

# Design of the Massachusetts Childhood Obesity Research Demonstration (MA-CORD) Study

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## Abstract

**Background:** Childhood obesity is highly prevalent, is associated with both short- and long-term adverse outcomes, disproportionately affects racial/ethnic minority and economically deprived children, and represents a major threat to public health. Among the most promising approaches for its prevention and management are multilevel, multisector strategies.

**Methods/Design:** The Massachusetts Childhood Obesity Research Demonstration (MA-CORD) Study was a comprehensive, systematic intervention to prevent and reduce childhood obesity among low-income children ages 2–12 years in two selected cities in Massachusetts. Building on the Obesity Chronic Care Model, MA-CORD expanded a state public health department community-level obesity prevention initiative that incorporated evidence-based interventions in primary healthcare, the Women, Infants, and Children program, early care and education, schools/afterschool programs, as well as community-wide programs to improve food, beverage, physical activity (PA), and messaging environments. The study used a combination of pre- and post-time series and quasi-experimental designs to examine the extent to which the intervention resulted in changes in BMI, individual-level lifestyle behaviors, satisfaction with healthcare services, and quality of life among children, as well as changes in health policies, programs, and environments in the two intervention cities, compared to a comparison city. The intervention period was 2 years.

**Conclusions:** MA-CORD will determine the extent to which a multisetting, multilevel intervention that integrates activities in primary care with broader public health interventions in schools, early care and education, and the community at large can improve children's dietary and PA behaviors and ultimately reduce obesity in low-income children.

## Introduction

Obesity represents a major threat to public health and results in significant excess burden of chronic diseases, adverse quality of life, and health and societal costs.<sup>1–4</sup> Though obesity rates in the United States may have plateaued in some population subgroups, overall

rates remain stubbornly high and racial/ethnic and socioeconomic disparities appear to be increasing.<sup>5,6</sup> Many factors contribute to the intractability of obesity and related racial, ethnic, and socioeconomic disparities, ranging from the social, built, and economic environments to individual behaviors and physiology. Given the complexity and interconnectedness of etiologic factors of obesity,

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proposed solutions will need to be similarly broad and include sustainable, cost-effective, multisector strategies that support change at the individual, system, and community levels.<sup>7-9</sup>

The Massachusetts Childhood Obesity Research Demonstration (MA-CORD) Study was designed to implement and test an integrated approach across multiple sectors and levels to prevent and treat obesity among low-income children. MA-CORD was designed in the context of a comprehensive, state-wide wellness initiative launched by the Massachusetts Department of Public Health (MDPH), *Mass in Motion*.

MA-CORD was funded by the CDC in response to the legislative mandate in the reauthorization of the Children's Health Insurance Program and appropriations through the Affordable Care Act.<sup>10</sup> Dooyema and colleagues have previously published on the CORD framework and innovation, which includes a description of the additional demonstration grantees in Texas and California.<sup>10</sup> This article will summarize the conceptual framework, design, and methods of MA-CORD. A companion article focuses on the specific evaluation plan and baseline results.<sup>11</sup>

### *Conceptual Framework*

Our intervention drew upon the recommendations from the Institute of Medicine of integrating primary care with public health programs to improve the health of populations.<sup>12</sup> The two overarching models for MA-CORD were the chronic care model (CCM) originally developed by Wagner and colleagues<sup>13</sup> and the energy gap model (EGM) for children that quantifies associations of changes in energy intake and expenditure with weight change.<sup>9,14-16</sup> The CCM informed our approach to changing primary care and the healthcare system by identifying the essential elements of a healthcare system that encourage high-quality care of chronic conditions: the community; the health system; family and self-management support; delivery system design; decision support; and clinical information systems. MA-CORD implemented changes to each element of the CCM to improve childhood obesity screening and management across clinical and community settings as well as among families.

