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The role and impact of community health workers in childhood obesity interventions: a systematic review and meta-analysis

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Summary

Childhood obesity increases the risk for poor health during childhood, as well as for adult obesity and its associated comorbidities. Children from racial/ethnic minority groups or who live in poverty experience elevated rates of obesity. One potential method for reducing childhood obesity disparities is to involve community health workers (frontline public health workers who are trusted members of and/or have an unusually close understanding of the community served). The purpose of this systematic review and meta-analysis was to explore the role and effectiveness of community health workers in childhood obesity interventions. Eleven studies met inclusion criteria, of which nine were eligible for inclusion in the meta-analysis. Results demonstrated that community health workers played various roles in childhood obesity interventions in the home, clinic, school, and community setting. Interventions focused primarily on children from underserved populations. Meta-analytic findings demonstrated a small but significant impact on BMIz and BMI percentile (BMIz [7 studies]: -0.08 , 95% CI: -0.15 , -0.01 , $p = 0.03$, $I^2 = 39.4\%$; BMI percentile [2 studies]: -0.25 , 95% CI: -0.38 , -0.11 , $p < 0.01$, $I^2 = 0\%$). Findings from this review demonstrate that partnering with community health workers may be an important strategy for reducing childhood obesity disparities and advancing health equity.

Keywords

childhood obesity; community health worker; health equity

Introduction

Children with obesity are at increased risk for hypertension, left ventricular hypertrophy, atherosclerosis, metabolic syndrome, type 2 diabetes, asthma, obstructive sleep apnea, nonalcoholic fatty liver disease, musculoskeletal issues, depression and poor psychosocial health during childhood (1–4). Social, economic and healthcare inequities lead to higher rates of childhood obesity in populations who are affected by health disparities, such as

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children of Black race or Hispanic ethnicity or from families living in poverty (5–8) (hereafter referred to as: ‘underserved populations’).

Social determinants of health (SDOH) limit the ability of traditional obesity interventions (e.g. lifestyle modification programmes, health behaviour counselling) to be effective for underserved populations. SDOH are the conditions in which individuals are born, live, grow, work or attend school and age (9) and include economic factors, education, social support and culture, neighbourhood and built environment and access to healthcare (10). Such factors may create barriers to implementing health behaviour change. For example, obesity interventions often centre on promotion of healthy eating and exercise (11,12); however, family poverty limits ability to afford nutritious food (13) and physical activity programmes (14); and neighbourhood poverty is associated with fewer healthy food stores, more fast food restaurants, fewer parks and fitness facilities and limited safe areas to exercise (15–17). In addition, obesity interventions often require frequent clinic visits (18). Yet barriers that are disproportionately experienced by families with low socioeconomic status, such as limited transportation options (19) or lack of paid sick leave (20), inhibit ability to attend intensive treatment.

Addressing SDOH and reducing childhood obesity disparities will require ‘upstream’ approaches to obesity prevention and treatment. Upstream interventions are actions that are taken to address the health of populations within their social context prior to reaching the healthcare system (21); such interventions address the root of a health condition (such as obesity) and are informed by the understanding that health does not occur within a vacuum but is intimately linked to social, economic and environmental context. One potential upstream method for reducing childhood obesity disparities is to include community health workers (CHW) in childhood obesity interventions. CHW are frontline public health workers who are trusted members of and/or have an unusually close understanding of the community served (22,23). CHW are increasingly being involved in healthcare delivery and work in communities around the nation in settings such as primary care, schools and home health agencies. CHW can provide social support, connection with relevant local resources and actionable strategies for overcoming SDOH-related barriers; they can also help individuals capitalize on SDOH-related strengths such as strong community cohesion and resilience. Importantly, CHW often live in the community they serve, so they are easily accessible to and have a shared experience with children and families. CHW have demonstrated effectiveness in helping individuals manage other complex health conditions (22–24). However, the role and effectiveness of CHW in childhood obesity management has not yet been thoroughly examined.

Purpose

The purpose of this systematic review and meta-analysis was to explore the role of CHW in childhood obesity interventions. First, the role of CHW in childhood obesity interventions was qualitatively explored via systematic review. The systematic review assessed the populations and settings with which CHW are involved. CHW role in addressing SDOH-related barriers to a healthy weight was also evaluated. Second, the impact of childhood

obesity interventions that involve CHW on reducing obesity was quantitatively examined via meta-analysis.

Methods

All study processes were conducted in accordance with the Preferred Reporting Items of Systematic Reviews and Meta-Analyses (25).

