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Implementation of a school-based Internet obesity prevention program for adolescents

Robin Whittemore, PhD, APRN, FAAN [Associate Professor],
Yale School of Nursing

Ariana Chao, MSN, RN, FNP-BC [Doctoral Student],
Yale School of Nursing

Myoungock Jang, MSN [Doctoral Student],
Yale School of Nursing

Sangchoon Jeon, PhD [Associate Research Scientist],
Yale School of Nursing

Tara Liptak, MPH [Trial Coordinator],
Yale School of Nursing

Rachel Popick, MSN, MPH, ACNP [Graduate Student], and
Yale School of Nursing

Margaret Grey, DrPH, RN, FAAN [Dean and Annie Goodrich Professor]
Yale School of Nursing

Abstract

Objective—To evaluate the reach, adoption, and implementation of HEALTH[e]TEEN, a school-based Internet obesity prevention program, and examine differences in student participation and satisfaction by school, gender, age, and race/ethnicity.

Design—Mixed methods, clinical trial of HEALTH[e]TEEN.

Setting—3 Public high schools in Connecticut.

Participants—384 adolescents, 8 teachers.

Intervention(s)—HEALTH[e]TEEN vs. HEALTH[e]TEEN + coping skills training.

Main Outcome Measure(s)—Demographic and state-available data, measurements of student satisfaction and participation, interviews with school administrators and teachers.

Analysis—Mixed and logistic models, content analysis.

Results—The sample (n=384) was diverse (35% White), with a mean age of 15.3 years, and mean BMI of 24.7 kg/m². Student participation (83% of lessons completed) and satisfaction (mean 3.6 out of 5) was high. Schools implementing the program in class had higher satisfaction and

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Corresponding Author: Ariana Chao MSN, RN, FNP-BC, Yale School of Nursing, 100 Church Street South, New Haven, CT 06536-0740, Ariana.Chao@yale.edu.

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participation compared to schools that implemented the program as homework ($P<.001$, $<.001$). Girls had higher satisfaction and participation compared to boys ($P=.02$, $.03$). Younger students had higher participation compared to older students but no difference in satisfaction was noted ($P=.03$).

Conclusions and Implications—Two school-based Internet programs to decrease obesity reached diverse adolescents, and were adopted and implemented with high student satisfaction and participation. Implementation of the intervention was influenced by setting (classroom vs. homework), teacher characteristics, student age and gender.

Keywords

Adolescent; obesity; prevention; clinical trials

In the United States, obesity among adolescents aged 12 to 19 years has more than tripled over the past 30 years, increasing from 5% in 1976 to over 18.4% in 2010.^{1,2} The increase in obesity rates is even more profound in minority adolescents, with obesity rates exceeding 20% for Latino and Black adolescents.¹ The alarming increase in obesity in youth has resulted in a marked rise in type 2 diabetes, hypertension, asthma, and depression in this age group.^{3–6}

The primary strategy for decreasing the prevalence of childhood obesity is prevention, with schools representing a popular setting for obesity prevention programs.^{7,8} While school-based obesity prevention programs are multi-faceted and heterogeneous, the majority of programs provide curricular content aimed at increasing physical activity and improving dietary intake.⁹ Several meta-analyses and systematic reviews have been conducted on school-based obesity prevention programs indicating that most programs (>75%) significantly improve knowledge, self-efficacy, and health behavior (physical activity, nutrition).^{10,11} However, effects on body mass index (BMI) have been inconsistent, with some interventions demonstrating a decrease in BMI^{12,13} and others having no effect on BMI.¹⁴ This result may be explained by potential variations in the amount of behavioral change in youth across studies, inadequate power to detect differences between groups, and the challenges of evaluating BMI changes in programs of short duration, which may not allow for consideration of normal growth and development in youth or factors influencing intervention implementation.

