

# Interventions for Reducing Body Mass Index and Other Weight-related Indicators: A Review of Systematic Reviews

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# Table of Contents

<b>Background</b> .....	2
<b>Methods</b> .....	3
<b>Results</b> .....	4
Diet and Exercise.....	5
Clinic-based Approaches .....	5
School-based Approaches.....	5
Policy, Systems, and Environmental Approaches .....	6
Age Considerations .....	7
Family Life Considerationss .....	8
High-risk Population Considerations.....	9
Religion, Spirituality, and Mindfulness .....	10
<b>Discussion</b> .....	10
Summary of Findings .....	10
Limitations .....	11
Translating Research into Practice .....	11
Conclusions .....	12
<b>Table 1. Guidance on the Prevention and Management of Obesity from Governmental and Intergovernmental Organizations</b> .....	12
<b>Works Cited</b> .....	16
<b>Appendix A</b> .....	25

# Background

Obesity remains one of the most complex and critical health issues of our time. It is highly prevalent in the United States (US), linked to elevated morbidity and mortality, and costly to individuals and health care systems. Obesity and its sequellae disproportionately affect vulnerable populations, including low-income communities and racial and ethnic minority groups.<sup>1-3</sup> Effective strategies for stemming the obesity epidemic are essential to reducing the burden of chronic disease and improving quality of life for current and future generations.<sup>4</sup>

In response to the obesity epidemic and its far-reaching consequences, the California Department of Health Care Services and University of California, Davis Institute for Population Health Improvement have partnered to develop and test a community-based program designed to reduce the risk and prevalence of obesity among low-income Californians. Funding for this effort is provided by the United States Department of Agriculture Supplemental Nutrition Assistance Program-Education.

To ensure the program is grounded in the best available evidence, we reviewed leading clinical and population health guidance from the National Academy of Medicine (NAM, formerly the Institute of Medicine), Centers for Disease Control and Prevention, United States Preventive Services Task Force, and Community Preventive Services Task Force (Table 1).<sup>5-11</sup> We also conducted a review of systematic reviews exploring interventions for reducing Body Mass Index (BMI) and other weight-related indicators among children, teens, and adults. The purpose of the review was to: (1) obtain a comprehensive perspective on community-based intervention studies demonstrating reduction in overweight and obesity; (2) identify themes from the reviews that could guide the development of intervention approaches for our obesity program; and (3) determine whether gaps exist in the recent scientific literature that might help to identify areas for innovation.

# Methods

A search was conducted in the Cochrane Database of Systematic Reviews, the Agency for Healthcare Research and Quality's Effective Health Care Program, Health Evidence, and PubMed (Medline) to identify systematic reviews published between January 2006 and January 2016. The search strategy is detailed in *Appendix A*.

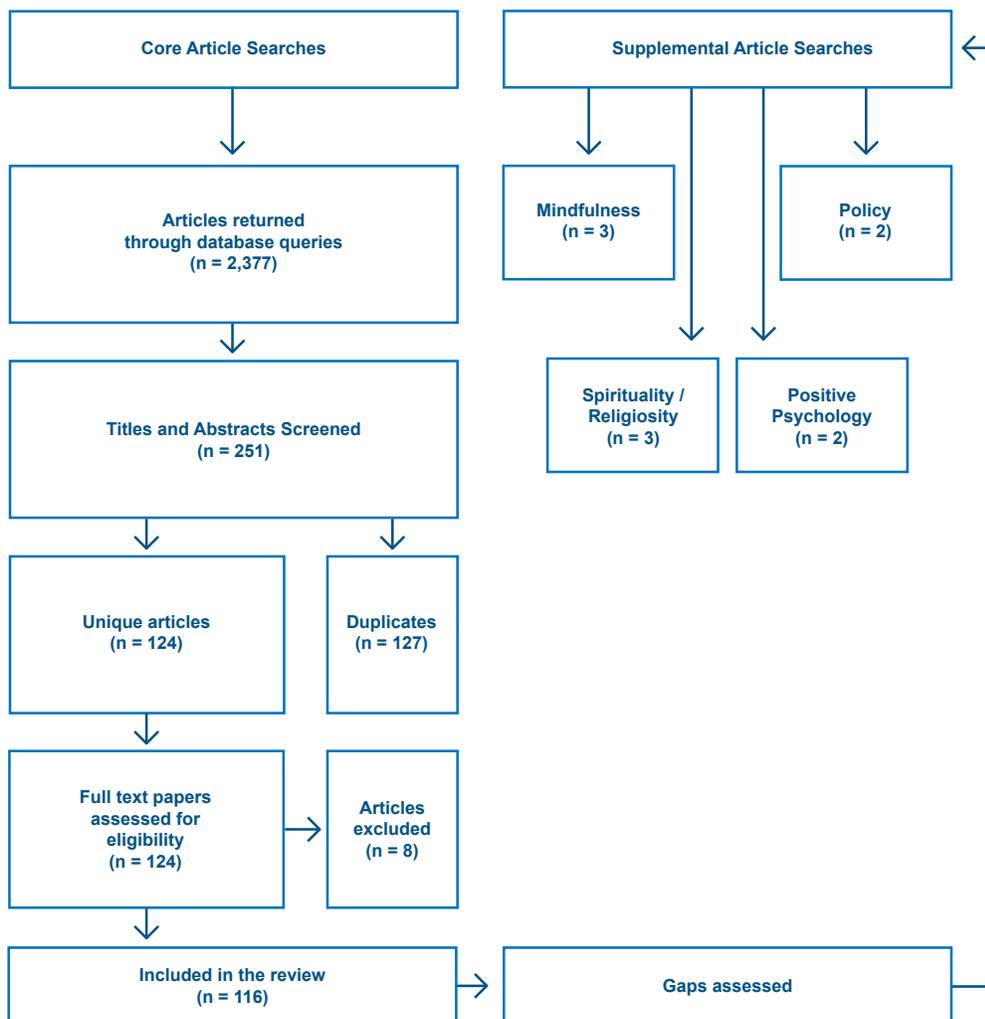
The primary outcomes of interest were weight loss, waist circumference, and variants of BMI, including BMI, BMI percentile, and BMI z-score. These outcome measures were selected because they are commonly used in studies to measure adiposity.<sup>12</sup>

