Improving Self-Regulation for Obesity Prevention in Head Start: A Randomized Controlled Trial

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abstract

OBJECTIVES: To determine the effect of an intervention to improve emotional and behavioral self-regulation in combination with an obesity-prevention program on the prevalence of obesity and obesity-related behaviors in preschoolers.

METHODS: This was a cluster-randomized intervention trial in Head Start (HS) classrooms conducted in each of 4 academic years from 2011 to 2015. Participants (697 children; 49% boys; mean age: 4.1 ± 0.5 years; 48% white, 30% African American, 12% Hispanic) were randomly assigned by classroom to 1 of 3 intervention arms: (1) HS + Preschool Obesity Prevention Series (POPS) + Incredible Years Series (IYS) (HS enhanced by the POPS [program targeting evidence-based obesity-prevention behaviors] and the IYS [program to improve children's self-regulation]), (2) HS+POPS, or (3) HS. Primary outcomes were changes in prevalence of obesity, overweight/obesity, BMI *z* score, and teacher-reported child emotional and behavioral self-regulation; secondary outcomes were dietary intake, outdoor play, screen time, and parent nutrition knowledge and nutrition self-efficacy.

RESULTS: HS+POPS+IYS improved teacher-reported self-regulation compared with HS+POPS ($P < .001$) and HS ($P < .001$), but there was no effect on the prevalence of obesity (16.4% preintervention to 14.3% postintervention in HS+POPS+IYS versus 17.3% to 14.4% in HS+POPS [$P = .54$] versus 12.2% to 13.0% in HS [$P = .33$]). There was no effect of HS+POPS compared with HS alone ($P = .16$). There was no effect on other outcomes except for sugar-sweetened beverage intake (HS+POPS+IYS resulted in a greater decline than HS; $P = .005$).

CONCLUSIONS: An intervention for parents and children to improve HS preschoolers' emotional and behavioral self-regulation in combination with an obesity-prevention curriculum did not reduce obesity prevalence or most obesity-related behaviors.

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Dr Lumeng conceptualized the study and drafted the initial manuscript; Drs Miller, Horodynski, Brophy-Herb, Contreras, and Peterson conceptualized the study and provided critical review of the manuscript; Ms Lee coordinated data collection and provided critical review of the manuscript; Ms Sturza and Dr Kaciroti carried out statistical analyses and provided critical review of the manuscript; and all authors approved the final manuscript as submitted.

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WHAT'S KNOWN ON THIS SUBJECT: Less-optimal emotional and behavioral self-regulation has been associated with increased obesity risk in children.

WHAT THIS STUDY ADDS: An intervention to improve Head Start preschoolers' emotional and behavioral self-regulation in combination with an obesity-prevention curriculum did not reduce obesity prevalence or most obesity-related behaviors.

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An estimated 23% of US preschool-aged children are overweight or obese,[1] with higher rates among lower socioeconomic groups.[2] Interventions that could be widely disseminated are needed, yet few obesity-prevention programs for preschoolers have been tested in randomized trials,[3] and just 1 such program designed for delivery to US low-income preschoolers in the classroom setting has been described in the literature.[4–6] This intervention, which focused on promoting healthy nutrition and physical activity behaviors, had effects in some,[4] but not all,[5] racial/ethnic groups. Furthermore, very few of these interventions have included a substantial component for parents and their results have been mixed.[3,7] New approaches that could generate stronger and more consistent effects are needed.

Self-regulation is a multidimensional construct that encompasses emotional and behavioral regulation.[8,9] Emotional self-regulation, or the capacity to remain calm in challenging or frustrating situations, is a key aspect of self-regulation. Poor emotional regulation, negativity, or negative reactivity in early childhood have been linked with obesity risk.[10] Impulsivity, or a lack of inhibitory control, is an indicator of poor behavioral self-regulation. Impulsivity has been linked with child obesity risk with a moderate effect size in meta-analysis.[11] Few studies have examined whether poor self-regulation in general confers obesity risk or if the effect is limited only to poor self-regulation in relation to food.[12–14] Results have been equivocal and the topic remains an active area of research.