School adoption and implementation of obesity prevention programs may impact BMI and health behavior outcomes in adolescents. However, schools have multiple curriculum mandates and limited financial and personnel resources.¹⁵ Teachers, while highly motivated to implement an obesity prevention program, may not provide the program as intended due to such constraints. Process evaluation of program fidelity has been lacking in school-based obesity prevention programs.^{7,13,15} Thus, lack of improvement in BMI or health behaviors may occur because programs were not implemented as intended.^{13,15}

Interactive multimedia (i.e., the Internet) provides numerous benefits to program implementation in schools including standardization of program delivery, reduced teacher burden, and the ability to present content in an engaging and interactive format in which students can learn at their own pace.^{7,16} More than 93% of adolescents use the Internet¹⁷ and adolescence may represent a developmental stage particularly receptive to Internet obesity prevention programs. Adolescents have demonstrated significant improvements in dietary behaviors,^{18–22} physical activity^{18,20–22} and BMI¹⁸ while participating in Internet obesity prevention programs, thus demonstrating the promise of this approach. Incorporation of interactive multimedia has been widely recommended when developing school-based obesity prevention interventions.²³

Although adolescents have reported a preference for multimedia obesity prevention programs over print materials or lectures¹⁸, very little research has been conducted on their satisfaction and participation with multimedia programs. In the few studies that have evaluated satisfaction, scores have varied. Researchers who performed a 12-week study to increase physical activity in girls found that 95% of the girls reported that they would use the program again and suggest the program to their friends.²⁴ In a pilot test of a multi-behavior program conducted over 2 class periods, 67% of participants found the program interesting²⁵, while in a dietary fat educational program conducted in 1 class period, 34% of participant found the program interesting.²⁶ Girls and younger adolescents have also reported higher satisfaction with multimedia programs compared to boys and older adolescents.²¹ With respect to participation, some health-related Internet interventions for youth have demonstrated a decrease in participation over the study's duration as well as a correlation between participation and outcomes.^{20,27} While few school-based Internet obesity prevention programs have examined differences in outcomes by demographic variables, there is some indication that outcomes of obesity prevention programs differ by gender,^{28–30} age,³¹ and race/ethnicity.³⁰ This may be the result of higher satisfaction and participation in some groups. More research on Internet obesity prevention programs targeting adolescents is indicated.

One framework for evaluating health behavior programs is the RE-AIM framework that assesses Reach, Efficacy, Adoption, Implementation, and Maintenance.³² A major premise of the framework is that efficacy is necessary but not sufficient when measuring the potential impact of public health programs. Programs must also reach a diverse sample, representative of the population at-risk (Reach). They must be realistic to conduct in diverse school settings, including low-resource schools and be appealing to teachers and students (Adoption). Programs must also be able to be delivered as intended (Implementation). Lastly, programs need to be sustained by both the student and the school (Maintenance).

Thus, the purpose of this study was to: (1) Describe the reach, adoption, and implementation of 2 school-based Internet obesity prevention programs conducted in 3 high schools; (2) Compare satisfaction and participation between programs and schools; and (3) Explore factors (gender, age, race/ethnicity, and school) associated with student satisfaction and participation.

METHODS

Study Design

A mixed method design was employed for this analysis of data from a clinical trial comparing the effectiveness of 2 Internet obesity prevention programs delivered in public high schools. Details about this trial have been published previously.³³ In brief, 1 program (HEALTH[e]TEEN) provided interactive education (8 lessons) and behavioral support on healthy eating and physical activity to reduce overweight and obesity in adolescents (active control group). The other program [HEALTH[e]TEEN + coping skills training (CST)] was identical to the HEALTH[e]TEEN program with the addition of 4 lessons on coping skills to address the psychosocial challenges of healthy eating and physical activity. The programs were developed using an iterative process incorporating feedback from targeted users, based on a previous study where teachers implemented the programs.²⁸ Each program included lessons, self-assessments, questions on content, and individualized feedback to students. Behavioral strategies of self-monitoring and goal-setting activities included a blog by a “coach”, opportunities to interact with a health coach and other students, and a personal journal section.

The trial was conducted between October, 2010 and June, 2011. Yale University's Institutional Review Board and each school's Board of Education approved the study. Meetings with school administrators and the research team were conducted to discuss how to best integrate the program into the curricula and school settings. School administrators identified potential courses and held discussions with teachers of these courses to determine if the proposed obesity prevention program could fit into their course content and schedule. All of the identified teachers agreed to participate. Two schools opted for classroom participation (Health or Biology) and 1 school provided the program as homework in a Biology or Public Health course (Table 1). The content of the program includes science and health education information; thus, teachers were willing to use the program as a complementary part of their curriculum. Results of the study have been previously reported.³³ There were no significant differences between programs on health behaviors or BMI; however both groups had a significant improvement in eating behaviors, physical activity, and self-efficacy, with a significant decrease in sedentary behavior over 6 months.