A single reviewer (MJ) screened titles and abstracts to determine eligibility. Reviews were eligible for inclusion if they described interventions designed to prevent or treat overweight or obesity in children (individuals between the ages of 0 and 12), adolescents (individuals between the ages of 13 and 17), or non-elderly adults (individuals between the ages of 18 and 64). Interventions for all BMI classes were included, whether healthy weight (BMI 18.5 to 24.9 for adults and 5<sup>th</sup> percentile to less than the 85<sup>th</sup> percentile for children), overweight (BMI between 25.0 and 29.9 for adults and 85<sup>th</sup> percentile to less than the 95<sup>th</sup> percentile for children), or obese (BMI of 30 or above for adults and 95<sup>th</sup> percentile and above for children).<sup>12</sup> Reviews were excluded if they addressed pregnant women, critically ill individuals, individuals for whom obesity was symptomatic of an underlying disease (e.g., Prader-Willi syndrome), or individuals diagnosed with anorexia and/or bulimia nervosa. Interventions that were exclusively pharmacological, surgical, or related to environmental exposure to obesogens (e.g., endocrine disruptors) were also excluded. However, four systematic reviews comparing the effectiveness of behavioral interventions to pharmacological treatments were included, as these focused primarily on the efficacy of behavioral interventions.

Electronic searches of the four databases returned 2,377 citations (211 from the Cochrane Database of Systematic Reviews, 12 from the Agency for Healthcare Research and Quality's Effective Health Care Program, 414 from Health Evidence, and 1,740 from PubMed). The abstracts were screened for relevance, and 124 unique articles met inclusion criteria. Based on a review of the full text of each article, eight articles were excluded because they did not include weight-related outcome measures, were not available in English translation, did not adopt a systematic approach to their literature review, or were reviews of systematic reviews.

Upon reviewing the remaining 116 systematic reviews, several current intervention modalities were not addressed including: policy approaches, faith-based interventions, mindfulness, and positive affect (the experience of positive emotions, like joy or excitement). To address this deficiency, four supplemental searches were conducted in PubMed (Medline). When systematic reviews were unavailable on the topic, primary research articles were sought. Refer to *Figure 1* for further detail on the search and selection process.

**Figure 1: Flowchart of the selection process**



## Results

Interventions described in this review were overwhelmingly designed to change diet and/or physical activity behaviors. Individual systematic reviews often focused on select intervention settings, target populations, or unique features of interventions; thus we discuss findings in terms of these topics. Intervention settings included clinics; schools; and policies, systems, and environments. Target populations were defined by age groups but included special considerations for families and high-risk populations. Unique intervention features included religion, spirituality, and mindfulness. Primary research studies are used as illustrative examples, as appropriate.

## ■ Diet and Exercise

Interventions designed to address both energy intake and expenditure had the greatest effect on BMI and other weight-related outcomes for all age groups. Although stand-alone dietary<sup>13-15</sup> and physical activity<sup>16-21</sup> interventions have been shown to reduce weight, programs that included both demonstrated greater impact on weight than programs promoting diet<sup>22-26</sup> or physical activity<sup>27</sup> alone. Among children, programs promoting physical activity alone had inconclusive impact on BMI.<sup>28</sup> Programs designed to reduce sedentary behavior had the potential to impact both energy intake and expenditure.<sup>29-32</sup> These programs reduced BMI by simultaneously promoting physical activity and healthy eating by limiting sedentary snacking and exposure to food marketing.<sup>30,31,33,34</sup> However, one review reported that interventions to reduce screen time among children reduced neither screen time nor BMI.<sup>35</sup>

