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Evaluation of a Primary Care Intervention on Body Mass Index: The Maine Youth Overweight Collaborative

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Abstract

Background: We evaluated the impact of a brief primary-care–based intervention, The Maine Youth Overweight Collaborative (MYOC), on BMI (kg/m^2) *z*-score change among participants with obesity (BMI $\geq$95th percentile for age and sex), overweight (BMI $\geq$85th and $<$95th percentile), and healthy weight ($\geq$50th and $<$85th percentile).

Methods: A quasi-experimental field trial with nine intervention and nine control sites in urban and rural areas of Maine, MYOC focused on improvements in clinical decision support, charting BMI percentile, identifying patients with obesity, appropriate lab tests, and counseling families/patients. Retrospective longitudinal record reviews assessed BMI *z*-scores preintervention (from 1999 through October 2004) and one postintervention time point (between December 2006 and March 2008). Participants were youth ages 5–18 having two visits before the intervention with weight percentile greater than or equal to 95% ($N=265$). Secondary analyses focused on youths who are overweight ($N=215$) and healthy weight youth ($N=506$).

Results: Although the MYOC intervention demonstrated significant provider and office system improvements, we found no significant changes in BMI *z*-scores in intervention versus control youth pre- to postintervention and significant flattening of upward trends among both intervention and control sites ($p<0.001$).

Conclusions: This brief office-based intervention was associated with no significant improvement in BMI *z*-scores, compared to control sites. An important avenue for obesity prevention and treatment as part of a multisector approach in communities, this type of primary care intervention alone may be unlikely to impact BMI improvement given the limited dosage—an estimated 4–6 minutes for one patient contact.

Introduction

High rates of obesity among children and adolescents call for intervention strategies that are broad based and include multiple sectors of society.[1–3] One important focus for intervention is the primary healthcare setting, where providers already see most children and youths in the United States. Though primary care setting interventions alone may not be sufficient to change growth trajectories, they represent an important place where messages to improve nutrition and physical activity (PA) can create awareness and motivate change that can be reinforced across community sectors in a powerful way.[4] Current gaps in care and provider attitudes highlight opportunities.[5] Providers are not widely measuring BMI percentiles for children, are not delivering preventive

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behavioral messages, nor are they providing appropriate medical evaluation for obese children. There is also a documented lack of provider confidence (or self-efficacy) for addressing obesity in children, as well as addressing lifestyle issues with children and their families.[6–10] Unfortunately, there is very limited evidence for effective clinical interventions to prevent or treat obesity in primary care settings or routinely deliver preventive messages related to healthy nutrition and PA.[11–13] One major limitation is the very ''low dose'' of intervention possible because of the limited time parents/guardians and children spend with a primary care provider (PCP).

The Maine Youth Overweight Collaborative Intervention

The Maine Youth Overweight Collaborative (MYOC) is a primary-care–based intervention implemented from 2004 to 2009 over three phases (52 months) and targeted youth and their families ages 2–18. Phase 1, with 12 original sites, began in November 2004 and ended in November 2006. Phase 2, with 10 additional sites, began in November 2006 and ended in May 2008. Phase 3, with an additional 14 sites, began in May 2008 and ended in May 2009.

Overall, the MYOC intervention took place in 36 sites in both urban and rural areas of Maine. Intervention materials were based on the conceptual framework of the Chronic Care Model derived from the Institute for Healthcare Improvement's Breakthrough Series Collaborative model.[14–16] Key change components of the MYOC intervention included: (1) approximately one 1.5-day learning session (for the practice team to attend) every 6 months; (2) 4–6 minutes during each well-child visit for the healthcare provider to deliver the 5210 healthy habits message (five servings or more of fruit and vegetables; 2 hours or less of screen time; 1 hour or more of PA; and zero sugar-sweetened beverages [SSBs]), to promote self-management skills, and set goals; (3) 5 minutes during each well-child visit for another practice team member (*e.g.*, medical assistant or nurse) to measure height and weight for BMI; (4) two 30-minute meetings per month to assess team progress and discuss partnerships with community and state organizations; (5) one to two 1-hour conference calls per month; and 6) a 1-hour site visit every few months. The MYOC intervention improved clinical office systems, provider knowledge, attitudes, skills, and practices, and patient experiences and was shown to add an average of 4 minutes to the overweight patient well-child encounter and 6 minutes to the obese patient encounter, on average.[17] All tools and the Key Change Package and Evaluation Logic model are available online.[18] The low dose of this intervention could mean that the chance of behavioral change (*e.g.*, reduced intake of SSBs or reduction of television [TV] viewing) was limited. Previous research has indicated that learning collaboratives were associated with changes in physician practices, as well as evidence for increased parents' conversations with clinicians on the targeted topics.[19] We designed a study with a relatively large sample to show potentially small effects on changing BMI *z*-score trajectories in children and youth.

