			3
Stanford GEMS ⁵³	0.39	0.10	0.00	0.10	x	x	x	x			x			4
LEAP ⁵⁴	0.38	0.38	1.00	0.17	x		x	x					X	4
School-Garden Initiative ⁵⁵	0.38	0.50	1.00	0.33		x		x			x			4
Challenge ⁵⁶	0.38	0.50	0.50	0.50	x	x	x	x						4
Community engagement–outcome correlation ^d	—	0.66*	0.26	0.67*	—	—	—	—	—	—	—	—	—	—
p-value	—	0.005	0.327	0.009	—	—	—	—	—	—	—	—	—	—
M	0.60	0.50	0.59	0.42	—	—	—	—	—	—	—	—	—	—
Weighted pooled M	—	0.46	0.57	0.43	—	—	—	—	—	—	—	—	—	—
CI	—	(0.33, 0.60)	(0.25, 0.87)	(0.28, 0.58)	—	—	—	—	—	—	—	—	—	—

Note: “x” indicates specific outcome category and/or diverse group was involved in study. Blank space indicates outcome category and/or diverse group was not involved in study.

^aCommunity engagement performance is calculated as number of community engagement metrics fulfilled by an intervention, divided by maximum number of metrics (24). Outcome performance represents number of outcomes achieved over number of outcomes targeted (primary, secondary, or primary and secondary combined).

^bOutcome type refers to category of primary or secondary outcomes targeted in intervention as defined in study introduction and methods. Weight=anthropometric measures including BMI; BMI z-score; adiposity; waist–hip ratio; waist circumference; body fat; fat-free mass; prevalence; incidence; and risk of obesity/overweight. Diet=total calorie consumption; percentage fat consumption; percentage sugar consumption; consumption of specific food groups (sugary beverages, fruits, vegetables, healthy entrees); nutritional knowledge; and attitude measures. Physical activity=minutes moderate-to-vigorous physical activity or vigorous physical activity, resting heart rate, fitness test scores, sedentary behavior, TV/screen time, awareness, knowledge, and attitude scores.

^cDiverse group category is defined as ethnic minority group constituting at least 30% of target population.

^dCommunity engagement–outcome correlation is the Pearson product–moment correlation between community engagement performance and relevant category of outcome score.

*Significant at $\alpha=0.01$ level.

AA, African-American; AI, American-Indian; BP, BasicPlus; CATCH, Coordinated Approach to Child Health; F, female; GEMS, Girls Health Enrichment Multi-Site Studies; H, Hispanic; HOP'N, Healthy Opportunities for Physical Activity and Nutrition; HYP, Health Youth Partnership; LEAP, Longitudinal Emerging Adulthood Program Study on Health and Wellness of Teenagers; LI, low-income (defined as percentage qualifying for free school lunch); M-SPAN, Middle-School Physical Activity and Nutrition; N/A, not applicable; PA, physical activity; R, rural; SNaX, Students for Nutrition and Exercise

Weight/anthropometric. Seven of 12 studies with anthropometric primary or secondary targets, including BMI, BMI z-score, risk, and prevalence or incidence of obesity/overweight, reported at least one significant outcome.^{12,43,45,46,49,56,57} Two interventions reported decrease in BMI z-score by 0.1005 and 0.04 ($p < 0.05$), respectively, after 3 years.^{43,57} Three studies reported significant reductions of obesity and/or overweight prevalence (in two studies, limited to specific subgroups) ranging from 2.2% to 8%.^{43,45,56} The two studies targeting obesity risk and incidence reduction reported significant reductions compared to controls: 8% to 11% relative risk reduction in obesity and 50% relative incidence reduction in obesity (the latter especially pronounced in African-American boys).^{46,49}

Physical activity outcomes. Six^{45–47,52,54,56} of 10 studies targeting physical activity measures as primary or secondary outcomes reported at least one significant outcome. Three studies^{46,54,56} reported significant physical activity increases in boys, girls, or obese/overweight children, and 2 studies^{47,52} reported specific increases in those groups ranging from 5.9 to 7.5 minutes/day. One intervention reported reduced TV-watching and screen time.⁴⁵

Nutrition outcomes. Increasing fruit and vegetable consumption, reducing fat and calorie intake, and changing cafeteria food content were least-achieved outcomes. Five studies^{44,49–51,55,56} reported small, positive effects on consumption of specific foods: soft-drink/sugary beverage, fat, vegetables, breakfast, and snacks/dessert. Three studies^{48,50,51} reported improved dietary knowledge/attitudes but inconsistent effects on food intake.