Self-regulation, considered as emotional and behavioral self-regulation, may confer obesity risk through several mechanisms. Poor emotional self-regulation is theorized to increase obesity risk through eating behavior, sedentary behavior, physical activity, and physiologic stress pathways (eg, cortisol).[15] Poor behavioral regulation has been linked to greater high-calorie food consumption as well as sedentary behavior.[16] Therefore, improving children's self-regulation may be a novel strategy for preventing obesity. At least 2 studies have shown that an intervention to improve self-regulation had an ancillary effect of reducing the prevalence of obesity years later.[17,18]

The primary aim of this study was to test the following hypotheses: (1) that an education program targeting evidence-based obesity-prevention behaviors embedded in Head Start (HS), a federally funded preschool program for low-income children (the Preschool Obesity Prevention Series [POPS]; HS+POPS[19]), would be effective in reducing the prevalence of obesity, overweight/obesity, and BMI *z* score compared with HS alone and that (2) adding an intervention to improve self-regulation (the Incredible Years Series [IYS]; HS+POPS+IYS[20]) would be more effective than HS+POPS or HS.

METHODS

Study Design

The Growing Healthy Study[19] was a cluster-randomized community-based intervention trial in urban and rural Michigan HS programs occurring during the 4 academic years between the fall of 2011 and spring of 2015. Three separate HS agencies each had 6 classrooms (2 classrooms in each of 3 study arms) participate during each academic year. Each classroom had a 2-teacher teaching team. In the spring of 2010, the study team explained the 3 study arms to the teachers and each HS agency director selected 6 teaching teams (12 teachers) who were willing to participate and gave written informed consent for randomization. The 6 teaching teams (hereafter referred to as "classrooms") within each agency were randomly assigned by using an automated system overseen by the study statistician to 1 of 3 study arms, with the limitation that each agency have 2 classrooms allocated per study arm and that the classrooms were located in different communities to prevent cross-contamination. The 3 study arms were as follows: (1) HS, (2) HS+POPS, and (3) HS+POPS+IYS.

Families were assigned to a study arm as a function of their classroom assignment, which was based on the location geographically closest to their home address. All primary and secondary outcome measures were collected both pre- and postintervention. Preintervention data were collected in the fall (September–October) and postintervention data in the spring (April–May) of a single academic year for each participant. Data collectors and interventionists did not interact, and data collectors were blinded to study arm. Families received $150 for participating in data collection activities; families were not compensated for participating in the interventions. Data collection occurred in the home and classroom. This study was approved by the institutional review boards of the University of Michigan and Michigan State University. After classroom assignment by HS, families received written and verbal information about the study and provided written informed consent. Exclusion criteria were significant medical problems or developmental disabilities, foster care, or nonfluency in English. Forty-two children attended HS for 2 years; only data from their first year of attendance were included in the analysis.

Interventions

Interventions included complementary but separate activities for parents (outside school hours) and children (during school).

Transportation and child care were provided as needed.

The POPS,[19] based on social cognitive theory, was developed to provide developmentally and culturally appropriate, evidence-based,[21,22] and coordinated obesity-prevention messages to preschoolers and their parents. Behavioral goals included increased frequency and variety of fruit and vegetable intake, reduced sugar-sweetened beverage consumption, reduced screen time, cooking healthy meals at home, eating family meals, and eating healthy foods when eating out. Both parent and child components were delivered from October to January by a master's-level nutrition educator, who received 1.5 days of training, in collaboration with the classroom teacher, who received 2 hours of training. The preschool classroom component consisted of 6 lessons incorporating children's stories and associated classroom activities implemented by teachers, classroom cooking experiences implemented by the nutrition educators partnering with the teachers, and goal setting, jointly supported by both the teachers and nutrition educators. The parent component implemented by the nutrition educator consisted of eight 75-minute lessons that incorporated a cooking activity and focused on building knowledge and self-efficacy, as well as developing and practicing skills and strategies. Fidelity was assessed by video observers (parent sessions) and live observers (classroom) trained to inter-rater reliability in recording observed target behaviors (intraclass correlation coefficient > 0.70).