## ■ Clinic-based Approaches

There was limited evidence regarding the efficacy of clinic-based approaches for managing weight.<sup>36-39</sup> Weight counseling prompted by Electronic Medical Records was found to improve BMI screening rates in clinics, though investigators were unable to determine if increased screening led to improved outcomes for patients.<sup>40</sup> Pharmacological treatments, such as orlistat, were found to produce similar or lesser effects on BMI than behavioral treatment.<sup>41-43</sup> Brown et al.<sup>44</sup> provided an overview of evidence-based steps that pediatricians could take to help address childhood obesity, including avoiding unnecessary use of broad-spectrum antibiotics for children under 2 years of age, advising late introduction of solid foods in infancy, encouraging self-regulation of feeding for toddlers, recommending exergaming and technology-based interventions for school-aged overweight or obese children, and using peer groups for adolescent-focused interventions. Authors also advised annual BMI screening, use of motivational interviewing (MI) to prompt families to make healthy choices, and providing guidance on nutrition and physical activity at each well child visit.<sup>44</sup> For adult obesity, in addition to screening and counseling in the primary care setting, providers may play an instrumental role in referring patients to weight management programs or supporting community-level efforts to encourage healthy eating and active living.

## ■ School-based Approaches

The school environment offers an ideal setting for multi-component childhood obesity interventions because nutrition education and physical activity can be incorporated into curriculum, the food environment can be modified to encourage healthy eating, the physical environment can be modified to encourage physical activity, overall wellness can be encouraged through lessons or activities such as gardening, and even health-related behaviors at home can be modified through homework assignments. Obesity prevention interventions for children conducted in educational settings were more effective than those conducted in other settings.<sup>45</sup> Similar to the overall findings, school-based programs incorporating both diet and physical activity tended to report positive impacts on weight outcomes.<sup>46-50</sup> Among programs solely promoting physical activity, most reviews described either inconsistent or no impact on weight outcomes.<sup>51-62</sup>

Examples of multicomponent school-based interventions include the Dutch Obesity Intervention in Teenagers (DOIT),<sup>63</sup> Healthier Options for Public Schoolchildren (HOPS),<sup>64</sup> and the Child and Adolescent Trial for Cardiovascular Health (CATCH).<sup>65</sup> Studies of these interventions suggest that programs and policies can positively change the health environment at school,<sup>66</sup> prevent weight gain,<sup>64</sup> improve body composition,<sup>63</sup> and establish long-term healthier diet and physical activity habits.<sup>67</sup>

## ■ Policy, Systems, and Environmental Approaches

Interventions to support healthy weight among entire communities include changes to policies (written statements of an organizational position, decision, or course of action), systems (unwritten, ongoing, often qualitative organizational decisions/directives), or environments (including built, social, economic, normative, and message environments).<sup>68</sup> Often these approaches focus on providing individuals with the information necessary to make healthy choices. Interventions that relied on passively providing information, however, were ineffective in reducing body weight, especially among families with low socioeconomic status.<sup>37,69-72</sup> Furthermore, programs and policies that relied on an individual's intent to modify their behavior (such as nutrition guidelines, menu labeling, or mass media campaigns) had limited impact on weight outcomes for low-income individuals.<sup>38,73-76</sup>

Changes to the environment designed to make healthy choices easier and more appealing were more promising. Community-based strategies that worked to increase environmental resources were effective for improving dietary intake and reducing BMI among low socioeconomic status participants.<sup>38,73,77-81</sup> Effective approaches included opening grocery stores in underserved areas, providing healthy meals at worksites and schools, and banishing junk food in schools.<sup>80,81</sup> Modifications to the built environment designed to promote physical activity, such as the construction of green spaces and sidewalks, commonly reported positive impact on activity levels, but were less likely to report improved weight outcomes, perhaps due to a lack of long-term follow-up.<sup>82</sup> Yet, neighborhood features that discourage physical activity (such as perceived danger and the absence of parks or bike paths) were consistently associated with increased BMI.<sup>83</sup>

Comprehensive community-based obesity prevention interventions were rare – Shape Up Somerville provides a singular US example.<sup>79</sup> Shape Up Somerville project personnel engaged with the community to design activities that would influence every part of an early elementary schoolchild's day in the school, at home, and in the broader community. Those involved in implementation included: children, parents, teachers, school food service workers, city departments, policymakers, health care providers, before- and after-school programs, restaurants, and the media. Specific activities spanned a 2-year period and included school and city policy changes, a newsletter, classroom curriculum, parent nutrition forums, a walk to school campaign, local physician and clinic staff training, and more. The intervention was associated with both decreased BMI z-scores in schoolchildren<sup>84,85</sup> and decreased BMI in their parents<sup>86</sup> compared to control communities.