Study selection

Studies of interest were relevant to the role and impact of CHW in childhood obesity interventions. Inclusion criteria were quasi-experimental or experimental design, sample included children (0–18 years), implemented in developed nation as defined by the United Nations (26,27), intervention focused on childhood obesity prevention or treatment, interventionists included CHW, results reported change in adiposity (e.g. BMI percentile, BMI z-score, percent overweight or any other relevant metric). Exclusion criteria were non-intervention design (e.g. report of study protocol, cross-sectional), adult population (>18 years), implemented in developing or transitioning nation as defined by the United Nations (26,27), no inclusion of CHW, no reported change in adiposity (e.g. only changes in health behaviour), not published in English. Studies were limited to developed nations because CHW play a substantially different role in developed versus developing or transitioning nations (28–30). CHW were defined as individuals who fit the following definition ‘a community health worker is a frontline public health worker who is a trusted member of and/or has an unusually close understanding of the community served’ and received formal public health/medical training (31). Studies that involved only interventionists who were not CHW, such as parent volunteers or university student mentors, were excluded. Whether or not a CHW was paid and specific components of CHW training were not included in the definition and therefore did not impact study inclusion/exclusion.

Search strategy

The literature search was developed in consultation with a research librarian. There was no restriction on length of follow up or years searched. MEDLINE, PsycINFO, ProQuest, Cumulative Index to Nursing and Allied Health Literature, Embase, Web of Science and Scopus databases were searched in September 2017, with automatic weekly recurring searches set up to ensure that newly published studies were considered for inclusion. Key terms were focused around obesity and CHW. (For full search strategy for each database see Fig. S1).

Study characteristics

Studies resulting from the literature search were screened for duplicates using EndNote X7. Studies were screened independently by two authors (KS, RM) at the title and abstract/full-text level facilitated by Covidence online systematic review software (32). Reason for excluding each excluded study was noted. Any discrepancy in studies inclusion/exclusion was discussed among the research team until consensus was achieved. Reference lists of included studies were searched to ensure no relevant articles were missed; if a relevant

article was discovered, it was imported into Covidence (32) to proceed through the full screening process by both screeners.

Data collection and data items

Data were extracted by one author (KS) into a Microsoft Excel spreadsheet with relevant study characteristics including study citation, study design, study setting, intervention characteristics, CHW characteristics (e.g. demographics, education, experience and salary), intervention-specific CHW training, sample characteristics, measurement time points, analytic techniques and obesity outcomes.

Risk of bias

Risk of Bias assessment included the Cochrane Risk of Bias Tool (33) for randomized controlled trials and ROBINS-I Tool for Assessing Risk of Bias in Non-randomized Studies of Interventions (34) for quasi-experimental studies. The Cochrane Risk of Bias Tool includes assessments on key aspects of study quality in five domains, which are rated as low, high or unclear risk of bias (33). The ROBINS-I tool, which was also developed by experts at Cochrane, assesses risk of bias in seven domains and overall risk of bias as low, moderate, serious, critical or no information (34). Assessment using each tool, as appropriate for study design, was performed independently by two authors (KS, RM); after completion of the assessment, results were discussed collaboratively until consensus was achieved.

Meta-analysis

A meta-analysis was conducted to calculate the pooled decrease in body measures resulting from childhood obesity interventions that involved CHW. All studies that reported unadjusted change in body measures with measures of variance were included. The homogeneity required for a fixed effects meta-analysis is rare in biomedical and social science; therefore, measures were combined in an inverse variance weighted meta-analysis using a random effects model (35,36). Analyses were conducted using Comprehensive Meta-analysis Software Version 3 (37). I-squared was used to test for heterogeneity; I-squared was considered to be low if <25%, moderate if 25–75% and high if >75% (38). Tests for publication bias included failsafe N test and visual inspection of funnel plots (35).

Results

Study selection

Figure 1 shows the results of the study search and selection. The search resulted in 1,958 studies with two additional studies gleaned from manual search of reference lists. After removal of duplicates, 1,230 studies remained. Nine-hundred and ninety-five were excluded during title/abstract screening. Two-hundred and twenty-four were excluded during full-text screening, most commonly for not being focused on obesity (n = 101), not being experimental or quasi-experimental design (n = 59) or not including CHW (n = 24). Upon completion of screening, 11 studies met criteria for inclusion in the systematic review (39–49) and nine met criteria for inclusion in the meta-analysis (39,41–47,49). Three studies did not report all data necessary for inclusion in the meta-analysis (40,46,48) (e.g. a measure of variance was not reported). Consistent with standard practice for meta-analyses (50,51)

authors of the three studies were contacted, of which one was able to provide necessary data (46).

Risk of bias

Table 1a visually displays the results of the Risk of Bias assessment for the five randomized controlled trials (41–44,49), assessed with the Cochrane Collaboration Tool for Assessing Risk of Bias (33). Overall quality was moderate. Reporting of random sequence generation ranged from clear reporting (44,49) to no reporting (41). For all trials, interventionist blinding was not reported and/or not possible due to the nature of the intervention; no trial had a formal attention control. Most did not have or report blinding of outcome assessors (41–44); one trial did blind outcome assessors, although researchers noted that full blinding was not possible due to observable presence of intervention content at intervention sites (49). Two trials reported blinding of data analysts (41,49). For all trials, attrition was reported and ranged from 5% (44,49) to 25% (42). Risk of selective outcome reporting was deemed low for all trials.