The IYS is an evidence-based program that emphasizes positive behavioral management techniques and enhances self-regulation in young, low-income children.[20,23,24] The IYS uses observational learning and reinforcement techniques and emphasizes behavior-change strategies such as descriptive commenting about child behavior, role-plays, and coaching to encourage and model positive behavior.[25] The IYS has been shown in multiple randomized controlled trials that used measures comparable to those used here to improve children's emotional and behavioral self-regulation with moderate to large effect sizes.[26,27] Both parent and child components were delivered from October to April by a master's-level mental health specialist trained in the IYS program, in collaboration with teachers who participated in IYS teacher training. The preschool classroom component consisted of 60 lessons followed by smaller group activities that addressed self-regulation skills, problem-solving strategies, and prosocial behavior. The parent component consisted of lessons delivered by using video vignettes in 14 group sessions or 10 home visits that were reinforced with homework and follow-up phone calls. Fidelity was assessed by video coders trained to reliability.

Data Collection Procedures

Primary Outcomes

Research staff measured participants without shoes or heavy clothing. Measures were taken twice and averaged. BMI was calculated and child BMI *z* score derived.[28] Child obesity was defined as a BMI ≥95th percentile and overweight/obesity defined as a BMI ≥85th percentile for age and sex.

To assess self-regulation, teachers completed a modified 60-item version of the Social Competence and Behavior Evaluation.[29] The Social Competence and Behavior Evaluation assesses emotional and behavioral regulation difficulties typically seen in the preschool setting. It includes both positive (competence) and negative (emotional or behavioral problems) items, including internalizing (ie, anxious, sad) and externalizing (ie, oppositional) behaviors, both of which are indicators of poor behavioral self-regulation. The General Adaptation T-score assesses child overall emotional and behavioral self-regulation in the classroom setting. Higher scores indicate better self-regulation. Internal reliability was high (Cronbach's α = .96 preintervention and .96 postintervention).

Secondary Outcomes

Three unannounced 24-hour dietary recalls were collected via phone by trained dietitians from parents regarding child intake by using the US Department of Agriculture's 5-step Automated Multiple Pass Method.[30] Families were provided handouts showing child-appropriate portion sizes to assist them. The goal was to obtain recalls for 2 weekdays and 1 weekend day over a 2- to 3-week period. Given that parents were not present to observe the child's intake at preschool and therefore could not report it, research staff trained in dietary recall methods observed each meal and snack at school and recorded each child's intake; these data were incorporated into the recall. At preintervention, of the 697 children randomly assigned, 349 provided 3 recalls, 174 provided 2 recalls, 93 provided 1 recall, 66 provided no recalls, and 15 provided >3 recalls. Of the 690 children participating in any postintervention data collection, 303 provided 3 recalls, 148 provided 2 recalls, 82 provided 1 recall, 145 provided no recalls, and 12 provided >3 recalls. Recalls with implausible kilocalorie counts (n = 41 of 2925 total recalls across pre- and postintervention) were removed before analysis with the use of established criteria.[31] Variables reflecting servings per day were generated for individual foods[32] and food groups[33]: vegetables (not fried, not including white potatoes or legumes), whole fruit, 100% fruit juice, and sugar-sweetened beverages.

Parents reported how much time their child spends playing outdoors on a typical day separately for weekends and weekdays, in hours and minutes, and average time was calculated.[34] Parents reported how many hours per day the child watches television or videos and plays video games or plays on a computer on an average weekend and weekday, and categorical responses were converted to average hours of screen time.

Parent nutrition knowledge was assessed by using a 10-item true-false questionnaire developed for this study (potential range: 0–10). Parent nutrition self-efficacy was assessed by using a 13-item questionnaire developed for this study to which participants responded on a scale from 0 (not at all confident) to 10 (extremely confident). The total score was the mean (Cronbach's $\alpha = .76$ preintervention and .80 postintervention).

Statistical Analyses

The sample size was estimated at 150 per arm, which would enable detection of small to moderate effect sizes of $f = 0.16$ with a power of 80%, $\alpha = .05$, and assuming an intraclass correlation $r = 0.05$ among classrooms. Baseline comparability of the 3 study arms was assessed by using analysis of variance and χ^2. Mixed models were used to account for having repeated measures (pre and post) as well as for clustering of children within a classroom. All analyses were conducted in SAS 9.4 (SAS Institute, Cary, NC) by using mixed models for continuous measures and generalized linear mixed models for binary measures. All analyses were adjusted for race/ethnicity, which was significantly different across the 3 study arms, and child's sex. Analyses were based on the intention-to-treat principle, such that all randomized participants were included in the analysis on the basis of their randomized intervention group.[35] Significance was assessed by using a 2-sided test at $\alpha = .05$.