Sample

The sample was recruited from 3 high schools with diverse students in or near New Haven, CT. Exclusion criteria included cognitive functioning that would prohibit students from completing program materials. Informed consent from parents and assent from students was obtained by trained research assistants. All students in the identified classes (n=604) were exposed to 1 of the 2 programs, though only consented students participated in the research study. Classes were randomized to provide either HEALTH[e]TEEN or HEALTH[e]TEEN + CST. Sample size was determined using a power analysis to test for differences in the primary study outcomes, eating behaviors, physical activity, sedentary behavior, self-efficacy, and BMI, between groups, accounting for the cluster randomization procedure. Four hundred and three students who were approached consented to participate in the study. In total, 384 students from 35 classes across 3 schools enrolled in the study: 9 classes from School 1, 6 classes from School 2, and 20 classes from School 3. Attrition at 3-month follow-up was very low at 3% (Figure 1).

Procedure

Targeted users were included in the development of the programs. Initially, focus groups with teachers, administrators, and students were conducted after informed consent to elicit preferences for an Internet obesity prevention program. Specifically, the groups discussed likes and dislikes of health-related websites as well as suggestions on healthy eating and physical activity content. A prototype of the website was developed and further feedback was elicited from students and teachers. While the response to the prototype was very positive, students and teachers indicated the need for greater visual appeal, less text, more interactive activities, and simplification of information. During this developmental process, logistical issues (e.g., school Internet firewalls) that could impede implementation of the program were identified and resolved.

The program was developed to be self-standing with little teacher involvement required. Teachers were provided access to the program, a list of all the components of the program, and suggested prompts to be used if students had questions. Teachers were asked to schedule approximately 12 classes or homework assignments so students could complete lessons, and if provided in class, to help students with logging onto the program and to monitor student activity to assure that they were using classroom time on the website (vs. exploring other websites). Lessons took approximately 20–30 minutes to complete. Members of the research team were present during the first 2 days of classroom implementation at each school to ensure that the website worked properly.

Data Collection

Data were collected on reach, adoption, and implementation. Data on reach consisted of a demographic questionnaire that was completed by parents/guardians with questions about age, gender, and race/ethnicity of students. School demographic characteristics were retrieved from the state Department of Education.

Adoption and implementation data were collected from teachers, school administrators, and students. A research assistant recorded meeting notes at all planning and implementation meetings with teachers and administrators. At the end of the program, a trained research associate conducted semi-structured interviews with all teachers (n=8) on their perception of the program, the implementation process, and student engagement with the program. Interviews took approximately 30 minutes and the interviewer recorded detailed notes.

Data from students consisted of assessments of satisfaction and participation. Satisfaction was measured using a 6-item survey on the presentation of content, enjoyment, helpfulness, ability to navigate website, practice content, and how worthwhile the program was. These variables were measured on a Likert scale of 1–5, with higher scores indicating higher satisfaction. Internal consistency reliability was 0.79. These data were collected 3-months after the start of the Internet program. Participation data include the percent of lessons completed. These data were generated from programming that linked student ID with user statistics.

Data Analysis

SAS v. 9.2 (SAS Institute Inc., Cary, NC, 2008) was used for all quantitative data analyses. Descriptive statistics were calculated for sample characteristics and the percent of lessons completed. These data were also used to examine the distribution of data. To assess the cluster correlation among adolescents in the same classroom, intraclass correlation coefficients (ICC) were calculated using PROC NLMIXED. The ICCs for class were 0.08 (± 0.04) and 0.42 (± 0.09) for satisfaction and participation, respectively. This indicates poor agreement in satisfaction among students in the same class compared to students in other classes, and a fair to moderate agreement in participation between students in the same class compared to students in other classes. Thus, to be conservative and consistent, the random effect of class was included in all subsequent analyses. Random effects of school were not significant. To compare satisfaction by program and school, mixed model analyses with a random effect of class were used. Analyses were conducted for the combined sample and by program, adjusting for age, gender, race/ethnicity, and school. Because participation was highly skewed, general linear models or mixed models could not be used. Therefore, participation was dichotomized into high participation (completion of 90% or greater lessons) or low participation (less than 90% of lessons) and a logistic model with a random effect of class was used.

An expert in qualitative research analyzed data from meeting notes and interviews using a content analysis procedure.²⁹ Data were initially categorized into positive comments, critiques, and suggestions for improvement. Within each category, comments were coded according to meaning. Codes were then collapsed and clustered into categories according to similarity of meaning. An iterative process continued until all codes were categorized.