## ■ Age Considerations

We found that program effectiveness differed depending on the participants' ages. Two reviews suggested that interventions for children aged 0 to 5 did not commonly demonstrate improved weight outcomes among participants.<sup>87,88</sup> Notable exceptions were interventions conducted in the home or health care settings,<sup>89</sup> those including long-term individual counseling sessions for parents,<sup>69,70,90</sup> or interventions that worked to build parents' skills and connect families with resources in their communities.<sup>78</sup> Australian Healthy Beginnings<sup>91</sup> is an example of an intervention that included all these components: specially trained community nurses periodically visited economically disadvantaged new mothers in their homes up until their child was aged 2. Nurses delivered training on healthy infant feeding practices and active play, but also discussed any issues or concerns raised by the parents. Compared to a control group, children in the Healthy Beginnings group had a lower BMI at age 2.<sup>91</sup>

For children aged 6 to 12, education interventions, such as Planet Health and Kaledo, resulted in significant reductions in weight outcomes.<sup>92,93</sup> Educational interventions that combined environmental approaches, such as improving access to healthy foods and physical activity, yielded even greater reductions in BMI.<sup>94</sup>

For teens, interventions incorporating technology, such as e-learning, active video games, or mobile phones, had well documented success in reduced BMI.<sup>94-98</sup> For example, overweight or obese children and adolescents who participated in an exergaming for health program for 10 weeks with their families had an average 0.48 reduction in BMI.<sup>99</sup> Further, one review suggested that school-based internet obesity prevention programs appeared to be superior to standard care and traditional classroom education among adolescents.<sup>95</sup>

In addition to teens, adults also benefitted from interventions utilizing technology to promote weight loss. Interventions included in this category were highly heterogeneous, encompassing anything from calorie counting applications, to educational podcasts, to motivational text messaging. Yet, regardless of the modality, programs informed by theory, including Social Cognitive Theory, Elaboration Likelihood Theory, Control Theory, and Goal Theory, performed better than those that did not.<sup>100</sup> Mobile phone-supported text messaging, multimedia messaging, or mobile phone applications were generally effective for promoting weight loss in adults.<sup>101-104</sup> Further, one review of mobile phone interventions identified a proportional relationship between program use and weight loss: weight loss increased as utilization rose.<sup>105</sup> Much like their mobile counterparts, internet-based lifestyle interventions have achieved positive impact on weight outcomes,<sup>106-108</sup> especially when these programs incorporated social support, such as email contact or in-person counseling.<sup>109,110</sup> Several reviews suggested that internet-based education and support programs were effective adjuncts to in-person therapy. Educational sessions, however, were ineffective as stand-alone programs.<sup>111-113</sup> Social networking services, such as the Nutri-Expert System and Calorie King, also served as an effective medium for promoting information exchange, social connection, and individualized goal setting and tracking. Social networking services achieved a significant impact on BMI reductions when continued for six months or more.<sup>114</sup>

Two theory-based counseling approaches were found to reduce weight in adults and children. Transtheoretical Model Stages of Change (TTM SOC) is a theoretical model that describes the progressive stages an individual experiences when transitioning from an unhealthy behavior to a healthy behavior.<sup>115</sup> TTM SOC allows practitioners to tailor their feedback to individuals and predict which strategies may be most suitable given the individual's current stage.<sup>116</sup>

Interventions utilizing TTM SOC as a guide for lifestyle modification resulted in statistically significant improvements in weight, fruit and vegetable consumption, and physical activity levels compared to usual care.<sup>117</sup> For example, one intervention described by Mastellos et al.<sup>117</sup> mailed three individualized reports to participants based on their SOC for three health behaviors: healthy eating, physical activity, and emotional eating. The mailings were staggered such that recipients first received informational materials relating to the behavior change they were most interested in improving. The reports offered participants stage-based instruction for the health behavior they were most interested in targeting.<sup>117,118</sup>

A second counseling approach, called MI, also demonstrated efficacy in reducing weight in adults<sup>119</sup> and children.<sup>120</sup> MI is a counseling style that focuses on exploring and resolving individuals' indecision around behavior change.<sup>121</sup> For example, a counselor using MI might inquire about an individual's readiness for change in an open-ended and accepting fashion (e.g., "Would you like to talk about incorporating exercise into your daily routine?"). Then, the counselor might use affirmative statements and reflective listening to support the individual's plans to modify their behavior (e.g., "If you decide to join your friend's walking group, I believe that you can eventually succeed in your goal of incorporating exercise into your day."). MI allows practitioners to identify and engage individuals' intrinsic motivation to attain a healthy weight.<sup>120</sup>

Other effective approaches for adults included behavior change techniques and lifestyle interventions. Behavior change techniques seek to impact participants' dietary and physical activity habits by first targeting individuals' attitudes or perceived self-efficacy regarding health behaviors.<sup>122</sup> For example, a program utilizing these techniques might prompt participants to form intentions about their eating habits for the coming day or guide individuals in seeking social support for health improvement. Among obese adults, behavior change techniques were found to be effective for weight reduction.<sup>122</sup> Likewise, lifestyle interventions, defined as multi-factorial programs designed to meet the needs of participants according to their health risk factors, were found to significantly reduce body weight among overweight and obese participants even at three years follow-up.<sup>123</sup> Common features of lifestyle interventions for overweight and obesity included dietary counseling, goal setting, and physical activity training.<sup>123</sup> Examples of lifestyle intervention programs included commercial weight management programs such as Weight Watchers® as well as programs designed to prevent obesity sequela, such as the Diabetes Prevention Program.<sup>124</sup>