Process measures. Measures of intervention implementation included attendance; number of policy/program changes; and percentage of classes, activities, and training sessions occurring as planned. When reported, such measures ranged from 80% to 100%.^{44–46,50,54,56,57} Skill-building/capacity components such as best-practices workshops and leadership training consistently achieved near-100% attendance rates.^{44–47} Six studies reported number of new policies and program changes in intervention group settings ranging from 2 to 26.5.^{43–47,57}

Community engagement performance measures. Overall, included studies met 60.1% of community engagement metrics, incorporating 6.4 of 10 capacity-building metrics (range 3–9) and engaging 3.94 school-community partner types in three research stages. Teachers or staff were the most common partner type (14 studies), followed by district officials/administrators (12); community-based groups, neighborhood residents, universities, or public health officials (ten); parents (four); and students and policymakers (three

each). All studies included partners in intervention delivery; 15 involved partners in intervention design. Partners less commonly were involved in data analysis/results (ten studies) and identifying need/setting priority stages (seven studies). Within each stage, the extent and depth of community involvement varied markedly.

Capacity-building approaches often were manifested as lay staff and school-partner training in various skills, ranging from instructions on delivering a specific curriculum to building “change-oriented” skills in navigating bureaucratic channels, working through real-time obstacles, and identifying “best practices” for health. Twelve studies attempted to remove participation barriers for underserved or disadvantaged groups; four studies^{44,47,53,56} targeted individual empowerment by incorporating self-esteem and cultural awareness messages, leadership training, and peer-role model components. Three^{43,45,57} featured at least one structured element designed to sustain program funding beyond study duration, including facilitating durable school-community financial partnerships or providing grant writing and development assistance.

Objective 1: Degree of Community Engagement and Outcome Achievement

Community engagement and combined outcome performance demonstrated a positive correlation ($r = 0.66$, 95% CI = 0.25, 0.88), suggesting that a greater degree of community engagement is linked to greater achievement of intervention outcomes (Table 1). The two “gold standard” CBPR studies, with community engagement performance scores of 0.96 and 0.89, achieved the highest outcome performance in this review (0.833, 1.00). A correlation between community engagement and secondary-outcome performance also was found for all studies ($r = 0.68$, 95% CI = 0.28, 0.88). However, no correlation existed between community engagement and primary-outcome performance ($r = 0.26$, $p = 0.33$). No correlation existed between total number of outcomes targeted and community engagement performance ($p = 0.27$), or total number of outcomes targeted and number of positive outcomes ($p = 0.09$), suggesting that the community engagement “effect” was not purely a reporting phenomenon. Further, no correlation was noted between the combined outcome performance and the sample sizes of included studies ($p = 0.33$).

Objective 2: Relationship Between Specific Community Engagement Features and Outcomes

Research stage. No differences were found when comparing pooled outcome performance among groups of interventions stratified by type of stage involved (Figure 2). Additionally, community engagement-outcome relationships were analyzed separately for groups of studies with and without involvement in “needs assessment/goal-setting” and “results dis-

semination” stages. (Other comparisons were not done because of markedly different sizes of study groups). The needs-assessment group ($n=7$) demonstrated a positive community engagement-outcome correlation ($r =0.77$, $p=0.04$), whereas the group without community needs assessments ($n=9$) showed no relationship ($r =0.23$, $p=0.54$).

Qualitatively, involving communities in needs assessments/goal-setting appeared to promote outcomes by increasing community support for the intervention, facilitating subsequent implementation and well-tailored design. For example, the Coordinated Approach to Child Health (CATCH) intervention in Travis County TX and the School Nutrition Policy Initiative engaged “action teams” involving parents, teachers, coaches, and nurses in conducting self-assessments of school environments to set priorities.^{45,46} This community-based prioritization generated contextually relevant solutions such as weekly break-