RESULTS

Reach

A total of 384 students participated from 3 schools and were distributed over 35 classes. The mean age of students across all schools was $15.3 \pm .69$ years with a mean BMI of 24.7 ± 5.58 .

The majority were girls (62%) of diverse race/ethnicity (35% white non-Latino; 23% white Latino; 22% black non-Latino; 20% other/multiracial), and recruited from School 3 ($n=263$; 68.5%) (Table 1). There were significant differences between schools with respect to gender and race/ethnicity. School 1 had more girls in the study ($P<.01$), while School 3 had fewer minority students ($P<.01$) (Table 1). Within each school, the percent of minority students who enrolled in the study was equivalent or greater than the overall school demographic characteristics.

Adoption and Implementation

School factors—School policies and procedures pertaining to Internet use affected implementation including firewalls, password requirements, and technical challenges. Schools that participated in this study had firewalls that limited access to Internet sites within the school building. Technical assistance was necessary to approve the program *url* address at the beginning of the study. Once this was completed, there was no difficulty accessing the program at any school; however, occasionally, students were not able to view the video components of the program due to technical difficulties. All schools required students to have a password to access the Internet and the HEALTH[e]TEEN programs required an additional user name and password. Teacher assistance was needed if students could not recall their user name and/or password. Over time, students became more capable to enter both systems independently.

Teachers—Qualitative analyses of interview data showed that teachers provided positive feedback on the content of the program, use of the reality TV concept, functionality of the website, ability of students to complete the program online and at their own pace, and ability of students to interact with one another. Select representative comments included: “The program was very informative and put together in a way that the kids can relate to.” “The website looked engaging. The videos were cool to the kids and they felt like it was more of a fun activity than being in the regular classroom.” Critiques of the program included the length of the lessons and the amount of reading that was required of students. “Some lessons were too long for the students to focus.” Teachers also expressed that more teacher and student instruction was necessary. “Kids need a lot of guidance and there weren’t enough instructions for them to follow.” “I wish that there was more prep time...and an instruction guide for teachers.”

Student Satisfaction

Satisfaction with the programs was high. The mean satisfaction score was 3.6 ± 0.5 (out of 5). There were significant differences in satisfaction by school ($P<.01$) with the schools providing the program in class having higher satisfaction (Table 2). Across both programs, girls and students in schools providing the program in class (vs. homework) had higher satisfaction (Table 3). This project was not powered to determine significant differences among programs for participation and satisfaction, so the lack of significance between programs could be due to too few participants rather than a lack of effect (Table 3).

Student Participation

Overall, student participation in the programs was also high with students completing 83% of lessons (Data not shown). There were significant differences in participation by school ($P<.01$) with School 3 (in class) having the highest participation (Table 2). There was no significant difference in participation between programs. Across both programs, girls, younger students, and students in School 3 (in class) had higher participation. There was no difference in participation by students of different race/ethnicity (Table 3). When programs were analyzed separately, the gender and age effect was not significant.

DISCUSSION

These findings demonstrate that 2 school-based Internet programs to decrease obesity reached diverse adolescents and were adopted and implemented in 3 high schools with high student satisfaction and participation. The use of a high school setting increased the reach of the program, providing further evidence that schools represent a setting conducive to providing an obesity prevention program for adolescents at risk for overweight or obesity.^{34,35} Though a critique of the program was the need for further teacher and student instruction, prior research supports that adoption of the program was likely enhanced through the use of a relatively self-standing program^{28,36} and collaborative processes between the research team, and school teachers and administrators.³⁷

Despite standard procedures, implementation of the HEALTH[e]TEEN programs varied across schools, which may account for differences in satisfaction and participation between schools. Schools represent a complex environment with many factors affecting program implementation.^{38,39} School 3 provided the program during class time with high student satisfaction and participation, supporting previous research that adolescents are more likely to participate consistently in an Internet intervention during class time than on their own time.⁴⁰ While School 2 also provided the program during class time with high satisfaction, participation was considerably lower, suggesting that other factors aside from assignment type influence participation. One factor that may explain the lower participation in School 2 is school closings due to inclement weather. All 3 schools closed 8 days because of snow, but HEALTH[e]TEEN classes were impacted only in School 2. However, systematic data on the impact of school closings on program participation were not collected.