Community and environmental interventions were chosen based on their potential to reduce the childhood energy gap and ability to be incorporated into the initiatives already underway through existing *Mass in Motion* projects. Wang and colleagues<sup>15</sup> have proposed the EGM for children, which suggests that changes averaging 64 kcal/day could meet the 2020 Healthy People goal for children ages 2-19 years. The energy gap approach helps to identify dietary and physical activity (PA) behaviors that can alter energy balance. In addition, all of our intervention approaches build on social cognitive theory to identify and target critical social and environmental factors underlying the performance of specific health-related behaviors in different settings where children spend their days.<sup>17-24</sup>

## Methods

### *Overview of Study Design*

MA-CORD was a multisector, multilevel whole-of-community intervention in Fitchburg and New Bedford, Massachusetts, that incorporated evidence-based interventions across multiple sectors and at multiple levels (Fig. 1). The overall aim of the study was to examine the extent to which the comprehensive, systematic intervention reduced childhood obesity among underserved children. Evidence-based interventions were incorporated in (1) pediatric primary care, (2) the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC); (3) early care and education, (4) public elementary and middle schools and afterschool programs, and (5) policy change and community-wide programs to improve food, beverage, PA, and messaging environments among predominantly low-income children ages 2-12 years. The study used a combination of pre- and post-time series and quasi-experimental designs to examine the extent to which the interventions resulted in changes in BMI, individual-level lifestyle behaviors, satisfaction with healthcare services, and quality of life among children, as well as changes in health policies, programs, and environments in the two intervention cities, compared to a comparison city. The intervention period was 2 years. The study protocol was approved by the human subjects committees of the MDPH, Harvard School of Public Health, Massachusetts General Hospital, and Harvard Pilgrim Health Care Institute.

### *Building Upon a State-wide Initiative*

In 2009, the MDPH launched *Mass in Motion*, a community-based, multifaceted initiative to address the growing public health threat posed by obesity and its numerous adverse health consequences. The *Mass in Motion* initiative included: (1) an executive order requiring implementation of strict nutrition guidelines in state food procurement; (2) the development of regulations requiring BMI measurement of all school children in grades 1, 4, 7, and 10 and the sharing of this information with local and state policy makers; (3) the development of regulations for strong nutrition standards for competitive foods in public schools; (4) the establishment of a *Mass in Motion* website<sup>25</sup>; (5) support and training for more than 60 worksite wellness programs; (6) a joint program with the Department of Early Education and Care to promote PA and healthy eating in child care settings; and (7) *Mass in Motion* Municipal Wellness grants to 51 communities representing 30% of the state's population to support multisector coalitions to decrease obesity and related chronic diseases.

### *Eligibility for MA-CORD*

*Intervention communities and settings.* In the Spring of 2011, the MDPH published a request of interest to communities in the Commonwealth (of Massachusetts) for participation in MA-CORD. To be eligible for consideration, municipalities had to be participants in the *Mass in*

		Intervention Sectors				
		Primary Care	WIC	Child Care	School/After-school	Community
Intervention Level	Community	Practice change initiatives	Practice change initiatives	Mentors implement interventions	Multiple linked interventions	Local coalition initiatives
	Community Health Workers and physician champions link with local initiatives	WIC providers link with local initiatives	Interventions link with local initiatives	Interventions link with local initiatives	Learning communities for afterschool sites	Youth-driven media competition to change community norms Environment & policy change
	System	Obesity Learning Collaborative to improve quality of care for providers	WIC provider training to improve obesity and obesogenic behavior counseling	<i>Nutrition and Physical Activity Self-Assessment for Child Care</i> supports policy, practice change in child care sites	Policy & practice changes within schools and afterschool programs Provide physical activity equipment to schools	Environment & policy change focused on increased activity and increased access to healthy food
Individual & Family	Assessment Coaching Coordinated support	Assessment Counseling Enhanced referrals	<i>I Am Moving, I Am Learning</i> promotes daily physical activity and healthy food choices among children, staff, and parents	Opportunities for students/parents to learn to eat better and move more Encourage healthy role modeling among school and afterschool staff	Support for activity groups Prompts for healthier decision making	

Figure 1. Massachusetts Childhood Obesity Research Demonstration (MA-CORD) Study overview. WIC, The Special Supplemental Nutrition Program for Women, Infants, and Children.

Motion initiative,<sup>25</sup> have existing coalitions already working on obesity prevention initiatives, and have the support of leaders from the multiple sectors in which interventions were planned. Nine Mass in Motion communities submitted applications, and two communities were selected. Whereas all nine met the requests for applications<sup>26</sup> criteria for low income and existing capacity for obesity prevention, Fitchburg and New Bedford scored especially high on a range of relevant criteria, including coalition participation, the availability of trained community health workers, previous successes in planning and implementation of community-based initiatives, and participation in existing obesity prevention initiatives. Both communities received \$50,000 Mass in Motion Wellness grants that allowed MA-CORD to leverage the community- and state-wide infrastructure for assessment, planning, and implementation of the community-wide childhood obesity prevention initiatives in the two study communities.