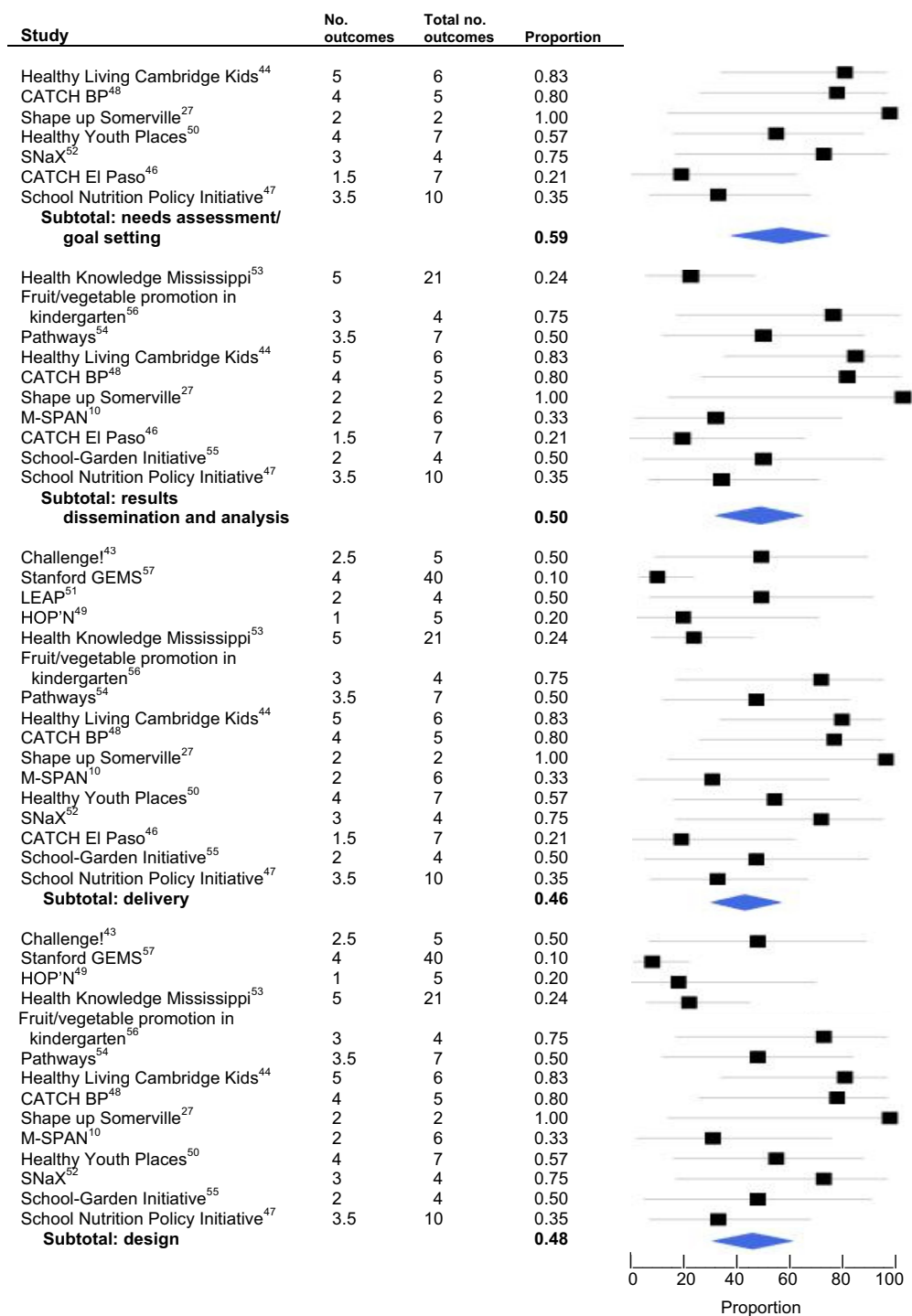


Figure 2. Forest plot of pooled proportions of outcome performance by stage type

Note: Proportions for outcome performance were calculated based on the number of outcomes achieved divided by the number of outcomes targeted (according to the text of the publication). For the purposes of the meta-analysis, using the Freeman-Tukey variant of the arcsine square root transformed proportions, the proportions were transformed into quantities. Then, using DerSimonian-Laird weights for random effects, the weighted summary proportion was calculated via back-transform of the weighted mean of the transformed proportions. The binomial proportion CI was calculated using the exact method.

BP, BasicPlus; CATCH, Coordinated Approach to Child Health; GEMS, Girls Health Enrichment Multi-Site Studies; HOP'N, Healthy Opportunities for Physical Activity and Nutrition; LEAP, Longitudinal Emerging Adulthood Program Study on Health and Wellness of Teenagers; M-SPAN, Middle-School Physical Activity and Nutrition; SNaX, Students for Nutrition and Exercise

fast clubs, healthier foods at fundraisers, school gardening programs, and classroom activity breaks. In both studies, primary outcome achievements (reduction in obesity prevalence) were strengthened by evidence of strong community “buy-in” and attendance/participation rates exceeding 90%.

Inclusion of community partners in interpretation of study results also appeared to qualitatively mobilize community action toward outcomes. Especially in underserved areas, results dissemination connected school staff and partners with medical tools and knowledge, providing incentives for recruitment and retention of diverse, historically hard-to-reach populations.^{46,51,55} In a rural school-based intervention, parents received and analyzed health and BMI assessments along with researchers during a “Parents’ Night.” Many participants had not had previous access to exercise or nutritional resources. Ninety-two percent of participants remained in the intervention group, compared to 72% in controls; the provision of health data and collective assessment may have played a role.⁵¹

Partner type. No relationship existed between number of partners involved and outcomes achieved (ANOVA, $p = 0.33$), and there were no differences among pooled outcome performance means for groups stratified by type of partner involved (Figure 3). Positive community engagement–outcome correlations were evident within groups that engaged “community/academic entity” ($r = 0.74$, $p = 0.02$) or “administrator” ($r = 0.68$, $p = 0.05$) partner types. In contrast, no community engagement–outcome relationship existed in either of the two groups without such involvement. (Other comparisons were not made because of markedly different sizes of comparison groups.)