Teachers' perceptions about the program, involvement with the program, and ability to provide student support may also influence implementation.³⁰ Teachers responded positively about the informative contents of the program and techniques within the program to increase student engagement. However, even though an Internet-based program reduced teacher burden, the teachers expressed a need for more instruction about the program and were concerned about the students' workload for lessons. These findings support prior research that greater instruction about the program may have enhanced the standardization of implementation.^{41,42}

There were no significant differences between HEALTH[e]TEEN and HEALTH[e]TEEN + CST with respect to satisfaction and participation. Both programs were identical in overall look and interactive features, with the only difference between programs being the addition of 4 lessons on CST in the HEALTH[e]TEEN + CST program. Thus, it is not surprising that satisfaction did not differ between programs.

Student satisfaction and participation with this obesity prevention program varied by student gender and age, although students of diverse race/ethnicity did not differ with respect to satisfaction or participation across all 3 schools. While this suggests that the program is appealing to students of diverse race/ethnicity, there was some variation in satisfaction and participation by gender with girls having higher satisfaction and participation in the combined sample. These findings are congruent with results from previous school-based obesity prevention studies, which demonstrate that girls have higher participation²¹ and better outcomes.^{43,44} It has been hypothesized that girls may respond better to cognitive-behavioral programs based on social learning theory.³¹ Girls may also be more interested in the content because girls are more concerned about their weight and body shape.^{45,46} On the other hand, boys responded more to physical activity programs to reduce BMI.⁴⁷ Thus, programs that include both a cognitive-behavioral and an active physical activity component may optimize participation, satisfaction, and outcomes for both boys and girls.⁴⁸

Younger students had higher participation in the combined sample, which is consistent with previous research²¹ and recommendations for obesity prevention programs to target younger adolescents who may be more receptive to program content.³¹ Despite age differences in participation, there were no differences in satisfaction by age; thus, lower participation in older students was not due to lack of engagement with the program.

The results of this study should be interpreted in light of several limitations. First, multiple statistical comparisons were undertaken with a small sample size for School 2. Second, it is unclear whether school differences resulted from the method of implementation or other variations between school environments. Third, there are other factors influencing participation and satisfaction that were not measured in this study, such as student motivation and learning style. While process evaluation of implementation was undertaken, a measure for teachers to document program implementation is recommended.^{49,50} Fourth, participants had access to computers during class time, which may limit translation to schools where computers are not as accessible. Nevertheless, technology is increasingly present in classrooms. Nationwide, public secondary schools have a ratio of students to classroom computers at 5.2 to 1 with 94% of these computers having Internet access.⁵¹ Fifth, this study was not initially powered to compare satisfaction and participation between programs and schools as these were secondary study outcomes. The study was adequately powered for cluster randomization procedures to detect differences in the primary study outcomes: eating behaviors, physical activity, sedentary behavior, self-efficacy, and BMI. Lastly, we conducted the study with only 3 schools: 2 Interdistrict Magnet schools and 1 suburban school. The Magnet schools do not have admission requirements, examinations, or prerequisites for their students, but each school offers unique curricula and programs. These 3 schools were selected to increase the diversity in the sample, and implementation of the program in these schools support that the program can be implemented in a variety of curricula and school settings; however, use of Magnet and suburban schools limits generalizability and results should be interpreted cautiously.

Implications for Research and Practice

The program reached racially and ethnically diverse adolescents and was adopted and implemented in 3 public high schools, suggesting the translatability and robustness in reach, adoption, and implementation of school-based Internet interventions for obesity prevention programs with adolescents. In this study, students actively participated in the program with high satisfaction. While Internet delivery standardizes content of obesity prevention programs, this study demonstrates that implementation in schools is complex: factors including implementation setting (i.e., classroom vs. homework) as well as student age and gender influence implementation. Teacher characteristics and teaching style may also influence implementation; however, these factors were not systematically evaluated in this study. Successful implementation of obesity prevention programs in schools may require attention to these factors. It is important for those doing school-based Internet research to get websites approved by each school's information technology security team. While this is fairly easy to do, it is crucial that it is addressed early in the implementation process. Providing teachers and students with support, guidance, and instruction is also essential for successful implementation. Determining the most effective way to do this is an important area for further study. Use of a collaborative process allowed the researchers to develop the program so that it would be relevant to adolescents and teachers in different settings, and so that it would be easy for any teacher to implement the program in their classes. Future dissemination of this intervention would only require teachers and administrators to determine what classes the program would be provided in and how to incorporate the program into their course grade. Decreasing burden to teachers and schools is critical in implementing Internet programs in the school setting. Other intrinsic factors such as

academic performance, student preferred learning style, and motivation may also influence participation and satisfaction as well as outcomes of an Internet obesity prevention program and should be considered in future research.