Fitchburg is located in north-central Massachusetts and is home to 40,000 residents. New Bedford is in southeast Massachusetts with 95,000 residents. Both communities have higher percentages of low-income residents than the state as a whole and childhood obesity rates substantially higher than the state-wide average. Population and environmental characteristics of the two communities are shown in Table 1.

*Comparison community.* Based on similar population demographics of the intervention communities, a third Massachusetts community participating in Mass in Motion was selected as a comparison in order to collect individual-level BMI and behavioral information from children who attend a large, federally qualified community health center, WIC, and public elementary and middle schools. As with other communities in the state, the comparison community could continue to plan and carry out health and wellness programs, but it was not expected to have an intensive multilevel intervention such as MA-CORD. Aggregate BMI of children in grades 1, 4, and 7 in the two MA-CORD communities was also compared with those of children across the 311 school districts in Massachusetts in which school-based BMI screening is mandated.

#### MA-CORD Behavioral Targets

In addition to system-level intervention targets, MA-CORD focused on five individual- and family-level behaviors that are evidence based and potentially actionable (Fig. 2). The behaviors represent domains of screen time,<sup>27,28</sup> beverage and diet quality,<sup>29</sup> PA,<sup>30</sup> and sleep,<sup>31–33</sup> which have been shown to have strong influences on child weight regulation and energy imbalance. These include: (1) decreases in screen time and television (TV) sets in bedrooms; (2) decreases in consumption of sugar-sweetened beverages; (3) replacement

**Table 1. Key Preintervention Characteristics of the MA-CORD Study Communities**

Sociodemographic characteristics	Massachusetts	Fitchburg <sup>a</sup>	New Bedford	Comparison
Total population <sup>b</sup>	6,436,940	40,514	94,502	106,519
Race/ethnicity				
% white alone <sup>b</sup>	76.1	68.2	67.9	52.8
% black or African American alone <sup>b</sup>	6.0	1.1	5.2	6.0
% Hispanic or Latino (any race) <sup>b</sup>	9.6	21.6	16.7	17.3
Per capita income <sup>c</sup>	\$35,485	\$22,949	\$21,343	\$23,793
% families with children whose incomes are less than the Federal Poverty level <sup>c</sup>	12.0	23.5	27.1	19.9
Primary care				
No. of CHCs	36	1	1	1
No. of CHCs patients < 18 years old <sup>d</sup>	137,993	6919	4861	7361
% of CHCs patients enrolled in MassHealth (Medicaid) <sup>d</sup>	41.9	47.9	52.0	62.9
% of CHCs patients ≤ 200% federal poverty level <sup>d</sup>	90.2	84.5	97.3	93.7
Women, Infants, and Children program				
% of 2- to 5-year-old children overweight/obese <sup>e</sup>	33.0	32.8	33.6	22.8
Number of 2- to 5-year-old children enrolled <sup>e</sup>	61,551	838	2037	2381
Early care and education				
Number of licensed child care slots <sup>f</sup>	229,312	1548	3298	3727
Public elementary and middle schools				
Number of elementary schools <sup>g</sup>	1152	4	20	14
Number of middle schools <sup>g</sup>	319	3	3	7
Pre-K to fifth grade enrollment, 2012–2013 <sup>g</sup>	450,633	2559	7392	7447
Grade 6–7 enrollment, 2012–2013 <sup>g</sup>	143,600	743	1696	3303
% of students in grades 1, 4, 7, and 10 with a BMI ≥ 85th percentile, 2010–2011 <sup>h</sup>	32.4	40.9	39.9	35.9

<sup>a</sup>Data only available for Community Health Connections, Inc., which includes one health center in Fitchburg and two in the surrounding area of Fitchburg.

<sup>b</sup>2010 U.S. Census.

<sup>c</sup>2008–2012 American Community Survey 5-year estimates.

<sup>d</sup>Health Resources and Services Administration, UDS Summary Report, 2011.

<sup>e</sup>CDC, Pediatric Nutrition Surveillance 2011 report.