RESULTS

The flow of participants through the trial is shown in the CONSORT (Consolidated Standards of Reporting Trials) diagram (Fig 1). Participant characteristics at the time of allocation are shown in Table 1; the study groups were similar except for child race/ethnicity.

Intervention effects are shown in Table 2. There was a 2.1% reduction in obesity prevalence in HS+POPS+IYS, a 2.9% reduction in HS+POPS, and a 0.8% increase in HS alone, but differences between study arms did not reach statistical significance. HS+POPS+IYS resulted in greater improvement in child teacher-reported self-regulation compared with HS+POPS (48.4 pre- to 52.3 postintervention versus 49.6 pre- to 50.8 postintervention; $P < .001$) and compared with HS (47.3 pre- to 48.2 postintervention; $P < .001$). There was no effect of either HS+POPS+IYS or HS+POPS on any secondary outcomes with the exception of sugar-sweetened beverage intake: HS+POPS+IYS resulted in a greater decline than HS (0.54 servings/day pre- to 0.47 postintervention versus 0.52 servings/day pre- to 0.66 postintervention; $P = .005$).

Fidelity to POPS was acceptable. Educators implemented 82% of child curriculum elements and 90% of parent curriculum elements. Teachers implemented 76% of child curriculum elements. Fidelity to IYS was high, with 87% of parent session and 80% of child session items rated as "meets" or "exceeds" expectations. Fidelity was significantly lower, although still acceptable, in year 4 for POPS and in year 1 for IYS. We reran our main analysis excluding intervention years with lower fidelity and found no consistent differences in our results.

Although child participation in the intervention components was high, parent participation was low. Of the 224 parents randomly assigned to HS+POPS, the mean attendance was 1.2 (SD: 2.2) of 8 lessons; 31.5% participated in at least 1 lesson. Of the 255 parents randomly assigned to HS+POPS+IYS, the mean IYS attendance was 2.1 (SD: 3.3) lessons (of 10 group or 14 home lessons) and POPS attendance was 1.2 (SD: 2.2) lessons; 50.4% participated in at least 1 IYS lesson and 32.3% participated in at least 1 POPS lesson.

DISCUSSION

In this randomized, community-based intervention trial, an intervention designed to improve children's emotional and behavioral self-regulation in combination with an obesity-prevention program improved teacher-reported self-regulation but had no effect on obesity prevalence and no effect on most obesity-related behaviors. There was also no effect of the obesity-prevention program alone on obesity prevalence or obesity-related behaviors.

A review of obesity-prevention interventions similar to POPS in preschool settings tested in controlled trials found mixed effects.[3] To our knowledge, just 1 other intervention has been tested in HS settings[4–6] and its effect was moderated by child race/ethnicity and the identity of the educator.[6,36] Interventions in other countries have reduced adiposity in some,[37–42] but not all, [43–47] trials. Additional work is needed to identify effect moderators for these types of interventions.

Although the self-regulation intervention was effective in improving teacher-reported self-regulation, it had no effect on obesity prevalence or most obesity-related behaviors. These results are not consistent with the 2 previous studies of which we are aware that