Qualitative evidence supported each of the included partner types’ influence in enhancing intervention buy-in, relevance, and participation to promote intervention outcomes. However, especially within school food environments influenced by multiple bureaucratic channels, partnerships with community-based entities, universities, and school administrators specifically supported intervention delivery via capacity and environmental changes. For example, the School Nutrition Policy Initiative (SNPI) involved early partnerships with the community-based Food Trust and the Food Service Division (the agency operating statewide school-cafeteria food services) to facilitate school-food environment changes. They successfully removed vending machines; lowered fat, sodium, and sugar content in school-sold snacks; and altered cafeteria beverage choices to include low-fat milk and water. In contrast, interventions without such partnerships predominantly reported few changes in food environments and behaviors, often citing cost

structure, control of centralized kitchens, and vendor-related concerns as barriers to healthful changes in school food availability.^{12,49,52}

Capacity-building. Qualitatively, capacity-building approaches improved outcomes by promoting environmental changes and practical skills on “macro” and “micro” levels. In two macro-level, capacity-building interventions, school staff, teachers, parents, and students attended “best practices” workshops; refined intervention goals; established relationships with district officials, policymakers, and school staff; learned how to create and analyze BMI reports; and worked with grantors to raise \$1.5 million in funds.^{43,57} Both interventions reported evidence of high acceptability, successful implementation, and numerous environmental changes, but also up-front resource requirements and multiyear formative research.

Other smaller interventions in the current review adopted micro-level techniques to build capacity and improve outcomes. For example, Healthy Youth Places targeted individual and school-staff capacity, creating and training “environmental-change teams” involving staff, students, and teachers.⁴⁷ Teams autonomously applied training skills by then selecting and remedying an unhealthy school “environment” and achieved numerous school and district policy changes.

In contrast, interventions adopting fewer capacity-oriented approaches often reported substantial implementation challenges. The Stanford GEMS interventions⁵³ provided culturally tailored and carefully designed, free afterschool classes promoting physical activity to low-income students but did not report steps designed to sustain the program and theoretic physical activity benefits beyond study duration. Study results were undermined by low participation rates, with girls attending an average of 11.6% of classes. Of note, critical contextual factors cited as reasons for low attendance—violent crime, transportation problems, and center leadership transitions that necessitated six site changes over 2 years—reflect capacity-related obstacles, illustrating the connection between capacity-building, intervention delivery, and achievement of intended outcomes.

Methodologic challenges and quality analysis. Process variables measuring participation and intermediate intervention effects enhance plausibility of outcomes by portraying level of implementation and mechanisms of change.^{58–61} In this review, less than half of included studies specified and measured process variables, compromising internal validity of positive outcomes. Only one study⁴⁵ measured environmental changes (e.g., new policies, programs) in intervention

settings relative to controls, and four did not report any measures of implementation, participation, or attendance.^{12,43,49,51}

For example, the Shape Up Somerville study⁵⁷ reported a BMI z-score reduction (primary outcome) but did not report changes in possible mediating variables such as dietary behavior, physical activity, or individual knowledge. Such omissions undermined the ability to causally attribute health outcomes to specific intervention effects.

Even among studies measuring implementation, inconsistent patterns sometimes undermined validity of final outcomes. For example, Foster et al.⁴⁶ noted that food and activity behaviors did not change in intervention schools compared to controls, clouding the mechanism for reductions in obesity incidence. Similar findings were seen in the CATCH El Paso trial.⁴⁹

Such experiences reflect inherent difficulties in measuring variables and outcomes: Food and physical activity behaviors were often measured by self-

Study	No. outcomes	Total no. outcomes	Proportion
Fruit/vegetable promotion in kindergarten ⁵⁶	3	4	0.75
Healthy Living Cambridge Kids ⁴⁴	5	6	0.83
M-SPAN ¹⁰	2	6	0.33
SNaX ⁵³	3	4	0.75
Subtotal: parents			0.63
Challenge! ⁴³	2.5	5	0.50
Stanford GEMS ⁵⁷	4	40	0.10
HOP'N ⁴⁹	1	5	0.20
Fruit/vegetable promotion in kindergarten ⁵⁶	3	4	0.75
Pathways ⁵⁴	3.5	7	0.50
Healthy Living Cambridge Kids ⁴⁴	5	6	0.83
Shape up Somerville ²⁷	2	2	1.00
SNaX ⁵³	3	4	0.75
School-Garden Initiative ⁵⁵	2	4	0.50
School Nutrition Policy Initiative	3.5	10	0.35
Subtotal: academic/community groups			0.50
M-SPAN ¹⁰	2	6	0.33
Healthy Youth Places ⁵⁰	4	7	0.57
SNaX ⁵³	3	4	0.75
Subtotal: students			0.53
LEAP ⁵¹	2	4	0.50
HOP'N ⁴⁹	1	5	0.20
Health Knowledge Mississippi ⁵³	5	21	0.24
Fruit/vegetable promotion in kindergarten ⁵⁴	3	4	0.75
Pathways ⁵⁴	3.5	7	0.50
Healthy Living Cambridge Kids ⁴⁴	5	6	0.83
CATCH BP ⁴⁸	4	5	0.80
Shape up Somerville ²⁷	2	2	1.00
M-SPAN ¹⁰	2	6	0.33
Healthy Youth Places ⁵⁰	4	7	0.57
SNaX ⁵³	3	4	0.75
CATCH El Paso ⁴⁶	1.5	7	0.21
School-Garden Initiative ⁵⁵	2	4	0.50
School Nutrition Policy Initiative ⁴⁷	3.5	10	0.35
Subtotal: teachers/staff			0.49
HOP'N ⁴⁹	1	5	0.20
Pathways ⁵⁴	3.5	7	0.50
CATCH BP ⁴⁸	4	5	0.80
Shape up Somerville ²⁷	2	2	1.00
M-SPAN ¹⁰	2	6	0.33
SNaX ⁵³	3	4	0.75
CATCH El Paso ⁴⁶	1.5	7	0.21
School-Garden Initiative ⁵⁵	2	4	0.50
School Nutrition Policy Initiative ⁴⁷	3.5	10	0.35
Subtotal: administrators			0.47
CATCH El Paso ⁴⁶	1.5	7	0.21
School-Garden Initiative ⁵⁵	2	4	0.50
School Nutrition Policy Initiative ⁴⁷	3.5	10	0.35
Subtotal: politicians			0.35