Table 1b displays the results of the risk of bias assessment for quasi-experimental studies, assessed using the ROBINS-I Tool for Assessing Risk of Bias in Non-randomized Studies of Interventions (34). Overall, risk of bias in the six non-randomized studies (39,40,45–48) was serious to moderate. Risk of confounding was assessed as serious in all except one study (48), due to factors such as key confounders not addressed or inadequate analytic methods. Regarding selection into the intervention, all participants received an intervention in three studies (39,45,46). In two studies, the entire school/centre received the intervention, but participation was voluntary (40,47). In one study, the intervention was implemented at the clinic level with the comparison group being a demographically matched clinic (48). Deviation from the intended intervention was assessed as low in most studies (39,40,47,48), although one demonstrated substantial variation in home visits received (45) and another demonstrated significant differences in intervention session participation among groups (46). Missing data risks were deemed as serious in two of the studies, with one reporting high turnover in childcare centre population between baseline and follow-up (40) and another reporting significant missing or unavailable data (48). Regarding outcome measurement, assessors would know intervention status in most of the interventions given the nature of the study design (39,40,45,46,48), although in one study it was unclear whether assessors were aware of intervention assignment (47). Five studies were rated to be of low risk of bias in result reporting (39,45–48); one study was rated as serious risk of bias because it was unclear why outcomes included only percent of the childcare centre with overweight/obesity (40).

Basic characteristics of included studies

Basic characteristics of the included studies are summarized in Table 2. Five were randomized controlled trials (41–44,49) and six were quasi-experimental studies (39,40,45–48). All were published within the past 10 years (2010–2017). Most interventions were delivered in the United States, with the exception of two studies that were based in Auckland, New Zealand (44) and Melbourne, Australia (49). Three of the American studies were based in California (39,41,42), and three were based in New England (40,47,48); most

American studies were based in urban settings (39–41,45,46). Sample sizes varied, ranging from 33 to 3,765 (48) (mean 792, SD 72; 9 with samples <1,000). Target ages included children from throughout the developmental spectrum; sample ages ranged from 24 months (mothers recruited during pregnancy) (43), young children (3–5 years) (39,40), school age (5–12 years) (41,42,44,45,47–49), to adolescents (46). No intervention was gender-specific. Other sample characteristics included Latino/Latina (39,41,42), American Indian (43), African American (46), from low income households and/or receiving care at Federally Qualified Health Center (39,40,42,45,48), or diagnosed with asthma (45). The intervention based in New Zealand contained approximately 50% children of Maori/Pacific ethnicity (44). Six of the 11 interventions focused on children with overweight and obesity (42,44,45,47,49) or obesity only (46). Most interventions lasted 6–12 months (39,40,45–47) (mean 15.8 months, SD 1.4 months), although the shortest lasted 10 weeks (42) and the longest lasted 3.5 years (49). Theoretical models and frameworks guiding interventions included Social Cognitive Theory (39,41,44), the Chronic Care Model (40), Health Belief Model (41), Transtheoretical Model (42), behavioural economics (44), the Warnecke Model for Analysis of Population Health and Health Disparities (45), the World Health Organization Health Promoting Schools Framework (49) and the International Obesity Task Force 10 Guiding Principles for Obesity Prevention (49).

CHW played various roles in interventions. In almost all interventions, they delivered health behaviour education or counselling and connected children and families to relevant resources (39–48). In some studies, CHW also helped coordinate interventions and worked with school staff or community partners to facilitate systems-level change (41,43,49). CHW worked in various settings, including the community (41,43), schools (49), clinics/medical offices (39,42,46,48), childcare settings and the home (41,43–46). CHW were the primary interventionists in five studies (39,40,43–45,47), although in others they worked with physicians or advanced practice nurses (41,42), registered dietitians (42,46), schools staff or clinic staff (e.g. nurses, medical assistants) (48). Five interventions included only CHW who met certain criteria, such as being bilingual (39–42,47) or female. One study described the education level of CHW recruited, ranging from at or above college level to no college (47). In terms of compensation or incentives, two studies reported paying CHW a salary ranging from \$16.49 per hour (42) to \$55,868 annually (49); three studies noted that CHW were ‘employed’ or ‘hired’ (44,46,48); while one study reported reimbursing them for their ‘time and travel’ (41).