<sup>f</sup>Massachusetts Department of Early Education and Care, 2010.

<sup>g</sup>Massachusetts Department of Elementary and Secondary Education, 2012–2013.

<sup>h</sup>Massachusetts Department of Public Health, The Status of Childhood Weight in Massachusetts, 2009–2011.

MA-CORD, Massachusetts Childhood Obesity Research Demonstration; CHCs, federally qualified community health centers.

of nutrient-poor foods with fruits and vegetables; (4) increases in moderate and vigorous PA; and (5) increases in sleep duration and improvement in sleep quality.

### *Descriptions of System-Level Interventions by Sector*

*Clinic intervention.* Evidence-based interventions were implemented in both cities' federally qualified community health centers (CHCs).<sup>19,34,35</sup> Intervention components

aimed to improve primary and secondary prevention of childhood obesity and implemented changes at four levels: clinician; parent-family; organizational; and environmental (Table 2). Additionally, training and educational materials were provided to other pediatric clinicians in the two communities. The clinical intervention components included: (1) advanced training on clinical quality improvement and obesity prevention, assessment, and management; (2) computerized, point-of-care decision support tools for clinicians;

# 5 Ways to Grow Healthy

5

Sleep at least **11 hours per day** (2-5 years old).  
Sleep at least **10 hours per day** (6-12 years old).



4

Replace sugary, salty, fried, and fast food with **fruits and vegetables**.



2

Watch no more than **2 hours of screen time per day** (includes TV, smartphones, and hand-held video games).



3

Get at least **1 hour of physical activity** (including active play) per day.



1

Switch from **sugary drinks** (like soda, sports, and fruit drinks) to **water**.



Figure 2. Individual- and family-level behaviors targeted in Massachusetts Childhood Obesity Research Demonstration (MA-CORD). TV, television.

**Table 2. MA-CORD Intervention Activities in the Community Health Centers in Fitchburg and New Bedford, Massachusetts**

Clinician	Parent/family	Organizational	Environmental
<ul style="list-style-type: none"> <li>• Computerized, point-of-care decision support tools to increase BMI screening and obesity-related counseling for all children</li> <li>• Computerized, point-of-care decision support alerts to identify children with a BMI <math>\geq</math>85th percentile and improve adherence to expert committee guidelines on pediatric obesity management</li> <li>• Advanced training on obesity care and motivational interviewing through a modified Breakthrough Series™ Learning Collaborative</li> <li>• Be Our Voice™ Advocacy training to amplify clinicians' knowledge of, and involvement in, local public health approaches for childhood obesity prevention</li> </ul>	<ul style="list-style-type: none"> <li>• Parent self-assessments of child's behavior risk factors</li> <li>• Consistent messages on targeted behaviors through posters, educational materials, and health center signage</li> <li>• Coordinated support by CHWs to increase confidence in obesity-related behavior change</li> <li>• CHW referral of patients to local resources for physical activity and social support services</li> <li>• Interactive coaching by CHWs for children with BMI <math>\geq</math>85th percentile</li> </ul>	<ul style="list-style-type: none"> <li>• Modified Breakthrough Series™ Learning Collaborative to improve obesity-related quality of care in the health center</li> <li>• Identification of physician champion, clinical team, and CHW to support practice changes, outreach to community, and participation in local Mass in Motion coalition</li> <li>• Healthy weight clinics with multidisciplinary team for in-house obesity management</li> <li>• Train medical assistants on accurate height and weight measurements</li> </ul>	<ul style="list-style-type: none"> <li>• Posters in waiting rooms to promote behavioral goals</li> <li>• Social marketing campaign throughout clinical setting to promote obesity-related behavioral targets</li> <li>• Promotion of the use of stairwells within the clinical environment using point-of-decision signage</li> <li>• Highlight healthy choices in health center vending machines</li> <li>• Removal of sugar-sweetened beverages from health center vending machines</li> </ul>

MA-CORD, Massachusetts Childhood Obesity Research Demonstration; CHWs, community health workers.

(3) implementation of multidisciplinary weight management programs within the CHCs (*e.g.*, healthy weight clinics; HWCs); (4) integrating community health workers (CHWs) into the primary care and HWC teams; and (5) health center environmental changes to support behavior change modification.