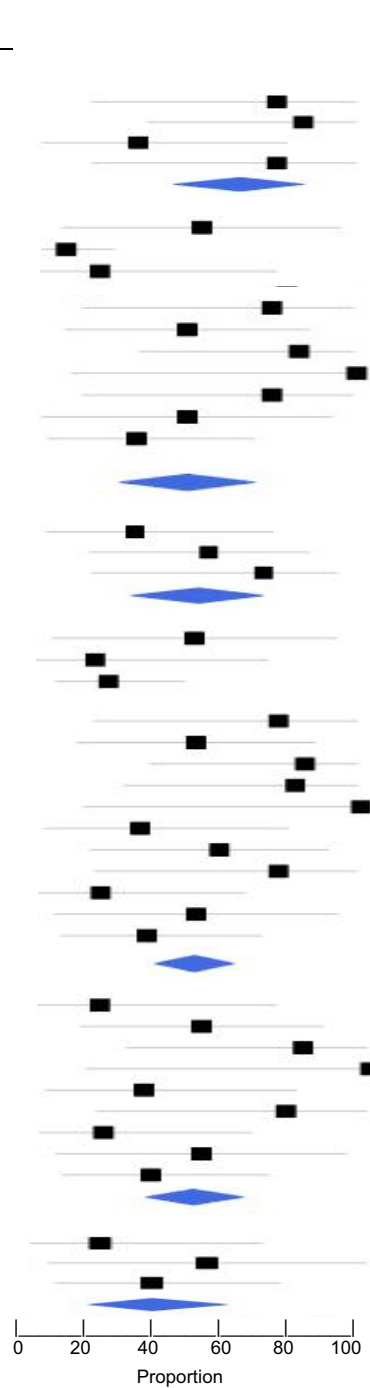


Figure 3. Forest plot of pooled proportions of outcome performance by partner type

Note: Proportions for outcome performance were calculated based on the number of outcomes achieved divided by the number of outcomes targeted (according to the text of the publication). For the purposes of the meta-analysis, using the Freeman-Tukey variant of the arcsine square root transformed proportions, the proportions were transformed into quantities. Then, using DerSimonian-Laird weights for random effects, the weighted summary proportion was then calculated via back-transform of the weighted mean of the transformed proportions. The binomial proportion CI was calculated using the exact method.

BP, BasicPlus; CATCH, Coordinated Approach to Child Health; GEMS, Girls Health Enrichment Multi-Site Studies; HOP'N, Healthy Opportunities for Physical Activity and Nutrition; LEAP, Longitudinal Emerging Adulthood Program Study on Health and Wellness of Teenagers; M-SPAN, Middle-School Physical Activity and Nutrition; SNaX, Students for Nutrition and Exercise

report; especially in younger populations, questions of accuracy and reliability arise if surveys are lengthy and require detailed, delayed recall. Finally, effects may not be observed over the relatively short duration of the study. Such a possibility was underscored by the Challenge! intervention, where all changes reported in BMI and behavior were seen only at 1-year post-intervention rather than at follow-up.⁵⁶

Discussion

This systematic review found that obesity-prevention interventions with greater school–community partnership achieved more weight-, diet-, and activity-related outcomes in diverse school-age populations in the U.S. compared to interventions with less community engagement. This is the first review to report on a statistical relationship between community engagement principles and quantitative health outcomes. Qualitative analysis reiterates that multiple components of community engagement, such as establishing representative partnerships, generating community capacity, and involving communities in needs assessments and results dissemination, improve outcomes by enhancing community support, participation, and intervention delivery.

This review's minimal threshold for community engagement widened the spectrum of included studies; indeed, only two specifically were framed by study authors as "CBPR." As predicted, these "gold standard" interventions experienced highest outcome performance, reflecting the direct relationship between *degree* of community engagement performance and outcomes suggested by this review. Nevertheless, included studies' generally "above average" community engagement performance indicates that several principles of community engagement, and theoretic outcome benefits, are currently applied and viable in a wide range of disadvantaged contexts.