## ■ Family Life Considerations

An interesting finding was the importance of family life in promoting a healthy weight for children and adolescents. Multiple reviews noted that nearly all interventions successful in reducing BMI in children and adolescents included a family component.<sup>48,78,125-128</sup> Not only did parents control access to opportunities for physical activity and healthy eating, they established a climate supportive of activity through messages and personal behavior.<sup>31,129</sup> A change in a parent's personal behavior that resulted in his or her own weight loss was the most important predictor of their overweight child's weight loss in whole-family interventions.<sup>130</sup> Although interventions that aim to improve weight among children and adolescents by indirectly encouraging behavior change in parents are scarce, these interventions have demonstrated success in improving diet, activity levels, and weight for entire families.<sup>131</sup> However, two reviews noted that the evidence in this domain is still emerging.<sup>132,133</sup>

Supplemental searches on positive psychology corroborated the importance of family relationships and suggested that parental emotions and stress levels had far-reaching implications for children’s weight. Parents with high levels of parenting stress and less positive affect were more likely to have an uninvolved feeding style, which entails low levels of parental control and responsiveness in the feeding process. In turn, children whose parents assumed an uninvolved feeding style had lower fruit and vegetable intake and higher weight than children whose parents assumed a more involved feeding style.<sup>134,135</sup> Parents who engaged in “disapproving or harsh statements (verbal content and/or tone) regarding another participant’s behavior or personality” during mealtime also were more likely to have overweight or obese children.<sup>136</sup> Even adolescents, who had greater autonomy in their food and physical activity choices, benefitted from positive parental engagement. One review reported that the strongest mediator of adolescent weight loss in family-based behavioral interventions was family climate, which is primarily characterized by the level of the parents’ satisfaction with life and their family. This suggested that family climate has the potential to impede or support adolescents’ weight loss efforts by promoting psychological health, setting expectations of success, and supporting intervention adherence.<sup>137</sup>

The Bright Bodies weight management program provides an example of a family-centered behavior modification intervention that included lessons on developing positive self-image and interpersonal relationships, as well as exercise and nutrition. This year-long program resulted in beneficial changes in weight, BMI, and body fat compared to usual clinical care among a sample of ethnically diverse overweight children aged 8 to 16 years.<sup>138</sup> Improved anthropomorphic outcomes were sustained for an additional year after completion of the active intervention.<sup>139</sup> Bright Bodies was found to be particularly beneficial for youth with low self-esteem and poorly functioning families.<sup>140</sup> And while the program was oriented toward overweight and obese children, overweight parents also realized greater decreases in BMI and body fat due to the coping skills training (CST) portion of the program.<sup>141</sup> CST topics included clear and constructive self-expression, conflict resolution, cognitive behavioral moderation, and social problem solving.

## ■ High-risk Population Considerations

Obesity prevalence is higher among blacks and Hispanics compared to whites,<sup>142</sup> and among women with lower incomes and less education.<sup>3</sup> Interventions targeting these high-risk groups could have a particularly large impact on obesity-related health outcomes. Few systematic reviews focused expressly on BMI reduction for specific racial or ethnic groups. Those that did often reported inconclusive or inconsistent results and called for additional research in this area.<sup>116,143,144</sup> Yet examples exist of successful interventions in Latino communities using both modified versions of existing weight management programs<sup>145</sup> and programs designed specifically for Spanish-speaking Latino family culture.<sup>146</sup> Findings from the religion and spirituality literature suggest that faith-based interventions could be effective among African Americans.<sup>147,148</sup>

Programs providing low-income and underserved individuals with vouchers for healthy food demonstrated signs of effectiveness as a BMI reduction strategy, but these results require further study to confirm their replicability and generalizability.<sup>81,149</sup> Conversely, programs offering participants direct remuneration in return for weight loss were ineffective for reducing body weight.<sup>150</sup>

At the neighborhood level, income inequality and racial composition were inconsistently associated with obesity.<sup>83</sup> While one study found no significant association between neighborhood racial composition and odds of obesity, other studies found that neighborhood racial isolation was detrimental to obesity prevalence for blacks, but not for whites. The same review reported that income inequality and obesity were positively associated in analyses conducted at the national, state, and community levels. However, country-level analyses suggested that neighborhood income levels had no effect on obesity rates.<sup>40</sup> More study is needed to understand the impact of neighborhood context on healthy weight.