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Figure 1.
CONSORT Diagram for HEALTH[e]TEEN Program

Table 1
Descriptive and Implementation Characteristics for High Schools Participating in HEALTH[e]TEEN Program

School Code	School Description	n	% Minority (2008–2009)	% Minority in this Study		% Girls in this Study		Delivery Method	Class Name	Number of Classes
				%	P-value	%	P-value			
1	Public Urban Magnet	90	83%	82%	<.01 ^a	78%	<.01 ^a	Homework	Biology or Elective Public Health	9
2	Public Urban Magnet	31	82%	93.8%		63%		In class	Biology	6
3	Public Suburban	263	50%	56%		57%		In class	Health	20

^aChi-square test used to compare differences in percentages between schools

Table 2
Satisfaction and Participation by Program and School for Adolescents Enrolled in HEALTH[e]TEEN (n=384)

	Overall n=384	School 1 n=89	School 2 n=32	School 3 n=263
Satisfaction	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)
HEALTH[e]TEEN	3.60(.67)	3.44 (0.70)	4.17 (0.35)	3.63 (0.66)
HEALTH[e]TEEN+CST	3.57(.69)	3.28 (0.83)	3.86 (0.52)	3.60 (0.65)
<i>P</i> -value	.61 ^a	<.01 ^b		
Participation (% students completing 90% or more of lessons)	n (%)	n (%)	n (%)	n (%)
HEALTH[e]TEEN	123 (70%)	21 (44%)	2 (22%)	100 (83%)
HEALTH[e]TEEN+CST	124 (60%)	15 (36%)	9 (41%)	100 (70%)
<i>P</i> -value	.051 ^a	<.01 ^b		

Note. Satisfaction is measured on a scale of 1–5, with higher scores indicating higher satisfaction.

^aT-tests used to compare differences between programs

^bTwo-way ANOVAs used to compare differences between programs and schools

Table 3
Factors Associated with Satisfaction and Participation in the HEALTH[e]TEEN Program (n=384)

<i>Effects on Satisfaction</i>		Combined Sample	HEALTH[e]TEEN Only		HEALTH[e]TEEN + CST
		Coefficient ± StdErr	P-value ^a	Coefficient ± StdErr	P-value ^a
HEALTH[e]TEEN + CST vs. HEALTH[e]TEEN Only		-0.09±0.09	.28	-	-
Male vs. Female		-0.17±0.07	.02	-0.19±0.10	.08
Child Age		-0.08±0.05	.11	-0.06±0.08	.45
Race/Ethnicity					
Black/African American vs. White		-0.08±0.09	.39	-0.06±0.08	.36
Latino vs. White		-0.03±0.11	.77	-0.22±0.14	.11
Other vs. White		0.03±0.10	.77	-0.03±0.15	.86
School					
School 2 vs. School 1 (homework)		0.64±0.17	<.001	0.78±0.27	.01
School 3 vs. School 1 (homework)		0.27±0.11	.01	0.25±0.16	.12

<i>Effects on Participation (90% sessions completed)</i>		Coefficient ± StdErr	P-value ^b	Coefficient ± StdErr	P-value ^b
HEALTH[e]TEEN + CST vs. HEALTH[e]TEEN Only		-0.47±0.25	.06	-	-
Male vs. Female		-0.54±0.26	.03	-0.80±0.42	.06
Child Age		-0.39±0.18	.03	-0.51±0.33	.1166
Race/Ethnicity					
Black/African American vs. White		-0.54±0.32	.09	-0.42±0.52	.42
Latino vs. White		-0.39±0.33	.25	-0.22±0.54	.69
Other vs. White		0.15±0.40	.70	0.60±0.66	.36
School					
School 2 (in class) vs. School 1 (homework)		0.14±0.47	.77	-1.10±0.95	.25
School 3 vs. School 1 (homework)		1.74±0.30	<.0001	2.11±0.45	<.0001

Note. Intraclass Correlation Coefficient (ICC) by classes are 0.08 and 0.42 for satisfaction and participation (90% sessions completed), respectively.

^aMixed effect model with a random effect of class and controlling for program, gender, age, race/ethnicity, and school

b_7 Logistic regression model with a random effect of class and controlling for program, gender, age, race/ethnicity, and school