The most common component of treatment fidelity reported included CHW training, which varied greatly in intensity and included 22 hours of structured curriculum with biweekly check in meetings (for family-level intervention) or 16 hours structured curriculum with weekly meetings (for community-level intervention) (41); training in intervention content, principles of home visiting and outreach, behaviour change and motivational enhancement (43); 3 hours of training in intervention content, cultural context and motivational interviewing (44); 40 hours of intervention-specific curriculum (45); 80 hours of didactic training, 50 hours role playing and 170 hours in individual or interactive training activities (46); 36 hours over 6 days of didactic and role-playing training specific to intervention with monthly meetings throughout intervention (47); and full-day live learning sessions held every 6 months, supplemented by monthly interactive webinars and individualized coaching

(48). Some studies reported fidelity data related to intervention implementation or receipt. One included a bilingual investigator to ensure fidelity of treatment process (39); another assessed implementation frequency through CHW tracking records and research staff observations (41). A third described fidelity of intervention delivery through face-to-visit observations conducted by a member of the research team using a standard format. In this process, CHW delivering the intervention received feedback to ensure all components of the intervention were delivered (44). Another study reported quality assurance procedures, starting with a CHW hiring process that included assessment of behavioural interviewing skills, past performance and experience with motivational interviewing. This process was followed by consistent training, role playing, interactive activities and booster sessions. CHW then had monthly case review sessions with a clinical supervisor and dietitian, as well as having all intervention sessions recorded and rated for adherence to treatment modules based on the Motivational Interviewing Treatment Integrity (46).

In almost all cases, interventions were designed to engage with members of groups who experience obesity disparities, including children from low income households (39,40,42,45,48), children from racial/ethnic minority groups, children of African-American/Black (46) or American Indian (43) race, and children of Hispanic (39,41,42) or Maori or Pacific (44) ethnicity. Two of the interventions focused primarily on upstream environmental changes (41,49), while the others focused on education, support and connection to resources. CHW role in enacting upstream changes included petitioning city council to improve neighbourhood parks (receiving over \$400,000 in funding) (41) and working with school partners to improve playgrounds, cafeteria options and school policies (40,41,49). Details about how each intervention addressed social, contextual and environmental factors and SDOH are presented in Table S1.

Meta-analysis of impact of interventions involving community health workers on childhood obesity

Forest plots of the meta-analysis are presented in Figure 2. Nine of the 11 studies were included in the meta-analysis: seven evaluated BMIz (41–46,49) and two evaluated BMI percentile (of note, because of the very small number of studies in the BMI percentile meta-analysis, the results should be considered exploratory and interpreted with caution) (39,47). Two studies were excluded from meta-analyses because of not reporting within-child change in body measures (40) and not reporting unadjusted analyses (48). (Details of data points used from studies and computed effect sizes are available in Table S2.) Body measures were taken by trained staff in all studies, reducing but not eliminating the risk of inaccurate measurement (52). Prior to pooling, decreases in body measures (or smaller increases in intervention compared to control group) were noted in all but one of the studies included in the meta-analysis (41). Meta-analytic results demonstrated a pooled decrease in BMIz of -0.08 (95% CI: -0.15 , -0.01 , $p = 0.03$, $I^2 = 39.4\%$) and a pooled decrease in BMI percentile of -0.25 (95% CI: -0.38 , -0.11 , $p < 0.01$, $I^2 = 0\%$). Inspection of a funnel plot to test for publication bias demonstrated relative symmetry (Fig. S2); the dot to the lower left corner represents the study with the shortest duration and smallest sample size (42). Egger's test was significant, demonstrating potential publication bias, although it is important to note that

Egger's test is not reliable in meta-analyses of less than 10 studies (53). The failsafe N test demonstrated that 43 additional studies would be needed to remove statistical significance.

Discussion

The inclusion of CHW in health promotion and childhood obesity interventions is increasing; however, their role and impact had not yet been systematically evaluated until now. The results of this systematic review demonstrate that CHW played varied roles in interventions, although most commonly they delivered health behaviour education or counselling. Settings varied between school, home, clinic and community sites. Most interventions that included CHW were focused on engaging with children and families from underserved communities. Meta-analysis demonstrated that interventions led to small but statistically significant decreases in body measures. Given the heterogeneity of study populations, intervention characteristics and CHW roles, it is not possible to draw definitive conclusions about best practices. However, promising practices seem to be inclusion of the family unit (not only children or only parents), delivery in a group setting and including community-level intervention content.