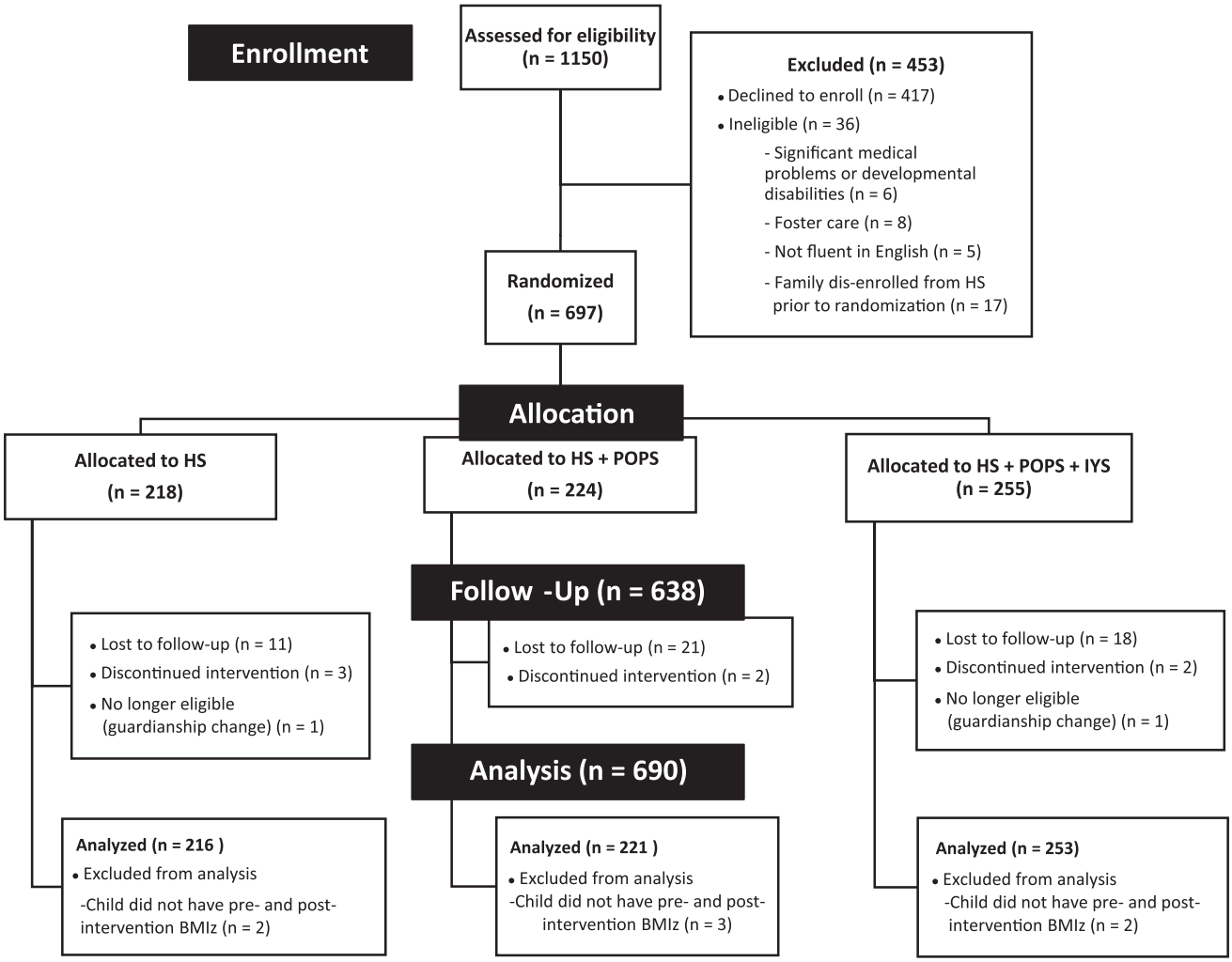

FIGURE 1
Flow of participants through the Growing Healthy Study. BMIz, BMI *z* score.

implemented similar approaches and found beneficial effects on children's BMI.[17,18] Our inability to detect effects may be attributable to the low rate of parent participation, which is common in low-income groups.[48–50] The protective effects against obesity that occurred in the previous studies emerged 2 to 3 years after the interventions.[17,18] It is possible that our follow-up period was not long enough. Our simultaneous presentation of the self-regulation and obesity interventions may have attenuated the effects of both.

There are several additional potential explanations for our null findings. First, we previously reported healthy changes in BMI associated with HS participation,[51] which were observed with a similar effect size in this study. Usual HS includes a focus on healthy nutrition; intensification of this focus through a didactic curriculum, as was done in this study, may not provide measurable additional benefit. To affect child BMI, more active parent participation in obesity-prevention curricula may be necessary than we were able to elicit. The POPS intervention concluded several months before postintervention measures were obtained and may have benefited from a booster. Engaging low-income parents in parenting programs is well known to be very challenging,[48–50] particularly when these programs are prevention and not treatment programs. Obesity prevention in this population may require more than the behavioral changes our curriculum targeted.