*Clinician training.* Teams from local pediatric practices and community organizations serving Fitchburg and New Bedford received advanced training on obesity prevention, assessment, and management through a combination of a modified Breakthrough Series™ Collaborative<sup>36</sup> and individualized team coaching to assist with implementation of evidence-based practices within the context of each participating organization. Participants included a physician champion, clinical staff such as nurses or medical assistants, administrative leaders, CHWs, and representatives from Mass in Motion coalitions. Training included: (1) quality improvement language and methods; (2) methods of encouraging health behavior change, including motivational interviewing; (3) best practices in treating childhood obesity; and (4) Be Our Voice™<sup>37</sup> Advocacy training, which engages and trains clinicians to be advocates of children in the fight against childhood obesity. Full-day live learning sessions were held every 6 months supplemented by monthly interactive webinars and individualized coaching.

*Point-of-care decision support tools.* To support evidence-based management of pediatric obesity, existing electronic health records in each health center were modified to deploy a computerized, point-of-care, decision support alert to

pediatricians at the time of a well-child care visit for a child with a BMI  $\geq$ 85th percentile shown to be effective in improving quality of care for overweight children.<sup>38,39</sup> The alert contained links to the child's growth chart and a link to a prepopulated, standardized note specific for obesity that included the ability to (1) document and code for BMI percentile and weight status diagnosis; (2) document and code for nutrition and PA counseling; (3) place referrals to the on-site HWC for weight management support; and (4) place orders for obesity-related laboratory studies, if appropriate.

*Healthy weight clinics.* In each health center, weight management support through multidisciplinary HWCs were developed (Fitchburg) and expanded (New Bedford).<sup>35</sup> Each clinic was staffed by a physician champion, a nutritionist, and a CHW who met with each patient and family in tandem during a single clinical encounter. Primary care providers referred eligible patients (BMI  $\geq$ 85th percentile, ages 2–18) to this specially trained, primary care team. Patients participating in the HWCs engaged in dietary and PA assessment, goal setting, and were connected to community resources to support healthy lifestyles. MA-CORD aimed for patients to be followed in the HWC monthly for a total of 6 months.

*Community health workers.* As part of MA-CORD, each health center employed a full-time CHW as a member of the primary care and multidisciplinary obesity management teams. The CHWs (1) served as members of the HWC, counseling patients referred to the program; (2) participated in the health centers' quality improvement

efforts; (3) served as “wellness navigators” connecting children and families with community resources for increasing PA and eating healthier; and (4) were liaisons to local Mass in Motion coalition activities in the broader community. They also cataloged local community resources to refer patients to, and conducted parent education and training sessions on, the MA-CORD target behaviors, in collaboration with research team staff.

*Environmental changes.* To improve the healthfulness of the clinical environment and support staff and families’ lifestyle modification, MA-CORD worked with health center administrators and the CHWs to implement clinical environmental changes. Subsequent to an environmental assessment, MA-CORD developed a menu of options in which the center could improve. These included signage related to the MA-CORD target behaviors and promotion of water, access to healthy food options within the health center building, and walking challenges.

### *Women, Infants, and Children*

MA-CORD collaborated with the local WIC programs in the intervention communities (one program in each community) to implement evidence-based activities.<sup>19,40</sup> Intervention activities included: (1) training of 20 WIC nutritionists and nutrition assistants in best practices on assessment and counseling for childhood obesity prevention; (2) development of an obesity counseling toolkit for WIC providers; (3) encouraging direct referrals from WIC to HWCs; and (4) linking WIC providers to activities in other sectors.

The full-day childhood obesity prevention training for WIC nutritionists and nutrition assistants included: (1) a primer on best practices in childhood obesity prevention; (2) evidence on MA-CORD behavioral targets; (3) a refresher on participant-centered interviewing techniques; (4) an overview of practical approaches to counseling on obesity risk factors; (5) small-group sessions to improve motivational-interviewing skills; and (6) a review of existing WIC education materials to ensure that messaging aligned with MA-CORD. The full-day training was supplemented with an on-site, 2-hour train-the-trainer program focused on sleep and screen time, areas previously identified as high priority in a state-wide WIC needs assessment. Trainings were based on two early childhood obesity prevention interventions that had demonstrated efficacy.<sup>19,40</sup> After completion of the train-the-trainer program, WIC trainers delivered the on-site trainings to all local WIC staff in the intervention communities.