Methods

Design

The focus of the current analysis is on data collected during the second phase of MYOC, which began in September 2006. Intervention sites had been participating in MYOC since November 2004, whereas control sites started to implement the intervention in September 2006. Our focused efforts at the start of phase 2 allowed us to compare patient growth trajectories from intervention sites to patient growth trajectories in sites where no intervention had yet occurred. The design of this evaluation was quasi-experimental,[20] with nine intervention (the 9 of 12 original sites that also participated in phase 2) and nine controls sites (9 of the 10 new phase 2 sites); sites were not randomized to intervention condition. The sites were self-selected. Intervention and control sites can be considered similar in demonstrating an interest in improving systems of care related to childhood obesity and appear similar on a number of characteristics. The intervention sites reported an average of 4600 children as having a medical home at that site; control sites reported an average of 4400; the average percentage of patients with MaineCare (Maine's version of Medicaid) was 45% in the intervention sites and 34% in the control sites. To check for potential differences in site characteristics, we compared the intervention sites with the three sites from MYOC phase 1 not participating in this new collaborative on survey data collected from parents of patients in the spring of 2006. We looked at the four questions asking about whether a doctor, nurse, or anyone at the site talked to the parents about each of the 5210 behaviors at the child's last visit. There were no significant differences between groups.

Retrospective data collection spanned the period 1999–2008. The primary outcome data were collected by retrospective chart reviews that took place in intervention and control sites during the period March 2007–March 2008. For a period of 1 year, practice personnel selected a sample of up to 50 charts per month of patients ages 2–18 years, who had completed a well-child visit. Practices were instructed to attempt to collect samples that were 80% from 8- to 18-year-olds, 10% from 5- to 7-year-olds, and 10% from 2- to 4-year-olds. Most practices collected data on paper forms. Data from these forms were electronically scanned and double data entered to limit coding errors. Seven practices (six intervention and one control) collected data electronically using the MaineHealth Clinical Improvement Registry (CIR). This registry is a secure database that allows Maine practices to enter and view patient information through website access. These data are available for use in individual clinical care and can be queried for data analysis. The CIR is able to track clinic visit data, lab results, and specific data related to chronic illnesses. No identifiable information was collected in either process.

Chart reviews were completed for 3009 intervention subjects and 3116 control subjects; of these, 569 (19%) intervention and 417 (13%) control met eligibility criteria. Major reasons for exclusion were: (1) less than age 5 (at beginning of intervention period ($N = 857$ intervention; 977 control); (2) no baseline BMI measure ($N = 600$ intervention; 500 control); (3) no valid post weight and height ($N = 107$; 54); and (4) implausible height loss ($N = 26$; 82).

The primary study focus was on children and youths ages 5–18 identified with obesity at the last two well-child visits before the start of the intervention ($N = 265$) in November 2004. The primary aim was to determine whether the MYOC intervention yields greater improvements in the primary outcome of BMI *z*-score, compared to the control condition. Secondary aims were to determine whether the MYOC intervention yields greater improvements in the primary outcome of BMI *z*-score, compared to the control condition, for children in the 50th–85th ($N = 506$) and 85th–95th ($N = 215$) percentile categories. Thus, we stratified the analyses into these three groups based on baseline BMI percentile. This stratification also provided additional assurance that, at baseline, intervention and control subjects were well matched in terms of baseline BMI *z*-score history.

Data

Study data were collected by retrospective chart reviews. Data collected from charts included birth date and date of examination (coded in year/month), weight, and height. In addition, for the most recent visit before the start of the intervention, and then for the visit at follow-up, data were collected about BMI and BMI percentile calculation, obese weight classification, and blood pressure assessment. Chart review data were abstracted by site personnel onto data forms and double entry coded. Age was calculated using birth date and date of examination; gender was noted from the chart. We defined obese following CDC guidelines and used CDC SAS software (SAS Institute Inc., Cary, NC).[21,22] We created a longitudinal data set to examine change over time for the subjects from pre-MYOC (1999 through October 2004) to post-MYOC (December 2006–March 2008). The study received institutional review board approval by the Committee on Human Subjects at the Harvard School of Public Health (Boston, MA).