Given the extent of existing childhood obesity disparities, interventions that are effective in helping children from underserved populations attain a healthy body weight are critically needed. Intervention on obesity during childhood is critical, as children with obesity in adolescence are likely to be affected by obesity as adults (54). Adults with obesity suffer from many related comorbidities; therefore, childhood obesity disparities exacerbate adult health disparities not only in obesity but in cancer, diabetes, cardiovascular disease and mortality (55). Given the effectiveness noted in this study, there may be potential to expand the role of CHW in obesity interventions that aim to reduce childhood obesity disparities. Because CHW have a close connection with the communities with whom they work, they may be able to help families address SDOH in a way that differs from that of clinicians; this may render CHW critical partners in effectively treating childhood obesity and reducing obesity disparities. Furthermore, if CHW share the same racial/ethnic or cultural background as the children and families with whom they work, they can help advance cultural relevance of obesity interventions. Future studies would benefit from providing additional detail to inform cultural adaptations for diverse populations. As with all obesity interventions, individuals from the target populations should be included in intervention development to ensure that the resulting intervention – including the CHW component – are designed to align with participants' priorities, goals and values.

CHW impacted SDOH in many settings including community and school environments and home environments. CHW were able to effect policy, systems and environmental-level change, as evidenced by their successful execution of petition to improve park environments which was awarded over \$400,000 by city council (41) and by influencing change in the environments and policies of school systems to improve playgrounds, cafeteria options and well-being policies (40,41,49). Additionally, CHW gained the trust of family members to work in intimate home settings where they influenced positive change in parental behaviours such as limiting TV time, making water and healthy snacks available and role modelling positive health activities (39,41–43,45–47). The environments where children live and grow

as well as the cultural beliefs and behaviours of influential adults are all SDOH that impact childhood obesity. This review supports that CHW have the flexibility, knowledge and trust of the community to work in a variety of settings to positively impact SDOH.

The interventions in this study focused primarily on children from underserved populations. We hypothesize that this is because CHW are recognized for particular strength for their cultural competence and for serving as the link between healthcare providers and members of diverse populations (56). The Institute of Medicine highlighted CHW as ideal team members for improving the health of underserved communities (57). However, it is important to recognize that the role of CHW may overlap with other members of the healthcare team and public health system. For example, social workers can help children and families address SDOH related to obesity. Public health professionals can engage with communities to increase access to and uptake of resources for health promotion. Healthcare providers can help children and families address more downstream factors (such as individual health behaviour) during clinic visits, while school and community leaders can help address more upstream factors (such as access to playgrounds and green space) via policy change. Thus, while CHW are particularly well-suited to partner with underserved communities to promote health, other members of the healthcare team and public health system also have an important role to play.

It is necessary for published studies to report elements of intervention fidelity in order to accurately interpret of treatment effects and support replication studies (58). Fidelity refers to the degree to which interventions are delivered according to theoretical and methodological protocols across participants (59). The most commonly reported fidelity component in the studies included in this review was CHW training and recruitment. Much variation existed; several studies sought to employ 'experienced' CHW, while others promoted cultural relevance through the inclusion of bilingual, bicultural CHW. Additional fidelity components that were reported include intervention design, delivery and receipt (58). Design is considered the first core of intervention fidelity, which can be outlined in a treatment manual to help guide interventionists through programme protocols and troubleshooting guidelines (58). Most studies did not describe their intervention manual or procedures of adaptation, which may impact translation of these interventions to practice. In terms of fidelity of intervention delivery, some interventions were implemented by various health care or research team members in addition to CHW, which made it difficult to determine the mechanism by which CHW uniquely impacted childhood obesity outcomes. One study did provide a promising approach in the field through a 'quality assurance procedures' that included tools to assess intervention integrity and delivery (46). However, because the included studies involved CHW as interventionists or 'treatment agents,' their role accounts for internal validity; therefore, more rigour is needed in evaluating their effectiveness.

It is critical to note that while CHW may be effective partners for helping to reduce childhood obesity disparities, meaningful decrease in childhood obesity and childhood obesity disparities will not result until substantial societal changes are made (60). This includes increasing access to healthy foods, improving safety and improving access to physical activity in majority minority and low income communities (61,62). The excessive

advertising of unhealthy foods to children from racial/ethnic minority groups and from low income neighbourhoods must also be curbed (63). Improved access to healthcare resources for treating obesity, through equitable access to insurance and high quality healthcare, will also be critical (64). CHW can play a role helping families overcome these barriers that contribute to obesity disparities, yet advancing health equity will require broader systems-level changes that remove these barriers. The root causes of disparities must be addressed at their core with far-reaching measures (such as policy change) that go beyond supporting an individual to optimize their well-being within an unequal society. Such changes require critical examination and disruption of factors that inhibit health equity such as racial bias in healthcare, neighbourhood segregation and volatile political support for social support programmes relevant to health (e.g. Supplemental Nutrition Assistance Program, Children's Health Insurance Program). CHW can certainly be important partners in this process, but they are not the sole solution; efforts from scientists, public health, policy makers, clinicians and government officials are also required.

