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Interactive Learning Activities for the Middle School Classroom to Promote Healthy Energy Balance and Decrease Diabetes Risk in the HEALTHY Primary Prevention Trial

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Abstract

The HEALTHY trial evaluated the effectiveness of a multicomponent intervention program to reduce risk for type 2 diabetes in middle school students. The comprehensive intervention addressed nutrition, physical activity, and behavior in the context of a social marketing–based communications campaign to promote healthy energy balance. One element was a classroom-based program called FLASH (Fun Learning Activities for Student Health). Five FLASH modules were delivered, one per semester. Process evaluation data were collected from teachers at 21 schools and study staff at seven national sites via survey, interview, and in-class observation. Data from the first four modules were evaluated and showed that FLASH was delivered with high fidelity. Sessions that required peer interaction were rated as the most effective in engaging students and promoting knowledge. Study-provided material resources and onsite support were identified as key facilitators. Student misbehavior was viewed as the greatest barrier. Although the high level of support provided by the study is not likely to be replicated in school systems, those developing wellness policies, health curricula, and teacher training programs may benefit from using the evidence-supported, publicly available HEALTHY materials in their efforts to reduce diabetes risk factors in middle school youth.

Keywords

process evaluation; obesity; diabetes prevention; physical activity; school nutrition; health promotion; health curriculum; school health; health teaching; teacher training

INTRODUCTION

The prevalence of childhood overweight and obesity has risen dramatically over the past 30 years (Ogden, Carroll, Kit, & Flegal, 2012) and so have rates of pediatric type 2 diabetes (Dabelea et al., 2007; Hedley et al., 2004). The purpose of the HEALTHY trial was to

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mitigate these risk factors in an ethnically diverse cohort of more than 4,000 middle school students. The rationale, design, and methods for the intervention have been described (HEALTHY Study Group, 2009). HEALTHY aimed to improve on previous school-based obesity studies by integrating behavioral, nutrition, physical education, and communications interventions to modify both the school environment and individual behavior. Results showed no difference in the effect of the program on combined prevalence of overweight and obesity (defined as body mass index [BMI] ≥ 85th percentile adjusted for sex and age) in the intervention compared with control schools. However, the program was associated with significant decreases in secondary outcomes, including BMI *z* scores, waist circumference ≥ 90th percentile, fasting insulin, and prevalence of obesity (BMI ≥ 95th percentile; HEALTHY Study Group, 2010).

Because HEALTHY was multifaceted, the successful reduction of risk factors among obese students cannot be attributed independently to any single element. Nonetheless, here we focus on process evaluation data from the classroom intervention component called FLASH (Fun Learning Activities for Student Health). First, there is precedence in examining the potential for translation of teacher-implemented health behavior change programs in school systems (Weicha et al., 2004). Second, and most important, there are mandates for schools to develop curricula that address obesity, yet the percentage of teachers receiving staff development for this purpose is quite low (Kann, Telljohann, & Wooley, 2007).

The FLASH component was based on social learning principles (Bandura, 2004), and a complete description of the objectives has been reported (Venditti et al., 2009). FLASH was informed by prior school-based health promotion studies, grounded in cognitive-developmental learning theory, particularly those relating to young adolescents (Glanz, Rimer, & Viswanath, 2008; Mellanby, Rees, & Tripp, 2000; Story, Lytle, Birnbaum, & Perry, 2002). Studies with theoretical origins in drug abuse prevention have demonstrated that peer-led interactions are critical components of social influence and behavior change among middle school–age students (Botvin & Griffin, 2007; Gottfredson & Wilson, 2003). Therefore, classroom social learning interactions were teacher facilitated but peer led. In addition, given extensive documentation in the obesity research literature that self-regulatory skills training and practice are critical for attaining healthy energy balance and a healthy body weight (Butryn, Webb, & Wadden, 2011; Rodearmel et al., 2007; Wilfley et al., 2007), FLASH included a compendium of skills activities (e.g., self-monitoring, stimulus control, goal setting, problem solving) to influence eating and activity behaviors in and out of school. In summary, FLASH was designed to enhance knowledge, awareness, and skills for the environmental changes that were occurring schoolwide. A key objective of this report is to reinforce the linkage between the findings of a very large multicenter research study of ethnically and regionally diverse youth and the work of health promotion and education practitioners in the field.