Three trends in community engagement–outcome relationships deserve discussion. First, the correlations between community engagement and combined outcome performance, and community engagement and secondary outcome performance, were not evident for primary outcome scores. Given the multilevel approaches and community autonomy that evolve in more-engaged initiatives, the "outcome benefit" of community engagement is perhaps nonselective, promoting a variety of targeted outcomes subsequently valued by community members beyond (or in addition to) initially defined primary study goals.

Second, this review found that overall community engagement performance, but not specific community engagement characteristics such as research stage, partner

type, or number of involved partners, was positively correlated with outcomes ($r = 0.66, p < 0.01$). The community engagement performance measure is driven by extent and quality of partner participation in addition to presence/absence of stage and partner involvement. The pattern above thus supports notions that meaningful partnerships with community stakeholders are preferable to expansive but superficial involvement, and that thorough partner involvement within even one stage may benefit outcomes.

Finally, positive community engagement–outcome correlations were present for interventions involving partners in needs assessments ($r = 0.77, p = 0.04$) but not for those without such involvement. Although small numbers render conclusions based on significance tenuous, these results suggest that this stage may be an important driver of *both* community engagement and outcome performance. The same inference may apply to the role of specific partner types—administrators and academic/community entities—in promoting both community engagement and outcomes.

Limitations of the present analysis must be noted. This review considered only peer-reviewed, published studies, given study objectives of assessing quantitative and statistically analyzable health outcomes. Complexities in retrieving community engagement literature limited systematization of the search process. Moreover, the multidisciplinary and intrinsically qualitative nature of community engagement mean that relevant interventions with negative findings and other important outcomes may not have been considered. Relevant studies may have been excluded if specific community engagement detail was absent from published reports (although the minimal threshold required for inclusion mitigates this possibility). Finally, because of the quality concerns and the small number of studies included in this review, future research is needed to describe theoretic mechanisms linking interventions, specific community engagement effects, and outcomes.

The associations between community engagement and obesity prevention outcomes in this review may generalize to multiple school environments in the U.S. Interventions employed many study designs and budget sizes, targeted a variety of populations, and occurred in rural, urban, and suburban settings. These diverse interventions, however, share basic principles of community engagement. By categorizing and analyzing such components, this review describes how abstract community engagement principles such as "collaboration" or "capacity" can be practically translated and successfully applied in a range of macro- or micro-level contexts.

This review hints at the potential usefulness of community-engaged research in translating evidence-

based guidelines of nutrition and physical activity in school communities, in formats likely to be accepted, promoted, and incorporated by populations most at risk. However, to fully understand the relationship between community engagement, intervention processes and outcomes, a deeper level of analysis is clearly needed. As prerequisites to assessing internal validity and effectiveness, process measurements and thorough descriptions of participatory components in community engagement/CBPR interventions deserve publication in peer-reviewed medical literature.

Future research must adopt sound design to identify specific “effective” community engagement components, document how given components can be incorporated and measured in preventive interventions, and assess intervention sustainability. A follow-up to this review incorporating multimethod case-study analysis, key stakeholder interviews, focus groups with participants, and archival review could facilitate analysis. By quantifying community engagement’s practical impact, such research ultimately can motivate public momentum, policy change, and better health.

The authors gratefully thank the following for their helpful comments, guidance and suggestions: Meredith Minkler, PhD, Sundararaghavan Krishnaswami, ME, Leonard L. Syme, PhD, George Rutherford, MD, MPH, Jennifer Ahearn, PhD, and Arthur L. Reingold, MD, MPH.

No financial disclosures were reported by the authors of this paper.