There is evidence that supports the role of CHW to help improve health care access and outcomes, particularly among low income, underserved and diverse communities (56). However, for the last several decades, most CHW have worked on short-term, grant funded projects or through volunteer activities (65). While this review found that most studies mentioned 'employment' of CHW, there is limited specificity and several did not mention this aspect. To address the sustainability of CHW interventions, payment for their services must be explicitly described. Some states in the United States are offering CHW certification programmes to promote role standardization and to provide reimbursement for services based on the 2008 Centers for Medicare and Medicaid Services (CMS)-approved Medicaid State Plan Amendment authorizing hourly payments for CHW (56). There is also movement towards accreditation and standardization of the CHW role in Canada and the United Kingdom (66), further demonstrating the growth and evolution of the role of CHW in developed countries. Of note, CHW role in developing or transitioning countries, where they are often more deeply and widely integrated into healthcare delivery (28,66), can provide guidance for growing the role of CHW in other nations. While the role of CHW in developing or transitioning countries is outside the scope of this review, the interested reader can refer to the extensive resources available via the World Health Organization, e.g. (28,67–70).

This study has several limitations. We did not include studies that were not published in English. Further, our search strategy may have missed relevant studies despite best efforts. Our exclusion criteria, while necessary to narrow our focus, limited our scope (e.g. focus on developed nations). In addition, we also focused only on change in BMI_z and BMI percentile as they were the most frequently and consistently reported outcomes. However, neither is an ideal measure for examining adiposity change in children; other measures such as BMI controlling for age and sex, percent change in overweight or waist circumference may provide a better indicator of change in a child's level of adiposity (71–74). Also, we did not examine intermediate factors that impact adiposity at the individual (e.g. physical activity, diet) or environmental (e.g. access to healthy foods, availability of green space) levels, which – while not the focus of this review – could provide additional important insight into intervention effectiveness.

This study has important implications for future research, particularly given the general low quality of evidence on childhood obesity intervention efficacy (75,76). Additional testing of obesity interventions that include CHW is merited. Maintenance of decrease in obesity after intervention completion also should be examined. Of note, the interventions that have been conducted in the United States have been conducted primarily in California and New England; the effectiveness in other geographic and cultural contexts – and particularly in rural areas – remains to be tested. Testing of interventions that are incorporated into the healthcare system, providing a means of long-term sustainability, are also necessary. Cost effectiveness analyses of obesity interventions that include CHW can support translation to policy. Qualitative work to assess participants' perceptions of the interventions and the CHW role will also be critical to intervention refinement. Finally, when CHW are recruited from the target community, they can enhance an intervention's cultural and contextual relevance, due to their unique knowledge of the local community, bilingual skills and deep understanding of the population. However, scientists must consider CHW evaluation and fidelity components through all phases of intervention research, particularly among underserved populations at risk for obesity.

Conclusion

Given the substantial health impact of childhood obesity and its contribution to health disparities in childhood and adulthood, effective methods for helping children from underserved populations reach a healthy body weight are critically needed. While broad-reaching systems-level changes are needed to advance health equity, effective interventions can help reduce health and obesity disparities. Childhood obesity interventions that include CHW may be effective for preventing and treating childhood obesity in children from underserved populations, helping children to attain a healthy body weight and live healthier lives.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Note:

CHW=Community Health Worker

Figure 1.
Summary of the literature search.

BMIz

Study name	Std diff in means	Lower limit	Upper limit	p-value
Crespo 2012	0.02	-0.19	0.23	0.85
Falbe 2017	-0.54	-1.17	0.09	0.09
Karanja 2010	-0.41	-0.73	-0.09	0.01
Maddison 2014	-0.06	-0.31	0.20	0.67
Martin 2016	-0.15	-0.28	-0.02	0.02
Naar-King 2016	-0.06	-0.13	0.01	0.12
Waters 2017	-0.03	-0.10	0.05	0.44
	-0.08	-0.15	-0.01	0.03

$I^2=39.4\%$, $p=0.13$

BMI Percentile

Study name	Std diff in means	Lower limit	Upper limit	p-value
Bender 2012	-0.21	-0.37	-0.06	0.01
Resnick 2009	-0.39	-0.72	-0.06	0.02
	-0.25	-0.38	-0.11	0.00

$I^2=0\%$, $p=0.34$

Figure 2.

Forest plots of studies included in meta-analysis. The forest plots display the results of the meta-analyses for change in BMIz and BMI percentile resulting from childhood obesity interventions that included community health workers. Nine of the 11 studies in the systematic review were eligible for inclusion in the meta-analyses. The effect size for BMIz was -0.08 (-0.15 , -0.01 , $p = 0.03$). The effect size for BMI percentile was -0.25 (-0.38 , -0.11 , $p = 0.00$); however, this should be considered exploratory and interpreted cautiously as only two studies were included in the BMI percentile meta-analysis. Table S2 has additional details about the data points and effect sizes used in the meta-analyses.