## ■ Religion, Spirituality, and Mindfulness

Our supplemental searches found promising research at the intersection of weight management and spiritual health. Religion and spirituality has been positively associated with healthier eating and increased levels of physical activity.<sup>151</sup> In particular, obesity-related interventions implemented within the faith-based community have been found, in some cases, to be an effective approach for promoting community-level weight reduction, especially in the African American community.<sup>147,148</sup> Many interventions utilizing mindfulness, which is generally the practice of focusing on the present moment in a nonjudgmental fashion, were successful in reducing weight or obesity-related eating behaviors, such as binge eating and emotional eating.<sup>152-154</sup> These results were attributed to mindfulness techniques aiding participants in tolerating the discomfort associated with dietary changes and exercise. A randomized controlled trial comparing a standard weight management program to the same program with an additional mindfulness component found a non-significant trend toward greater weight loss and weight loss maintenance among the mindfulness group, suggesting that mindfulness may help participants adhere to healthy behavior changes.<sup>155</sup>

# Discussion

## ■ Summary of Findings

This review found a variety of interventions with evidence for effective weight reduction. Successful interventions: (1) addressed both energy intake and expenditure; (2) ameliorated underlying environmental and social barriers to healthy behaviors through community-level interventions; (3) supported healthy family life through providing parents and children with skills to communicate with one another and resolve conflicts; (4) were tailored to participant age using appropriate theory-based counseling approaches, technology, and/or behavioral change techniques; (5) were tailored to participant race/ethnicity and socio-economic status; and (6) were implemented through existing local institutions such as schools and faith-based communities. While individually focused lifestyle interventions to change diet and exercise behaviors were found to reduce weight, family interventions appeared to be more effective for children, interventions that taught cognitive and social skills appeared to be more effective for long-term weight loss, and multi-component community-level interventions appeared to effectively impact a larger proportion of the population.

## ■ Limitations

Our review had several limitations. First, the search strategy may have failed to identify all systematic reviews relevant to this topic. We did, however, identify more than 100 reviews and used supplementary searches to fill gaps in the literature on emerging interventions. Second, there is known publication bias against studies with negative results, thus we focused on what appeared to work rather than attempt to identify what did not work. Third, many systematic reviews limited themselves to randomized controlled trials, thereby excluding quasi-experimental studies. This restriction may have resulted in more robust evidence for effective interventions, but limited our ability to identify the complete range of possible interventions. Fourth, reviews published in languages other than English were excluded, limiting the scope of the analysis. Our findings may only be relevant for interventions implemented in locations where English is the predominant language.

## ■ Translating Research into Practice

Due to the scale of the obesity epidemic in the US, researchers and public health leaders have argued that community-based and policy interventions are necessary to effectively reach the more than two-thirds of adults who are overweight or obese.<sup>5</sup> Findings from our review highlight the factors that limit the translation of scientific evidence into the practice of implementing such far-reaching interventions. First, most obesity interventions focus on treating overweight or obese individuals. There have been few large-scale (i.e., affecting hundreds of participants), community-based trials over the last 15 years and the great majority have been conducted outside the US. Shape Up Somerville was the only multi-pronged, community-based, large-scale intervention we identified. Yet it demonstrated that such a program could effectively reduce BMI in both children and adults.<sup>84-86</sup>

Second, many research studies have focused on nutrition or physical activity or both, while failing to address other contextual factors such as well-being, social support, and empowerment. Studies of the Bright Bodies weight management program showed that a family-based, intensive lifestyle intervention that addressed nutrition, physical activity, and psychosocial topics in a supportive group setting was more effective at reducing BMI than more traditional interventions.<sup>138,139,141</sup>

Third, few studies have demonstrated that population-based, environmental, and policy interventions can be scaled up and delivered successfully in diverse communities. The CATCH program was notable because the same school policy intervention was effective in creating a healthier school environment across four states with very different sociocultural environments.<sup>66</sup> It would be helpful to see how more comprehensive community interventions, such as Shape Up Somerville, might be replicated in other parts of the country.

Finally, most interventions have been studied in terms of short-term effects on individuals' weight. Interventions focused on children and their families have the potential to not only change children's weight trajectories across their life span and impact a range of individual health outcomes, but also diffuse healthy behaviors through the family unit and its broader social connections. Likewise, community-level interventions have the potential to impact thousands of individuals and change social norms surrounding health. Studies of the long-term, population-level impacts of multi-pronged interventions would be helpful for accurately quantifying their health benefits.

Interventions identified in this review provide piecemeal evidence that a large-scale, community-based intervention that addresses the contextual risk factors for obesity could effectively reduce weight and be scaled up across communities. Further research is necessary to demonstrate the feasibility of such an intervention and document its long-term, population-wide health impacts.

## Conclusions

The literature reviewed was largely composed of studies that were focused on nutrition, physical activity, or both. Typically, studies focused on relatively narrow interventions whether in clinical, outpatient, school, or community settings. In addition, most studies were 6 to 12 months in duration and involved a small number of participants. To address the ongoing obesity epidemic more effectively, future research should evaluate innovative intervention approaches that move beyond nutrition and physical activity into broader life contexts such as well-being, connection, and empowerment. Given the complexity of obesity as a population health issue, more multi-pronged interventions should be tested that explore individual, group, and community perspectives, simultaneously. Finally, more research projects need to conduct interventions at larger scale (e.g., hundreds of participants) to examine the feasibility of broad dissemination of intervention approaches that are proven effective.