A potential additional reason for the null effect of the self-regulation intervention on child BMI may be that these behaviors do not become relevant to obesity prevention until children are older and develop more autonomy in their food choices. Indeed, much of the literature examining links between various features of self-regulatory capacity and obesity or overweight has only identified associations in later school age or adolescence,[13,52] and not early childhood. In the previous studies examining a similar intervention,

intervention effects became stronger as children grew older.[17,18] Thus, although promoting children's self-regulation in the preschool-age period may have beneficial effects on a range of outcomes, these effects on obesity may not be detectable until years later. It is also possible that emotional and behavioral self-regulation is simply a correlate of obesity but is not causal, and therefore, changing these behaviors does not affect obesity.

There are strengths and limitations to our study. To our knowledge, this is the first randomized community-based intervention trial to test the effect of programming to improve low-income preschoolers' emotional and behavioral self-regulation on obesity. The interventions were implemented with high fidelity by members of the community traditionally employed in these preschool settings. With regard to limitations, results may not be generalizable to other populations. Parent participation in the interventions was low, and there was attrition. Much of the data were collected by parent report. There were missing data for dietary recalls, which may have limited power to detect effects. The questionnaires regarding POPS self-efficacy and knowledge were developed for this study without pretesting to confirm participant interpretation of questions.

Additional work is needed to understand the role of self-regulation interventions for preventing childhood obesity. This trial used a standard intervention designed to modify self-regulation and standard teacher-reported measures to assess change. The results of this trial may have been null because the conceptualization of self-regulation was not specific enough to childhood obesity prevention. Future studies should consider developing and testing an intervention focused on self-regulation specifically in a food context, as opposed to self-regulation more broadly as was done here. Researchers should consider testing interventions for behavioral self-regulation (ie, delay of gratification, impulse control) separately from interventions for emotional regulation (ie, improving emotional coping with stressors to prevent stress eating), with the goal of achieving a more robust effect with a more dedicated focus to one or the other. Finally, researchers should consider developing and testing interventions that apply the concepts in IYS specifically to obesity-prevention behaviors (ie, managing tantrums specifically in response to restrictions on television or sugar-sweetened beverages), as opposed to more broadly as done in this trial.

TABLE 1 Baseline Characteristics by Study Arm

	HS	HS+POPS	HS+POPS+IYS	*P*
n (%)	218 (31.3)	224 (32.1)	255 (36.6)	
Child age (mean ± SD), y	4.12 ± 0.53	4.10 ± 0.52	4.12 ± 0.52	.92
Child sex, *n* (%)				.63
Male	101 (46.3)	114 (50.9)	124 (48.6)	
Female	117 (53.7)	110 (49.1)	131 (51.4)	
Child race/ethnicity, *n* (%)				<.001
White, non-Hispanic	113 (52.1)	80 (35.9)	142 (56.4)	
African American, non-Hispanic	50 (23.0)	87 (39.0)	68 (27.0)	
Hispanic or other	54 (24.9)	56 (25.1)	42 (16.7)	
Child BMI *z* score (mean ± SD)	0.57 ± 1.18	0.62 ± 1.18	0.64 ± 1.18	.77
Child weight status, *n* (%)				.37
Obese	26 (12.2)	38 (17.3)	41 (16.4)	
Overweight	42 (19.7)	46 (20.9)	41 (16.4)	
Normal weight	141 (66.2)	128 (58.2)	163 (65.2)	
Underweight	4 (1.9)	8 (3.6)	5 (2.0)	
Parent age (mean ± SD), y	29.2 ± 6.5	29.8 ± 6.8	29.6 ± 6.7	.63
Parent race/ethnicity, *n* (%)				.0004
White, non-Hispanic	132 (63.6)	102 (46.0)	161 (63.1)	
African American, non-Hispanic	50 (23.0)	86 (38.7)	68 (26.7)	
Hispanic or other	29 (13.4)	34 (15.3)	26 (10.2)	
Parent education, *n* (%)				.43
Less than high school	31 (14.3)	38 (17.1)	37 (14.7)	
High school diploma or GED	77 (35.5)	72 (32.4)	78 (31.0)	
Some college courses but no degree	73 (33.6)	89 (40.1)	99 (39.3)	
2-y college degree	28 (12.9)	14 (6.3)	28 (11.1)	
4-y college degree or more	8 (3.7)	9 (4.1)	10 (4.0)	
Maternal weight status, *n* (%)				.87
Obese	102 (49.0)	102 (49.8)	118 (48.8)	
Overweight	49 (23.6)	51 (24.9)	65 (26.9)	
Normal weight	54 (26.0)	46 (22.4)	53 (21.9)	
Underweight	3 (1.4)	6 (2.9)	6 (2.5)	
Family income-to-needs ratio (mean ± SD)	0.88 ± 0.53	0.84 ± 0.53	0.84 ± 0.56	.77
Family structure, *n* (%)				.63
Single parent	77 (39.3)	88 (45.8)	99 (42.5)	
Married	64 (32.6)	50 (26.0)	66 (28.3)	
Committed relationship	55 (28.1)	54 (28.1)	68 (29.2)	