Table 1a
Risk of bias of included randomized controlled trials [Colour table can be viewed at <http://wileyonlinelibrary.com>]

Source of bias	Author				
	Crespo 2012	Falbe 2015	Karanja 2010	Maddison 2014	Waters 2017
Selection bias: random sequence generation
Selection bias: allocation concealment
Performance bias
Detection bias
Attrition bias
Reporting bias
KEY					
High
Unclear
Low

Table 1b
Risk of bias of included quasi-experimental studies [Colour table can be viewed at <http://wileyonlinelibrary.com>]

Source of bias	Author	Bender 2013	Cloutier 2017	Martin 2016	Naar-King 2016	Resnick 2009	Taveras 2017
Bias due to confounding							
Bias in selection of participants into the study							
Bias in classification of interventions							
Bias due to deviations from intended interventions							
Bias due to missing data							
Bias in measurement of outcomes							
Bias in selection of the reported result							
KEY							
Critical		XXXXXXXX					
Serious							
Moderate							
Low							
No information							

Table 2

Characteristics of included studies

Author and Year	Sample Size and Attrition	Sample Characteristics	Study Design	Intervention Duration and Location	Intervention and Control Characteristics	CHW Role Other Interventionists
Bender 2013	Baseline: 43; Follow up: 33	3.6 (0.7) years Race/ethnicity: Hispanic Mothers and their pre-school aged children from low income households	Quasi-experimental	9 months Southern California	I: Vida Saludable; Phase I included four biweekly group lessons on healthy drinks, physical activity, parental role modeling; Phase II included 6 monthly group community activities (e.g., cooking class with culturally-relevant foods, community walk) C: No control group	Experienced bilingual promotora enrolled participants, facilitated the intervention, assisted with data collection, and provided participant support No co-interventionists
Cloutier 2017	Baseline: 328, Follow up: 336; Measured at both time points: 129	41.1 (0.5) months Caregivers and their children attending childcare centers Caregivers from low income households	Quasi-experimental	12 months Hartford, CT	I: Brief, interactive educational models delivered in three locations in the childcare center C: No control group	Bilingual, bicultural promotoras delivered the intervention education sessions at the childcare center No co-interventionists
Crespo 2012	I: Baseline: 163, Follow-up: 145 C: Baseline: 223, Follow-up: 205	5.9 (0.9) years Predominantly (>70%) Latino/Latina	RCT	7 months (home visits); 3 years (school and Community changes) San Diego, California	I: Aventuras para Niños; monthly family home visits by promotoras focusing on increasing fruit, vegetable, and water consumption, increasing active play, and decreasing sugar sweetened beverage intake and TV viewing; school and community changes to physical structures (e.g., playgrounds), social structures and policies (e.g., public park maintenance), availability of protective or harmful products (e.g., healthy children's menus in restaurants), and culturally-appropriate media messages (e.g., posters, newsletters, and point-of-choice messages in grocery stores)	Bilingual female promotoras with intimate knowledge of the neighborhood did home visits and delivered intervention content Advanced practice nurses provided support to reinforce program for school staff and developed new programs for schools

Author and Year	Sample Size and Attrition	Sample Characteristics	Study Design	Intervention Duration and Location	Intervention and Control Characteristics	CHW Role Other Interventionists
Fable 2017	I: Baseline: 28, Follow-up: 21 C: Baseline: 27, Follow-up: 19	8.9 (1.8) years Hispanic Families with children with overweight or obesity who spoke Spanish and attended a Federally Qualified Health Center	RCT	10 weeks Contra Costa County, California	C: No intervention I: Familias Activas y Saludables; biweekly family-focused group medical appointments; provision of healthy incentives; phone call check in between sessions C: Wait list control	Bilingual promotoras participated in group medical appointments to engage families and facilitate understanding of content Physician, Registered Dietician
Karanja 2010	I: Baseline: 142, Follow-up: 124 C: Baseline: 63, Follow-up: 53	2 years American Indian Expectant mothers recruited during pregnancy to participate through child's first 24 months	RCT	2 years Idaho, Oregon, Washington	I: Eight clusters of three home family contacts (at least one of each three had to be face-to-face, the other two could be via phone or face-to-face); focus on increasing breastfeeding initiation and duration, limiting the introduction of sugar-sweetened beverages to infants and toddlers, and promoting the consumption of water for thirst among toddlers PLUS community interventions (described below) C: Community interventions designed in six-month cycles, using five strategies: raising awareness, providing health education, facilitating individual behavior change, augmenting public health practice and modifying environments and/or policies related to breastfeeding, sugar-sweetened beverages and water consumption; most were media-based (e. g., brochures, videos, newspaper articles, flyers)	CHWs did face-to-face and phone contacts and delivered all intervention content No co-interventionists
Maddison 2014	I: Baseline: 127, Control: 124 C: Baseline: 117, Control:	I: 11.2 years C: 11.3 years I: Maori 13%, Pacific 53%,	RCT	20 weeks Greater Auckland, New Zealand	I: Screen-Time Weight-loss Intervention Targeting	CHWs did home visits and delivered intervention content