### *Early Child Care and Education*

Early care and education providers were trained as “mentors” to assist in engaging six licensed child care centers in each intervention community with a goal to reach approximately 1500 children, linking to an existing joint program established by the MDPH and the Massachusetts Department of Early Education and Care. Before

the intervention, mentors received training focused on the five MA-CORD behaviors and two evidence-based interventions to be implemented in the early care and education sector: I Am Moving, I Am Learning (IM/IL)<sup>41</sup> and Nutrition and Physical Activity Self-Assessment for Child Care (NAP SACC).<sup>42</sup> As with interventions across all the other sectors, community-level change was achieved by linking early care and education centers with other MA-CORD activities. In addition, mentors and child care directors were included in the Mass in Motion coalitions to link them to community-level activities.

IM/IL focuses on individual change through staff training to increase the duration and quality of moderate-to-vigorous PA offered and to promote healthy food choices in early child care settings. An accompanying parent education component of IM/IL also aims to address family-level behaviors.<sup>41</sup> NAP SACC is designed to influence individual- and system-level change by enhancing policies, practices, and environments in child care using an organizational assessment of 14 areas of nutrition and PA (including screen time) policy, practices, and environments to identify the strengths and limitations of the early care and education facility. Subsequent to the self-assessment, a mentor works with the early care and education staff to set goals for change and develop plans for follow-up actions to improve practice, through staff training and targeted technical assistance.<sup>43,44</sup>

### *Elementary and Middle Schools*

Intervention components in each city’s public elementary and middle schools aimed to improve the MA-CORD target behaviors among students and make sustainable changes to school wellness programs. The school intervention targeted changes at four levels: student; teacher; organizational; and environmental (Table 3). Intervention components included: (1) evidence-based health education curricula; (2) teacher training and resources on the curricula; (3) establishment of school wellness champions and school district coordinators for MA-CORD; and (4) provision of PA supplies.

The evidence-based curricula—Eat Well Keep Moving<sup>24,45</sup> (grades 4–5) and Planet Health<sup>17,46</sup> (grades 6–7)—employ lesson plans designed for use by teachers in various disciplines to encourage learning about nutrition, PA, and screen time while building skills in language arts, math, science, and social studies. Planet Health also features Power Down, a 2-week classroom or school-wide campaign to reduce screen time. Teachers in grades 4–7 were trained in the curricula with a focus on delivery of lessons most relevant to the five MA-CORD behaviors. A particular strength of the curricula is that they have been adapted to existing curriculum frameworks. Consequently, once teachers and administrators learn how to implement and integrate lessons into existing practice, there is a greater likelihood for long-term sustainability.

To promote school-wide wellness activities related to the MA-CORD behaviors, the school intervention

**Table 3. MA-CORD Intervention Activities in Public Elementary and Middle Schools**

Student	Teacher	Organizational	Environmental
<ul style="list-style-type: none"> <li>Evidence-based curricula—Eat Well Keep Moving and Planet Health—to equip students with knowledge and skills related to the MA-CORD targeted behaviors</li> <li>Consistent messages on targeted behaviors through posters and educational materials</li> </ul>	<ul style="list-style-type: none"> <li>Teacher training and provision of materials for implementing the Eat Well Keep Moving and Planet Health curricula</li> </ul>	<ul style="list-style-type: none"> <li>Implementation of evidence-based health education curricula with integration of lessons into core subject areas such as math, increasing likelihood of sustainability</li> <li>Establishment of a district coordinator and at least one staff member per school as the school's wellness champion to support implementation of wellness activities and serve as liaisons to MA-CORD</li> </ul>	<ul style="list-style-type: none"> <li>Provision of physical activity supplies to each school to promote increased time in moderate-to-vigorous physical activity</li> <li>MA-CORD posters and educational materials</li> <li>Media competition</li> </ul>

MA-CORD, Massachusetts Childhood Obesity Research Demonstration.

also included establishing a school district coordinator for MA-CORD in each city and at least one school wellness champion in each school who could link MA-CORD activities with each school's existing wellness plan. District coordinators and school wellness champions received technical assistance through MA-CORD to ensure that wellness activities were carried out and that purchased PA supplies were distributed to schools. They also played a primary role in coordinating the media competition, an intervention with cross-sector linkages between schools and the community described below under *Community Activities*.