Statistical Analysis

The primary hypothesis is whether the MYOC intervention among youths with obesity yields greater improvements in the primary outcome of BMI *z*-score, compared to the control condition. Because intervention and control sites were not randomized, a concern is control for potential differences between participants in the two conditions. Because the best predictor of BMI *z*-score (BMI*z*) will be past BMI*z* and BMI*z* trajectory, our main strategy for control for confounding (beyond selection of similar intervention and control sites) is taking into account both baseline BMI*z* as well as each individual's BMI*z* trajectory before baseline. By controlling for multiple preintervention values of the dependent variable, we were able to more effectively control for the influence of other nonmeasured variables on BMI by controlling for the individual pretrends in BMI*z*.

We used SAS PROC MIXED[23] to test whether the MYOC intervention among youths with obesity yields greater improvements in the primary outcome of BMI *z*-score, compared to the control condition. For these analyses, we constructed person-period data sets[24] so that repeated BMI*z* measures at the person level could be analyzed, taking into account the clustering of observations within person over time and within site. Primary subjects were required to have two consecutive BMI percentiles greater than or equal to the 95th percentile before the November 2004 initiation of MYOC. This provided a close match of preintervention trajectories in intervention and control subjects. The rationale for the secondary aims examining children falling within the 50th–84th and 85th–95th percentiles was similar. We used linear mixed models with a random intercepts and slopes model, assuming compound symmetry, and using the repeated function to account for the nesting of repeated observations within youth. The dependent variable was BMI *z*-score. Our model included terms for the year of observation, change following the intervention, the intervention programs (= 1; vs. control = 0), and the period by intervention interaction. We controlled for potentially confounding variables, including age (binary variable coded 1 if 6–11, 0 otherwise); gender was included as a binary variable (0, female; 1, male).

The study was powered by assuming the prevalence of individuals with obesity in intervention and control sites and the standard deviation (SD) of change in BMI*z*. We also assumed low levels of clustering within site (rho of 0.01) and substantial correlation of BMI *z*-score over time ($r = 0.50$). This led to an estimated sample size of 400 intervention and 400 control site participants, and we assumed we could detect an effect of 0.27/1.25 or 0.22 of a SD.[24]

Results

Youths with obesity in both groups were similar before the start of MYOC intervention in November 2004 (Table 1). Both intervention and control groups had an average BMI percentile of 98 and had an average of three visits—meaning three data points before November 2004. Youth characteristics in intervention and control sites in the overweight and healthy weight groups were also similar (Table 1), with the exception of a lower percentage of males in the intervention group among the healthy weight subjects ($p < 0.01$).

We found a decrease in growth of BMI *z*-scores following the start of the intervention (Table 2) for subjects with obesity in both intervention and control sites (–0.028; $p < 0.001$). A statistically significant decline in the rate of increase of BMI *z*-score was found for the subjects with overweight and healthy weight as well. In all cases,

Table 1. Youth Characteristics among Intervention (I) and Control (C) Sites for the Children with Obesity (>95th Percentile), Who Are Overweight (>85th and <=95th Percentile), and Healthy Weight (>50th and <85th Percentile) Maine Youth Overweight Collaborative Study

BMI percentile	>50th<=85th		>85th<=95th		>95th percentile	
	I* N=278	C* N=228	I N=130	C N=85	I N=161	C N=104
Males, %	44	57	48	48	55	64
Age at November 2004, mean (SD)	9.9 (3.2)	10.0 (3.2)	10.4(3.3)	10.6 (3.2)	10.5 (2.9)	10.2 (3.2)
12+ years at November 2004, %	29	32	37	39	33	34
Age at last previsit, mean (SD)	9.2 (3.3)	9.2 (3.3)	9.6 (3.3)	9.8 (3.3)	9.8 (3.0)	9.3 (3.2)
Months from last previsit to November 2004 (start of intervention)	9.1 (6.5)	10.0 (7.3)	9.0 (6.7)	9.3 (6.9)	8.8 (6.4)	10.3 (7.8)
Anthropometrics at last previsit						
Height (m), mean (SD)	1.4 (0.2)	1.4 (0.2)	1.4 (0.2)	1.4 (0.2)	1.4 (0.2)	1.4 (0.2)
Weight (kg), mean (SD)	34.3 (14.3)	34.1(13.5)	42.7 (17.9)	43.6 (17.5)	56.5 (21.5)	52.2 (22.0)
BMI (kg/m^2), mean (SD)	17.9 (2.0)	17.9 (2.0)	21.0 (2.9)	20.9 (2.8)	26.5 (4.8)	25.1 (4.5)
BMI (z-score), mean (SD)	0.51 (0.28)	0.51 (0.29)	1.4 (0.16)	1.3 (0.18)	2.1 (0.36)	2.2 (0.31)
BMI percentile, mean (SD)	69 (9.8)	69 (9.8)	91 (2.6)	90 (3.0)	98 (1.2)	98 (1.3)
No. of previsits (before November 2004), mean (SD)	3.3 (0.8)	3.6 (1.0)	3.3 (0.8)	3.5 (0.9)	3.3 (0.8)	3.4 (1.0)

SD, standard deviation.