References

- Hedley AA, Ogden CL, Johnson CL. Prevalence of overweight and obesity among U.S. children, adolescents, and adults, 1999–2002. *JAMA* 2004;291(23):2847.
- Wang Y, Beydoun MA. The obesity epidemic in the U.S.—gender, age, socioeconomic, racial/ethnic, and geographic characteristics: a systematic review and meta-regression analysis. *Epidemiol Rev* 2007;29:6–28.
- Peterson KE, Fox MK. Addressing the epidemic of childhood obesity through school-based interventions: what has been done and where do we go from here? *J Law Med Ethics* 2007;35(1):113–30.
- Strauss SR, Pollack AH. Epidemic increase in childhood overweight, 1986–1998. *JAMA* 2001;286(22):2845–8.
- Rundle A, Neckerman KM, Freeman L. Neighborhood food environment and walkability predict obesity in New York City. *Environ Health Perspect* 2009;117(3):442–7.
- Brownson, RC, Baker EA, Housemann RA, et al. Environmental and policy determinants of physical activity in the U.S. *Am J Public Health* 2001;91(12):1995–2003.
- Mobley LR, Root ED, Finkelstein EA. Environment, obesity, and cardiovascular disease risk in low-income women. *Am J Prev Med* 2006;30(4):327–32.
- Kirk SFL, Penney TL, McHugh T-LF. Characterizing the obesogenic environment: the state of the evidence with directions for future research. *Obes Rev* 2010;11(2):109–17.
- Lovasi GS, Hutson MA, Guerra M, Neckerman KM. Built environments and obesity in disadvantaged populations. *Epidemiol Rev* 2009;31(4):7–20.
- Sallis J, Conway T, Prochaska J, et al. The association of school environments with youth physical activity. *Am J Public Health* 2001;91(4):618–20.
- Story M, Kaphingst KM, French S. The role of schools in obesity prevention. *Future Child* 2006;16(1):109–42.
- Sallis J. Environmental interventions for eating and physical activity: a randomized controlled trial in middle schools. *Am J Prev Med* 2003;24(3):209–17.
- Kumanyika S, Grier S. Targeting interventions for ethnic minority and low-income populations. *Future Child* 2006;16(1):187–207.
- Minkler M, Wallerstein NB. *Community based participatory research for health*. San Francisco: Jossey-Bass, 2008.
- Thompson-Reid PE. Engaging and mobilizing community members to prevent obesity among adolescents. *Prev Chron Dis* 2009;6(3):A100.
- Esperat MCR, Feng D, Owen DC, Green AE. Transformation for health: a framework for health disparities research. *Nurs Outlook* 2005;53(3):113–20.
- Israel BA. *Introduction to methods in community-based participatory research for health*. San Francisco: John Wiley and Sons, 2006.
- Yancey AK, Ortega AN, Kumanyika SK. Effective recruitment and retention of minority research participants. *Annu Rev Public Health* 2006;27:1–28.
- Sloane DC, Diamant AL, Lewis LB. Improving the nutritional resource environment for healthy living through community-based participatory research. *J Gen Intern Med* 2003;18(7):568–75.
- Israel BA, Coombe CM, Cheezum RR. Community-based participatory research: a capacity-building approach for policy advocacy aimed at eliminating health disparities. *Am J Public Health* 2010;100(11):2094–102.
- Wallerstein N, Duran B. Community-based participatory research contributions to intervention research: the intersection of science and practice to improve health equity. *Am J Public Health* 2010;100(S):S40–S46.
- Wallerstein NB, Duran B. Using community-based participatory research to address health disparities. *Health Promot Pract* 2006;7(3):312–23.
- Leung MW, Yen IH, Minkler M. Community based participatory research: a promising approach for increasing epidemiology’s relevance in the 21st century. *Int J Epidemiol* 2004;33(3):499–506.
- Task force on the Principles of Community Engagement. *Principles of community engagement*. 2nd ed. CDC/ATSDR Committee on Community Engagement. Atlanta GA. www.atsdr.cdc.gov/communityengagement/pdf/PCE_Report_508_FINAL.pdf.
- Draper AK, Hewitt G, Rifkin S. Chasing the dragon: developing indicators for the assessment of community participation in health programmes. *Soc Sci Med* 2010;71(6):1102–9.
- Wallerstein N. Evidence of effectiveness of empowerment interventions to reduce health disparities and social exclusion. *Health Evidence Network*. Geneva: WHO, 2006. www.euro.who.int/HEN/Syntheses/empowerment/20060119_10.
- Economos CD, Irish-Hauser S. Community interventions: a brief overview and their application to the obesity epidemic. *J Law Med Ethics* 2007;35(1):131–7.
- Viswanathan M, Ammerman A, Eng E. *Community-based participatory research: assessing the evidence*. Evidence report/technology assessment (summary). AHRQ Publication. Rockville MD: Agency for Healthcare Research and Quality, 2004.
- Chen PG, Diaz N, Lucas G, Rosenthal MS. Dissemination of results in community-based participatory research. *Am J Prev Med* 2010;39(4):372–8.
- Zakocs RC, Guckenburg S. What coalition factors foster community capacity? Lessons learned from the Fighting Back Initiative. *Health Educ Behav* 2007;34(2):354–75.