GED, General Educational Development.

CONCLUSIONS

In summary, a community-based intervention focused on improving children's general self-regulation as a strategy for obesity prevention was effective in improving children's emotional and behavioral self-regulation but did not change obesity or most obesity-related health behaviors. In addition, an obesity-prevention curriculum targeting evidence-based behaviors had no statistically significant effect,

TABLE 2 Effects of Each Intervention on Study Outcomes

				Pairwise Comparisons and Effect Size[a]		
	HS (n = 218)	HS+POPS (n = 224)	HS+POPS+IYS (n = 255)	HS+POPS versus HS	HS+POPS+IYS versus HS	HS+POPS versus HS+POPS+IYS
Overweight or obese, %						
Baseline	31.9	38.2	32.8	—	—	—
Follow-up	32.5	35.9	32.2	—	—	—
Δ[b]	0.6	−2.3	−0.6	—	—	—
RR[c]	1.02	0.94	0.98	0.92	0.96	0.96
P				.35	.77	.56
Obese, %						
Baseline	12.2	17.3	16.4	—	—	—
Follow-up	13.0	14.4	14.3	—	—	—
Δ[b]	0.8	−2.9	−2.1	—	—	—
RR	1.07	0.83	0.87	0.78	0.81	0.96
P				.16	.33	.54
BMIz (overweight or obese at baseline)[d] (mean)						
Baseline	1.74	1.80	1.95	—	—	—
Follow-up	1.63	1.69	1.79	—	—	—
Δ[b]	−0.11	−0.11	−0.16	0.00 (SD)	−0.12 (SD)	−0.12 (SD)
P				.98	.44	.40
Child self-regulation: teacher report of Child General Adaptation, T-score						
Baseline	47.32	49.56	48.44	—	—	—
Follow-up	48.25	50.84	52.36	—	—	—
Δ[b]	0.93	1.28	3.92	0.06 (SD)	0.47 (SD)	0.42 (SD)
P				.65	<.001	<.001
Vegetables, servings/d						
Baseline	0.79	0.78	0.83	—	—	—
Follow-up	0.76	0.76	0.78	—	—	—
Δ[b]	−0.03	−0.02	−0.05	0.01 (SD)	−0.02 (SD)	−0.03 (SD)
P				.90	.88	.78
Whole fruit, servings/d						
Baseline	0.91	0.87	0.91	—	—	—
Follow-up	0.94	0.92	0.89	—	—	—
Δ[b]	0.03	0.05	−0.02	0.02 (SD)	−0.04 (SD)	−0.06 (SD)
P				.86	.60	.48
100% Fruit juice, servings/d						
Baseline	1.03	1.12	0.94	—	—	—
Follow-up	0.86	0.91	0.88	—	—	—
Δ[b]	−0.17	−0.21	−0.06	−0.03 (SD)	0.10 (SD)	0.13 (SD)
P				.77	.39	.26
Sugar-sweetened beverages, servings/d						
Baseline	0.52	0.52	0.54	—	—	—
Follow-up	0.66	0.53	0.47	—	—	—
Δ[b]	0.14	0.01	−0.07	−0.20 (SD)	−0.32 (SD)	−0.12 (SD)
P				.12	.005	.23
Outdoor play, h/d						
Baseline	2.64	2.58	2.48	—	—	—
Follow-up	1.96	1.76	2.02	—	—	—
Δ[b]	−0.68	−0.82	−0.47	−0.08 (SD)	0.12 (SD)	0.19 (SD)
P				.48	.25	.06
Screen time, h/d						
Baseline	2.58	2.48	2.73	—	—	—
Follow-up	3.08	3.03	2.97	—	—	—
Δ[b]	0.50	0.55	0.24	0.03 (SD)	−0.17 (SD)	−0.20 (SD)
P				.75	.11	.06
Parent nutrition knowledge						
Baseline	7.58	7.47	7.66	—	—	—
Follow-up	7.55	7.66	7.84	—	—	—
Δ[b]	−0.03	0.19	0.18	0.15 (SD)	0.15 (SD)	−0.01 (SD)
P				.14	.13	.99
Parent nutrition self-efficacy						
Baseline	8.08	8.11	8.25	—	—	—