BMI *z*-score was still increasing after the start of the intervention, but at a lower level. We found no evidence of an intervention effect. For obese subjects, the estimate of intervention effect was 0.0008 ($p=0.81$); for overweight subjects, the estimate of intervention effect was 0.0067 ($p=0.10$); for healthy weight subjects, the estimate of intervention effect was 0.0025 ($p=0.41$).

What size of an effect on relative weight could this evaluation have detected? The 95% confidence interval (CI) of the intervention effect for the subjects with obesity is approximately 0.014 BMI*z* units. If we assume a 10-year-old female at the 95th percentile of BMI *z*-score with a weight of 96.1 lbs and height of 54.3 inches, a change in 0.02 BMI *z*-score would represent a change in weight of

Table 2. Coefficient Estimates from Linear Models Predicting BMI z-Scores Before and After Initiation of MYOC Intervention, Intervention, and Control Sites for Three Stratified Populations

Coefficient[a]	Stratified models predicting BMI z-score change pre to post for three stratified populations		
	>50th<=85th	>85th<=95th	>95th percentile
Preintervention increase in BMI z-score per year (95% CI; p value)	0.048 ($p<0.0001$)	0.062 ($p<0.0001$)	0.067 ($p<0.0001$)
Change in BMI z-score per year after intervention starts (95% CI; p value)	−0.013 (−0.02 to −0.006; $p<0.0001$)	−0.030 (−0.039 to −0.021; $p<0.0001$)	−0.028 (−0.036 to −0.02; $p<0.0001$)
MYOC intervention effect (change in intervention sites compared to change in controls) (95% CI; p value)	0.002 (−0.0034 to 0.0084; $p=0.41$)	0.0067 (−0.0013 to 0.15; $p=0.10$)	0.0008 (−0.0061 to 0.0077; $p=0.81$)

[a]Three coefficients for each model are provided. Also controlled are: terms for the year of observation; change following the intervention; the intervention programs (= 1; vs. control=0); and the period by intervention interaction, age (binary variable coded 1 if 6–11, 0 otherwise), and gender (binary variable: 0, female; 1, male).

MYOC, The Maine Youth Overweight Collaborative; CI, confidence interval.

approximately 0.5 lbs, so this is approximately the level of change our evaluation could have detected. This small change of 0.5 lb over a couple of years of intervention represents an energy imbalance of approximately 9.4 kcal/day.[25] Changes in weight we could detect in this way would be even smaller in the 50th–85th percentile for age and gender range. Thus, it seems the design was well powered to detect small changes in outcome.

Discussion

Our results show no impact of the intervention on BMI *z*-score, as well as a flattening of increasing BMI *z*-scores among children with obesity, overweight, and healthy weight in both intervention and control sites following initiation of MYOC. Our results mirror data from the Maine Youth Risk Behavior Survey, demonstrating an overall decreasing trend in the rate of obesity prevalence among middle and high school students since 2005.[26] In comparison, neighboring states Vermont and New Hampshire, for example, continued to see increasing trends among high school students through 2009 and 2011, respectively.[26] Maine may be unique among states, having devoted substantial funding to the Healthy Maine Partnership (HMP) coalitions to address behavioral risk factors for chronic disease across community sectors beginning in 2000, and their work may have played a part in these changes. Though we have no direct evidence for contamination[20] or spread of the MYOC intervention to control sites before controls actually started intervention work in 2006, this must also be considered as a potential alternative explanation for any observed difference because of the wide publicity given to the MYOC learning collaboratives. Though we monitored high-level components of MYOC implementation and dosage (*e.g.*, number of learning sessions and site visits provided), we do not have strong evidence for fidelity to specific intervention protocols used in MYOC (such as adherence to the brief focused negotiation protocol).

Changes within the primary care office setting, over time, can contribute to efforts in other community sectors to promote child health and decrease chronic disease. However, evaluations of primary care interventions are not widespread, and even more substantial interventions do not show large effects.[27] It may not be surprising that a 4- to 6-minute intervention taking place at primary care visits does not, by itself, produce weight change. Increases in obesity among children and adolescents call for intervention strategies that are broad based, including multiple sectors of society.[28–30] Even though our initial phase 1 MYOC sites can be considered relatively unique "early adopters,"[31] we were not able to measure an effect on BMI from the MYOC intervention alone. Though we were not able to quantify intervention dosage and look for effects based on dose, during the follow-up period of 15 months, we estimate, based on past visits, that the typical dose was one visit.