31. Lindamer LA, Lebowitz B, Hough RL. Establishing an implementation network: lessons learned from community-based participatory research. *Implement Sci* 2009;4:17.
32. Tapp H, Dulin M. The science of primary health-care improvement: potential and use of community-based participatory research by practice-based research networks for translation of research into practice. *Exp Biol Med* (Maywood) 2010;235(3):290–9.
33. Shalowitz MU, Isacco A, Barquin N. Community-based participatory research: a review of the literature with strategies for community engagement. *J Dev Behav Pediatr* 2009;30(4):350–61.
34. Sorensen G, Emmons K, Hunt MK, Johnston D. Implications of the results of community intervention trials. *Annu Rev Public Health* 1998;19:379–416.
35. Woodman J, Lorenc T, Harden A, Oakley A. Social and environmental interventions to reduce childhood obesity: a systematic map of reviews. EPPI Centre, Social Science Research Unit, University of London. epi.ioe.ac.uk/cms/Default.aspx?tabid=2395.
36. DeMattia L, Lee Denney S. Childhood obesity prevention: successful community-based efforts. *Ann Am Acad Pol Soc Sci* 2008;615(1):83–99.
37. Brown T, Summerbell C. Systematic review of school-based interventions that focus on changing dietary intake and physical activity levels to prevent childhood obesity: an update to the obesity guidance produced by the National Institute for Health and Clinical Excellence. *Obes Rev* 2009;10(1):110–41.
38. Katz DL, O'Connell M, Njike VY, Yeh M-C, Nawaz H. Strategies for the prevention and control of obesity in the school setting: systematic review and meta-analysis. *Int J Obes (Lond)* 2008;32(12):1780–9.
39. Veugelers PJ, Fitzgerald AL. Effectiveness of school programs in preventing childhood obesity: a multilevel comparison. *Am J Public Health* 2005;95(3):432–5.
40. Wolfenden L, Wiggers J, Tursan d'Espaignet E, Bell AC. How useful are systematic reviews of child obesity interventions? *Obes Rev* 2010;11(2):159–65.
41. Doyle J, Armstrong R, Waters E. Issues raised in systematic reviews of complex multisectoral and community based interventions. *J Publ Health (Oxf)* 2008;30(2):213–5.
42. Woodman J, Harden A, Thomas J. Searching for systematic reviews of the effects of social and environmental interventions: a case study of children and obesity. *J Med Libr Assoc* 2010;98(2):140–6.
43. Chomitz VR, McGowan RJ, Wendel JM. Healthy Living Cambridge Kids: a community-based participatory effort to promote healthy weight and fitness. *Obesity (Silver Spring)* 2010;18(S1):S45–S53.
44. Bogart LM, Elliott MN, Uyeda K. Preliminary healthy eating outcomes of SNaX, a pilot community-based intervention for adolescents. *J Adolesc Health* 2011;48(2):196–202.
45. Hoelscher DM, Springer AE, Ranjit N. Reductions in child obesity among disadvantaged school children with community involvement: the Travis County CATCH Trial. *Obesity (Silver Spring)* 2010;18 Suppl 1:S36–44.
46. Foster GD, Sherman S, Borradaile KE. A policy-based school intervention to prevent overweight and obesity. *Pediatrics* 2008;121(4):e794–802.
47. Dziewaltowski DA, Estabrooks PA, Welk G. Healthy youth places: a randomized controlled trial to determine the effectiveness of facilitating adult and youth leaders to promote physical activity and fruit and vegetable consumption in middle schools. *Health Educ Behav* 2009;36(3):583–600.
48. Blom-Hoffman J. Promoting healthy food consumption among young children: evaluation of a multi-component nutrition education program. *J School Psychol* 2004;42(1):45–60.
49. Coleman KJ, Tiller CL, Sanchez J. Prevention of the epidemic increase in child risk of overweight in low-income schools: the El Paso coordinated approach to child health. *Arch Pediatr Adolesc Med* 2005;159(3):217–24.
50. Caballero B, Clay T, Davis SM. Pathways: a school-based, randomized controlled trial for the prevention of obesity in American Indian schoolchildren. *Am J Clin Nutr* 2003;78(5):1030–8.
51. Harrell TK, Davy BM, Stewart JL, King DS. Effectiveness of a school-based intervention to increase health knowledge of cardiovascular disease risk factors among rural Mississippi middle school children. *South Med J* 2005;98(12):1173–80.
52. Dziewaltowski DA, Rosenkranz RR, Geller KS. HOP \square N after-school project: an obesity prevention randomized controlled trial. *Int J Behav Nutr Phys Act* 2010;7:90.
53. Robinson TN, Matheson DM, Kraemer HC. A randomized controlled trial of culturally tailored dance and reducing screen time to prevent weight gain in low-income African American girls: Stanford GEMS. *Arch Pediatr Adolesc Med* 2010;164(11):995–1004.
54. Pate RP, Ward DS, Saunders RP, et al. Promotion of physical activity among high-school girls: a randomized controlled trial. *Am J Public Health* 2005;95(9):1582–7.
55. Wang MC, Rauzon S, Studer N. Exposure to a comprehensive school intervention increases vegetable consumption. *J Adolesc Health* 2010;47(1):74–82.
56. Black MM, Hager ER, Le K. Challenge! Health promotion/obesity prevention mentorship model among urban, black adolescents. *Pediatrics* 2010;126(2):280–8.
57. Economos CD, Hyatt RR, Goldberg JP. A community intervention reduces BMI z-score in children: Shape Up Somerville first year results. *Obesity (Silver Spring)* 2007;15(5):1325–36.
58. Oakes MJ, Kaufman JS. Introduction: advancing methods in social epidemiology. In: *Methods in social epidemiology*. San Francisco: Wiley, 2006.
59. Oakes JM. The (mis)estimation of neighborhood effects: causal inference for a practicable social epidemiology. *Soc Sci Med* 2004;58(10):1929–52.
60. Craig P, Dieppe P, Macintyre S. Developing and evaluating complex interventions: the new Medical Research Council guidance. *BMJ* 2008;337(1):a1655.
61. Armstrong R, Waters E, Moore L. Improving the reporting of public health intervention research: advancing TREND and CONSORT. *J Public Health (Oxf)* 2008;30(1):103–9.

Did you know?

When you become a member of the **ACPM** (www.acpm.org) or **APTR** (www.aptrweb.org), you receive a subscription to *AJPM* as a member benefit.