Author and Year	Sample Size and Attrition	Sample Characteristics	Study Design	Intervention Duration and Location	Intervention and Control Characteristics	CHW Role Other Interventionists
	113	New Zealand/European 34% C: Maori 11%, Pacific 53%, New Zealand/European 35% Children with overweight or obesity			Children at Home (SWITCH); Focus on screen time reeducation via provision of behavior change strategies; primary caregivers given education and support to implement strategies in the home; assistance to budget media time (TV Time Machine device); activity pack for children; 12 week check in for adverse events; monthly newsletters; participant website for support to intervention content, monthly newsletters in e-format, additional tips and information, and links to community-based activity programs C: No intervention (had access to publicly available SWITCH website)	(Note: details of CHW training and involvement taken from related Foley 2016) No co-interventionists
Martin 2016	46	9.7 (2.2) years Diagnosed with asthma Children with overweight or obesity 95.7% Medicaid	Quasi-experimental	12 months Chicago, IL	I: Focus on asthma and obesity; monthly 60 minute home visits with social connection, health behavior change discussion (1–2 core curriculum topics based on family's interests and need), facilitation of self-management skills, and small goal setting for specific change over two week period C: No control group	CHWs performed home visits and delivered intervention content No co-interventionists
Naar-King 2016	Baseline: 186, Follow-up: 181	13.8 (1.4) years African-American	Quasi-experimental	7 months Detroit, MI	I: First 3 months: home or office-based counseling delivered in weekly 1 hour sessions focused on family engagement, nutrition/activity planning,	CHWs delivered all intervention content in home or office Registered Dietician joined CHW for delivery of 2 sessions

Author and Year	Sample Size and Attrition	Sample Characteristics	Study Design	Intervention Duration and Location	Intervention and Control Characteristics	CHW Role Other Interventionists
					and behavioral skills; second 15–45 minute sessions via phone to check in, practice, and troubleshoot; Second 3 months: participants who lost <3% weight were randomized to either incentives-based motivation OR continuation of first 3 months, participants who lost >3% of weight were assigned to relapse prevention weekly sessions; quarterly newsletters C: No control group	
Resnick 2009	I: Baseline: 46, Follow-up: 43 C: Baseline: 184, Follow-up: 175	Kindergarten through fifth grade Children with overweight	Quasi-experimental	Mean of 18 weeks (range 1–26 weeks) Framingham, MA	I: Materials group: education on walking, nutrition labels, healthful grocery shopping, television viewing, and healthful eating via 6 mailings sent over the course of 30 weeks; materials plus encounters: same education but via in-person visits, phone calls, or emails from CHW; both: given cookbook, physical activity book, hands on activity about portion sizes, pedometer C: Comprised of students who did not enroll in the intervention	CHWs did family encounters via in-person/phone/email contact to deliver intervention content (materials plus encounters group only) No other interventionists
Taveras 2017	3765	7.0 (3.0) years I: White 13.0%, Hispanic 75.7% Black 5.4%, Asian Site 2: 17.5% White, 65.2% Latino, 16.5% Black, 0.6 Other NH C: 19.3% white, 48.1% Latino, 10.3% black, 22.2% Asian, 0.1% other NH Receiving care at Federally Qualified Health Center	Quasi-experimental	20 months Massachusetts	I: Staff training on obesity prevention and treatment; decision support tools for clinicians; implementation of multidisciplinary Healthy Weight Clinics; integration of CHWs into the primary care and Healthy Weight Clinic teams;	CHWs served as a member of the Healthy Weight Clinic team, counseled patients, participated in the health center's quality improvement efforts, served as "Wellness Navigators," and acted as a liaison to local health and wellness activities Physicians, clinic staff such as nurses and medical

Author and Year	Sample Size and Attrition	Sample Characteristics	Study Design	Intervention Duration and Location	Intervention and Control Characteristics	CHW Role Other Interventionists
		Children with overweight or obesity for Healthy Weight Clinic intervention			environmental changes to support behavior modification C: Demographically-matched Federally Qualified Health Center; no intervention	assistants
Waters 2017	I: Baseline: 1594, Follow-up: 1346 C: Baseline: 1628, Follow-up: 1460	4–13 years	RCT	3.5 years Moreland, Australia	I: Schools were supported to develop programs according to the fixed requirement of a whole school combined focus on increasing fruit, vegetable and water consumption, increasing physical activity, and encouraging positive self-esteem in children; support from Community Development Workers C: No intervention	Community Development Workers acted as knowledge brokers, provided information, and guided schools' customized development of intervention strategies School staff and research team

NR = not reported, I = intervention, C = control, RCT = randomized controlled trial, CHW = Community Health Worker