**Table 1. Guidance on the Prevention and Management of Obesity from Governmental and Intergovernmental Organizations**

	NAM	CDC	USPTSF	CPSTF
<b>SOURCES:</b>	<a href="http://nationalacademies.org/hmd/reports/2012/accelerating-progress-in-obesity-prevention.aspx">http://nationalacademies.org/hmd/reports/2012/accelerating-progress-in-obesity-prevention.aspx</a>	<a href="http://www.cdc.gov/obesity/downloads/PA_2011_WEB.pdf">http://www.cdc.gov/obesity/downloads/PA_2011_WEB.pdf</a> <a href="http://www.cdc.gov/obesity/downloads/fandv_2011_web_tag508.pdf">http://www.cdc.gov/obesity/downloads/fandv_2011_web_tag508.pdf</a>	<a href="http://www.uspreventiveservicestaskforce.org/Page/Document/final-evidence-summary38/obesity-in-adults-screening-and-management">http://www.uspreventiveservicestaskforce.org/Page/Document/final-evidence-summary38/obesity-in-adults-screening-and-management</a> <a href="http://www.uspreventiveservicestaskforce.org/Page/Document/final-evidence-summary39/obesity-in-children-and-adolescents-screening">http://www.uspreventiveservicestaskforce.org/Page/Document/final-evidence-summary39/obesity-in-children-and-adolescents-screening</a>	<a href="http://www.thecommunityguide.org/obesity/provider.html">http://www.thecommunityguide.org/obesity/provider.html</a> <a href="http://www.thecommunityguide.org/obesity/communitysettings.html">http://www.thecommunityguide.org/obesity/communitysettings.html</a>
<b>Physical Activity Environment</b>	<p>Make physical activity an integral and routine part of life.</p> <ul style="list-style-type: none"> <li>• <b>Strategy 1-1:</b> Enhance the physical and built environment</li> <li>• <b>Strategy 1-2:</b> Provide and support community programs designed to increase physical activity</li> <li>• <b>Strategy 1-3:</b> Adopt physical activity requirements for licensed child care providers</li> <li>• <b>Strategy 1-4:</b> Provide support for the science and practice of physical activity</li> </ul>	<p>Community-wide campaigns</p> <p>Point-of-decision prompts to encourage use of stairs</p> <p>Individually adapted health behavior change programs</p> <p>Social support interventions in community settings</p> <p>Creation of or enhanced access to places for physical activity combined with informational outreach activities</p> <p>Street-scale urban design and land-use policies</p> <p>Community-scale urban design and land-use policies</p> <p>Transportation and travel policies and practices</p>		<p>Behavioral Interventions that Aim to Reduce Recreational Sedentary Screen Time Among Children (Recommended)</p>

	NAM	CDC	USPTSF	CPSTF
<b>Food and Beverage Environment</b>	<p>Create food and beverage environments that ensure that healthy food and beverage options are the routine, easy choice.</p> <ul style="list-style-type: none"> <li>• <b>Strategy 2-1:</b> Adopt policies and implement practices to reduce overconsumption of sugar-sweetened beverages</li> <li>• <b>Strategy 2-2:</b> Increase the availability of lower-calorie and healthier food and beverage options for children in restaurants.</li> <li>• <b>Strategy 2-3:</b> Utilize strong nutritional standards for all foods and beverages sold or provided through the government, and ensure that these healthy options are available in all places frequented by the public.</li> <li>• <b>Strategy 2-4:</b> Introduce, modify, and utilize health-promoting food and beverage retailing and distribution policies</li> <li>• <b>Strategy 2-5:</b> Broaden the examination and development of U.S. agriculture policy and research to include implications for the American diet</li> </ul>	<p>Promote food policy councils as a way to improve the food environment at state and local levels</p> <p>Improve access to retail stores that sell high-quality fruits and vegetables or increase the availability of high-quality fruits and vegetables in retail stores in underserved communities</p> <p>Start or expand farmers' markets in all settings</p> <p>Start or expand community supported agriculture programs in all settings</p> <p>Support and promote community and home gardens</p> <p>Include fruits and vegetables in emergency food programs</p>		