TABLE 2 Continued

				Pairwise Comparisons and Effect Size[a]		
	HS (n = 218)	HS+POPS (n = 224)	HS+POPS+IYS (n = 255)	HS+POPS versus HS	HS+POPS+IYS versus HS	HS+POPS versus HS+POPS+IYS
Follow-up	8.09	8.20	8.34	—	—	—
Δ[b]	0.01	0.09	0.09	0.06 (SD)	0.06 (SD)	0.00 (SD)
P				.48	.45	.98

N = 690. BMIz, BMI z score; RR, risk ratio; Δ, difference; —, not applicable.

[a] Effect size is shown as the rate of relative risk for overweight and obese measures and as the difference in SD for continuous measures.

[b] Difference between follow-up and baseline measures.

[c] The RR between follow-up and baseline measures.

[d] n = 68, 84, and 82 for HS, HS+POPS, and HS+POPS+IYS, respectively.

consistent with the findings of a number of other trials with similar interventions around the world. Future work is needed with more powerful and targeted behavioral approaches to self-regulation to adequately test whether improving children's self-regulation can prevent the development of obesity.

APPENDIX

POPS Self-efficacy Questionnaire

Participants responded to on an 11-point scale from 0 = not at all confident to 10 = extremely confident.

How confident are you that you can:

1. Include more fruit in your child's meals and snacks?
2. Serve child-sized amounts of food to your child?
3. Order a meal for your child at a fast-food restaurant that meets experts' health recommendations for preschool-aged children?
4. Tell when your child is hungry?
5. Keep the television off while your child eats meals and snacks?
6. Include more vegetables in your child's meals and snack?
7. Limit your child to 1 sugar-sweetened beverage per day?
8. Show your child how to try new foods?
9. Include a variety of fruit in your child's meals and snacks?
10. Tell when your child is full?
11. Plan a day of meals and snacks for your child that meet experts' health recommendations for preschool-aged children?
12. Limit your child to watching <2 hours of television a day?
13. Include a variety of vegetables in your child's meals and snacks?

POPS Knowledge

Participants responded to each item as true or false; responses considered to be correct based on the POPS curriculum are provided after each question item.

1. If young children do not like a new food after 3 tries, it's best to move on to offering a different food. (false)
2. Health experts recommend that half of a preschooler's plate at each meal be filled with fruit and vegetables instead of other foods. (true)
3. Children are more likely to try a new food in a quiet, calm environment than in a noisy environment. (true)
4. It is important that preschoolers eat everything on their plates at meals. (false)
5. Most 3-year-olds will naturally stop eating when they are full. (true)
6. For children ages 3 to 5, fruit juice and milk are equally healthy. (false)
7. Children naturally prefer sweet foods. (true)
8. Children who eat while watching television are more likely to be overweight. (true)
9. Food serving sizes are the same for children and adults. (false)
10. Preschool-aged children can be taught to listen to when their body is hungry and full. (true)

ABBREVIATIONS

HS: Head Start
IYS: Incredible Years Series
POPS: Preventing Obesity in Preschoolers Series

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