#### *Afterschool Programs*

MA-CORD worked with approximately six afterschool programs in each city to implement changes at five levels: student; family; staff; organizational; and environmental/policy. As with the other sectors, representatives from these programs were also part of the local Mass in Motion coalition. Intervention components included: (1) a curriculum to help children develop healthy habits afterschool; (2) a multifaceted organizational change initiative; and (3) learning communities for afterschool programs (Table 4).

MA-CORD afterschool programs implemented Food and Fun Afterschool (FFA), a curriculum for afterschool program staff to use with children ages 5–12 years. FFA includes 11 units with subactivities, parent communications about behaviors at home, and resources for program change.<sup>20</sup> Second, the intervention included the Out of School Time Nutrition and Physical Activity (OSNAP) Initiative, which offers resources, skill building, and supports for afterschool programs to make practice, policy, and environmental changes around PA opportunities, foods/beverages, and screen time through program assessments and action planning.<sup>47</sup> OSNAP has been shown to be effective at increasing servings of water during afterschool snacks and decreasing calories from beverages.<sup>18,48</sup> To train staff and reinforce new concepts acquired through MA-CORD, a series of three learning communities were offered to foster cross-site communication, skill building, and problem solving.

#### *Community Activities*

Mass in Motion coalitions in each community incorporated policy, systems and environmental change strategies, activity groups, and media communications designed to reach all of the approximately 18,000 children ages 2–12 in

**Table 4. MA-CORD Intervention Activities in Afterschool Programs**

Student	Family	Program staff	Organizational	Environmental/policy
<ul style="list-style-type: none"> <li>Evidence-based Food and Fun curriculum to promote MA-CORD target behaviors</li> <li>Consistent messages on targeted behaviors through posters and educational materials</li> </ul>	<ul style="list-style-type: none"> <li>Food and Fun and OSNAP Initiative parent educational materials on healthy habits</li> <li>OSNAP guidance and templates for communicating policies to families</li> </ul>	<ul style="list-style-type: none"> <li>Staff resources and tools to implement Food and Fun and OSNAP</li> <li>Learning communities to facilitate communication and problem solving and train directors and staff on developing action plans, setting goals, writing policies, implementing activity breaks, healthy celebrations and fundraising, and staff role modeling</li> </ul>	<ul style="list-style-type: none"> <li>Implementation of evidence-based curriculum and organizational change initiative</li> <li>Practice assessments and development of action plans</li> <li>Practice changes, such as serving fruits and vegetables at snack</li> </ul>	<ul style="list-style-type: none"> <li>Policy self-assessments</li> <li>Policy writing resources</li> <li>Development and/or improvement of written policies</li> <li>Environmental changes, such as availability of cups for water</li> </ul>

MA-CORD, Massachusetts Childhood Obesity Research Demonstration; OSNAP, Out of School Nutrition and Physical Activity Initiative.



the two cities, as well as their families. The community interventions were adapted for each city by its Mass in Motion municipal wellness coalition, building on existing initiatives and the particular assets and challenges faced by that community. The interventions were intended to change community norms, policies, practices, and aspects of the environment to support and sustain healthy living during the period of the project and be sustainable over the long term.

One key component of the community-level intervention was the use of media. MA-CORD supported a student media competition in the two cities, using a youth empowerment approach. The media competition was implemented to increase awareness of MA-CORD while promoting the target behaviors in each community. Students from elementary and middle school classes and afterschool programs were invited to submit videos, song/rap lyrics, or artwork and were judged on integration of MA-CORD goals, creativity, originality, clarity of message, and utility. Gift cards or prizes were provided to the winning schools, teachers, and students. The competition, including the winning entries, was publicized to the full community on the school district websites and through the Mass in Motion coalitions' communication channels. A student media competition was employed because empowering youth to develop and implement media efforts has positive outcomes, including increased self-efficacy and the development of a stronger sense of responsibility to others, among youth through the production of knowledge that impacts policy and action in their communities.<sup>49</sup>

A text messaging campaign was implemented to spread the MA-CORD brand and messaging on a larger community scale. The campaign was promoted through purchased advertising space and time in various media channels, including small billboards and transit ads, and handouts for use in community settings. MA-CORD also partnered with the local parks and recreation departments in each community to implement a "summer passport" program in which kids completed activities to earn a small prize.