	NAM	CDC	USPTSF	CPSTF
<b>Message Environment</b>	<p>Transform messages about physical activity and nutrition.</p> <ul style="list-style-type: none"> <li>• <b>Strategy 3-1:</b> Develop and support a sustained, targeted physical activity and nutrition social marketing program</li> <li>• <b>Strategy 3-2:</b> Implement common standards for marketing foods and beverages to children and adolescents</li> <li>• <b>Strategy 3-3:</b> Ensure consistent nutrition labeling for the front of packages, retail store shelves, and menus and menu boards that encourages healthier food choices</li> <li>• <b>Strategy 3-4:</b> Adopt consistent nutrition education policies for federal programs with nutrition education components</li> </ul>			Technology-Supported Multicomponent Coaching or Counseling Interventions (Recommended)
<b>Health Care and Work Environment</b>	<p>Expand the role of health care providers, insurers, and employers in obesity prevention.</p> <ul style="list-style-type: none"> <li>• <b>Strategy 4-1:</b> Provide standardized care and advocate for healthy community environments</li> <li>• <b>Strategy 4-2:</b> Ensure coverage of, access to, and incentives for routine obesity prevention, screening, diagnosis, and treatment</li> <li>• <b>Strategy 4-3:</b> Encourage active living and healthy eating at work</li> <li>• <b>Strategy 4-4:</b> Encourage healthy weight gain during pregnancy and breastfeeding, and promote breastfeeding-friendly environments</li> </ul>	<p>Transportation and travel policies and practices</p> <p>Start or expand farm-to-institution programs in schools, hospitals, workplaces, and other institutions</p> <p>Ensure access to fruits and vegetables in workplace cafeterias and other food service venues</p> <p>Ensure access to fruits and vegetables at workplace meetings and events</p>	<p>Recommends screening all adults for obesity. Clinicians should offer or refer patients with a body mass index (BMI) of 30 kg/m<sup>2</sup> or higher to intensive, multicomponent behavioral interventions.</p> <p>Recommends that clinicians screen children aged 6 years and older for obesity and offer them or refer them to comprehensive, intensive behavioral intervention to promote improvement in weight status.</p>	<p>Provider Education (Insufficient Evidence)</p> <p>Provider Feedback (Insufficient Evidence)</p> <p>Provider Reminders (Insufficient Evidence)</p> <p>Provider Education with a Client Intervention (Insufficient Evidence)</p> <p>Multicomponent Provider Intervention (Insufficient Evidence)</p> <p>Multicomponent Provider Intervention with Client Interventions (Insufficient Evidence)</p> <p>Worksite Programs (Recommended)</p>

	NAM	CDC	USPTSF	CPSTF
<b>School Environment</b>	<p>Make schools a national focal point for obesity prevention.</p> <ul style="list-style-type: none"> <li>• <b>Strategy 5-1:</b> Require quality physical education and opportunities for physical activity in schools</li> <li>• <b>Strategy 5-2:</b> Ensure strong nutritional standards for all foods and beverages sold or provided through schools</li> <li>• <b>Strategy 5-3:</b> Ensure food literacy, including skill development, in schools</li> </ul>	<p>Enhanced school-based physical education</p> <p>Active transport to school</p> <p>Start or expand farm-to-institution programs in schools, hospitals, workplaces, and other institutions</p> <p>Establish policies to incorporate fruit and vegetable activities into schools as a way to increase consumption</p>		School-based Programs (Insufficient Evidence)

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# Appendix

## APPENDIX A: Search details

**Table 1**

**Database:** Cochrane Database of Systematic Reviews

**Search date:** January 15, 2016

Search Terms	Hits	Included
1. Browse by: (All dates) AND (Review Group = Public Health Group) AND (Stage = Review)	57	1
2. Search by: (Publication Dates = 2006 – 2016) AND (Stage = Review) AND (“body mass index” in title, abstract, or keywords)	58	3
3. Search by: (Publication Dates = 2006 – 2016) AND (Stage = Review) AND (“overweight” OR “obesity” in title, abstract, or keywords)	96	8

**Table 2**

**Database:** AHRQ Effective Health Care Program

**Search date:** January 15, 2016

Search Terms	Hits	Included
1. Health Condition = “Obesity, general”; Language = “English”; Report Types = “Research Reviews”	3	2
2. Health Condition = “All”; Keyword = “obesity”; Language = “English”; Report Types = “Research Reviews”	5	0
3. Health Condition = “All”; Keyword = “body mass index”; Language = English; Report Types = “Research Reviews”	4	0

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## Appendix continued

**Table 3**

**Database:** Health Evidence

**Search date:** January 15, 2016 (searches 1- 4) and February 5, 2016 (searches 5 - 6)

Search Terms	Hits	Included
1. Limit: Date = Published from 2006 to 2016 Review Quality Rating = Strong (8 to 10 / 10) Topic Area = Obesity	122	42
2. [("body mass index") OR "BMI" OR "BMlz"] AND Limit: Date = Published from 2006 to 2016 Review Quality Rating = Strong (8 to 10 / 10)	109	63
3. [("body mass index") OR "BMI" OR "BMlz"] AND Limit: Date = Published from 2006 to 2016 Review Quality Rating = Strong (8 to 10 / 10) Topic Area = Nutrition, Physical Activity	82	34
4. [("body mass index") OR "BMI" OR "BMlz"] AND Limit: Date = Published from 2006 to 2016 Review Quality Rating = Strong (8 to 10 / 10) Topic Area = Obesity	56	37
5. SEARCH CRITERIA ("waist circumference") AND Limit: Date = Published from 2006 to 2016 Review Quality Rating = Strong (8 to 10 / 10)	26	9
6. ("body fat") AND Limit: Date = Published from 2006 to 2016 Review Quality Rating = Strong (8 to 10 / 10)	19	0

**Table 4**

**Database:** PubMed

**Search date:** January 7, 2016

Search Terms	Hits	Included
(((((systematic review OR meta analysis[Filter]) AND (obesity OR obesity, morbid[MeSH Terms])) AND "body mass index"[Title/Abstract]) NOT (bariatric[Title/Abstract] OR cancer[Title/Abstract] OR laproscopic [Title/Abstract] OR biomarker[Title/Abstract] OR surgical[Title/Abstract])))	1740	51