Similar findings have emerged in other areas: low-to-moderate-intensity physician counseling has not, by itself, been able to achieve clinically meaningful weight loss.[32] One potentially promising intervention strategy is grounded in an electronic medical record system compelling providers to give focused advice on clear, simple, and specific behavioral targets (*e.g.*, get sugary beverages out of the house) by PCPs.[33] After all, documented primary care success[34] with tobacco cessation concentrated clinician's efforts on simple messages to patients—to quit smoking. MYOC focused on office system changes using the Care Model framework and promoted provider patient interactions based on brief focused negotiation, asking patients to discuss their readiness to address lifestyle issues of their choosing and set varied individual behavioral targets with patients. This may have led to less fidelity in delivering the intervention and less clarity on changes parents should work on with their children.

An important outcome of the MYOC intervention is the spread of clinical childhood obesity prevention and treatment efforts throughout Maine and nationally. The idea for MYOC was born with a discussion of the need to address childhood obesity in the primary care setting after a conference on the topic in September 2003. Funding for the initial phase was secured and intervention began in November 2004, with an initial 12 practices representing 53 providers and over 80,000 patients. A second phase of MYOC begun in 2006 saw an additional 10 practices join MYOC. By the third phase of MYOC, which culminated in May 2009, 37 practices and 235 providers had implemented MYOC, representing over 189,000 patients in Maine alone. Because of MYOC's broad base of participants and partners, key MYOC improvement activities were sustained postintervention through other organizations and efforts, such as Maine's Healthy Maine Partnerships and the Maine Chapter of the American Academy of Pediatrics. MaineHealth, the leading healthcare system in Maine, invested heavily to disseminate MYOC key changes to its community practices through Let's Go!. The intervention also spread to numerous other states with the technical assistance of MYOC staff. Through its state-wide multisector efforts, the Let's Go! program expanded on the MYOC messages and improvements, engaging 133 of 321 practices caring for children statewide, or 41% of practices by 2013. MYOC has also been adopted and adapted by providers nationwide and spread through the American Academy of Pediatrics, The National Cancer Institute R-Tips (http://rtips.cancer.gov/rtips/programDetails.do?programId=2522963), and elsewhere. It is commonplace to hear about the 5210 message through national forums and trainings from PCPs around the country (Voices for Children—RWJ webinar, July 2013). The widespread reach of key MYOC messages and improvements 10 years after initiation of efforts demonstrates the value of broad partnerships and the importance of primary care organizational and system improvements. Additionally, the successful implementation and diffusion of MYOC may, in part, be predicated on its adherence to factors understood to be important for successful implementation of prevention programs. These factors include monitoring the implementation fidelity and dose of a program; employing a sound prevention delivery system or organizational structure to lead the implementation of the program; and programs', providers', and community characteristics that facilitate implementation and spread.[31,35,36] We closely monitored key components of MYOC implementation and dose in participating sites between 2004 and 2009. Let's Go! monitored implementation and provided incentives for practices to adapt key MYOC improvements post-2009.[37] First, the Maine Harvard Prevention Research Center and then Let's Go! provided sound organizational structures to lead implementation efforts. MYOC provided information and training to fill practice and system gaps identified by providers and office staff, and MYOC providers from the original cohort of seven were themselves innovators in developing the MYOC approach to obesity prevention and treatment. Finally, the HMPs were key collaborators working in child care, school, afterschool, parks, grocery venues, YMCAs, and other community settings where consistent messages across ecological sectors were able to mutually reinforce behavior change.

Even with many MYOC improvements sustained, there is still much opportunity for practice improvement. Brief focused negotiation and behavioral goal-setting skills, potentially powerful tools to assist in patient behavior change,[38–40] leave room for improvement, and providers sorely need resources in the community to support their patients' efforts once they leave their practices.

Conclusions

The MYOC intervention alone did not improve BMI *z*-score in intervention versus control sites. An important avenue for obesity prevention and treatment as part of a multisector approach in communities, this type of primary care intervention alone may be unlikely to impact BMI improvement given the limited dosage (an estimated 4–6 minutes per visit) of patient contact. Alternatively, perhaps other similar approaches could produce an effect if better strategies for intervention delivery are developed. Whereas clinical decision support and family management of risk behaviors are promising primary-care–based approaches to improving diet and PA and reducing TV viewing and obesity risk among children and youth, more effective primary care interventions embedded in broader multisector approaches need to be developed.

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