Another example of a community-level strategy employed by the Mass in Motion coalitions was Safe Routes to School.<sup>50</sup> Mass in Motion coalitions worked with local school officials, municipal leaders, community organizations, and a representative of the Massachusetts Department of Transportation's Safe Routes to School program to conduct School Route Analyses and Walkability and Bikeability surveys of the primary routes. The goal was to create a list of short- and long-term improvements—including traffic calming, the creation of traffic-separated cycle tracks, and other "complete streets" attributes—that make parents feel it is safer for their children to walk or bike to school.

### Evaluation

MA-CORD will be evaluated using a combination of pre- and post-time series and quasi-experimental designs

after the completion of the 2-year intervention in September 2014. A detailed summary of the evaluation of MA-CORD is outlined in Davison and colleagues<sup>11</sup> and is summarized briefly below. The MA-CORD evaluation will utilize data from multiple surveillance systems (*i.e.*, electronic health, WIC, and public elementary and middle school records) coupled with supplemental longitudinal survey data for a subsample of individuals from each of those systems. This approach combines the strengths of internal validity gained from a within-person design with those of generalizability gained from surveillance data while making efficient use of pre-existing data-gathering systems and minimizing respondent burden in the intervention and comparison communities.

Within the intervention communities, primary outcome data measuring BMI and the five target behaviors are being collected in the CHC, HWC, WIC, and public elementary and middle schools. Cost-effective analyses are also planned, and supplemental funding will allow for qualitative and quantitative process evaluation to be conducted across sectors. The primary outcome measures include children's BMI, the five behaviors targeted by MA-CORD, children's health-related quality of life, and parent's satisfaction with healthcare services.

### Discussion

MA-CORD's innovation is demonstrated through its high level of community coordination and use of multiple interventions that have demonstrated efficacy across various sectors. Further, by using consistent messaging and materials, all sector-wide activities were focused on the same five behavioral targets, which have strong evidence for association with childhood obesity. Emerging evidence indicates that effective and sustainable improvement in population health can be achieved through better integration and partnerships between primary care and community/public health programs.<sup>12</sup> Substantial evidence also suggests that single-sector interventions alone may be limited in their effectiveness in reducing childhood obesity. Sustainable changes to shift children's growth trajectories will require *coordinated*, multisector approaches, such as those being tested in MA-CORD, to impact environmental influences on obesity.<sup>10</sup> Such efforts should ideally include cost-effective policy and programmatic interventions across multiple sectors that are feasible and sustainable.<sup>9</sup>

A major strength of the MA-CORD project was the key role the state's department of public health played in developing the multisector intervention with a specific focus on both sustainability and replicability through existing mechanisms. For example, elements of the WIC intervention found to be effective can be replicated statewide immediately after the study through department policy directives. Similarly, community-level initiatives identified as beneficial can be incorporated into the work plans of the other 49 Mass in Motion communities. The explicit

linking of MA-CORD with MDPH strategic priorities ensures the sustainability of its findings.

As with all studies, MA-CORD has limitations. First, given the nature of a multilevel, multisector community intervention, it did not use a randomized or blinded design. Whereas the study was designed to produce fidelity to the evidence-based clinical, school, afterschool, and child care interventions across the two intervention sites, the community-level policy change activities reflected the specific needs and assets of the intervention communities and therefore were not identical. One comparison community was selected as a representative community that matched the community characteristics of Fitchburg and New Bedford as closely as possible. No comparison community could be a perfect match. There was also limited control over what wellness interventions were undertaken by the comparison community during the study period. Further, though we only collected longitudinal behavioral data from one community to serve as a comparison, we were able to compare BMI results with school districts across the state. Despite these limitations, MA-CORD reflects best practice in the design and evaluation of multilevel interventions and will add significantly to the knowledge base in addressing childhood obesity.

## Conclusions

MA-CORD implemented a multisector, multilevel intervention to prevent or reduce obesity among underserved children ages 2–12 years in Massachusetts. The study was informed by conceptual frameworks that guide healthcare system changes and aim to reduce the childhood energy gap. If successful, MA-CORD will provide new and sustainable approaches for accelerating the adoption of obesity prevention best practices in clinical and public health systems that serve a socioeconomically diverse population of children.

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