BACKGROUND

The school environment provides an important platform for obesity and diabetes prevention (Katz, O'Connell, Njike, Yeh, & Nawaz, 2008), given the significant exposure children have to the food service and physical activity milieu. Schools have also taken on greater responsibility for teaching about healthy lifestyle habits, and empirical evidence suggests that multicomponent programs can have a significant impact on middle school students (Fung et al., 2012; Gortmaker et al., 1999; Lytle, Ward, Nader, Pedersen, & Williston, 2004; Sallis et al., 2003). Previous research suggests that the fidelity of teacher implementation of various types of health curricula is positively associated with program effectiveness and student knowledge acquisition (Dusenbury, Brannigan, Hansen, Walsh, & Falco, 2005). Poor teacher implementation has been associated with competing demands on instructional

time, lack of commitment, and limited training and support (Hoelscher et al., 2004; Prelip et al., 2006). Other challenges include incomplete material resources, high staff turnover, difficulty integrating health material into existing curricula, and pressures to adopt commercial programs that are heavily marketed but not evidence supported (Hallfors & Godette, 2002). Franks et al. (2007) found that involvement of administrators and teachers in planning and evaluation, such as programs developed using a community-based participatory research model like Planet Health (Gortmaker et al., 1999; Wiecha et al., 2004), was critical to program success. Accordingly, the HEALTHY FLASH intervention involved local administrators and teachers in the planning stages to devise an optimal training approach that respected time constraints and used teacher- and student-friendly learning activities.

METHOD

Study Design and Measures

The HEALTHY research design has been described in detail elsewhere (HEALTHY Study Group, 2009, 2010). Schools, not individuals, were the primary unit of randomization and analysis for the major health outcomes; thus, HEALTHY was considered a cluster design trial (Donner & Klar, 2000; Murray, 1998). All members of the cluster—students—were exposed to the multicomponent intervention. Data were collected at the school and at the individual student and school staff level. There were three major data collection periods for student health outcomes: baseline (fall of sixth grade), interim (spring of seventh grade), and end of study (spring of eighth grade). The protocol was approved by all site institutional review boards, and data was collected only for participants who provided appropriate informed consent and assent.

The HEALTHY study incorporated process evaluation procedures to assess implementation fidelity, and these methods have also been reported (Schneider et al., 2009). Process methods followed the principles outlined by Steckler and Linnan (2002) and summarized by Saunders, Evans, and Joshi (2005). A process evaluation committee, representing all field centers (see Authors' Note for list), specified what constituted complete and acceptable program delivery. Efforts were guided by both a qualitative data core (QDC) located at the University of North Carolina at Chapel Hill and a central data coordinating unit at the Biostatistics Center of George Washington University. Choice of methods was influenced by feasibility, study resource limitations, likely respondent burden, and acceptability of measurements to local school and study staff.

Sample

In the main trial, 4,603 students were followed from the sixth through eighth grades in 42 schools at seven field centers across the United States. Their mean age was 11.3 (±0.6), 54.2% were Hispanic/Latino, 18% were African American, and 52.7% were girls. School eligibility criteria included the following: (a) ≥50% minority (African American, Hispanic/Latino, and/or American Indian) and/or greater than 50% eligible for free or reduced lunch, to ensure that those at highest risk for diabetes were sampled; (b) historic levels of annual attrition lower than 25%, to ensure adequate retention of the baseline cohort; and (c) schools authorities confirmed willingness to carry out the study protocol. Half of the schools were randomized to receive the HEALTHY intervention program and half to assessment only.

Intervention

The comprehensive intervention aimed to modify the overall school environment, including food service, physical education, classroom behavioral learning activities, and school communications and messaging. The organizing themes were to increase physical activity,

decrease sedentary behavior, increase healthy eating, and decrease the intake of foods low in nutritional value. HEALTHY was not a weight loss intervention, but collectively the modules were designed to enhance student understanding and skills for calorie awareness and energy balance in and out of school.

Implementation of FLASH—A specific aim of FLASH was to provide developmentally appropriate learning activities for ethnically diverse middle school students delivered by classroom teachers working with behavior modification experts. Standardized training and delivery procedures were used with an eye toward dissemination. FLASH was delivered by trained sixth-, seventh-, and eighth-grade teachers in five modules, one per semester (or half year), with the final module being a wrap-up of the four previous modules. A teacher manual and student workbooks were provided by the study for each module, along with materials for conducting the various games and activities that were part of the lesson. Each of the first four FLASH modules was intended to be delivered in 10 weekly half-hour sessions.

Small-group student interaction—Most learning activities were conducted in groups of three to five students, and each module ended with sessions devoted to creative mixed-media projects that highlighted a specific HEALTHY theme. Study personnel were dedicated to implementation of the behavioral intervention component, including one full-time health promotion coordinator (HPC) responsible for multiple schools and one study aide per school. School personnel worked with HEALTHY study staff to identify classrooms and teachers to administer FLASH each semester. Classrooms selected included social studies, electives, homeroom, health, physical education, and science. Teachers were not required to have prior health curriculum training or experience, but the aim was to recruit teachers with a stated willingness to teach the material.

Training and support of teachers—The HPCs received central, standardized training from behavior intervention experts for each FLASH module. They, in turn, trained classroom teachers and aides. Training for each module was designed to build a working relationship between researchers and school personnel and ensure protocol integrity. Training materials were standardized across all sites, but tailoring was permitted to meet individual school needs. Common training activities included a slide presentation, role-playing, and discussion related to FLASH classroom behavior management. The basic training was designed to be completed in less than 3 hours per module (per half year) and typically was held during one or two after-school periods, or free periods. Teachers received a FLASH teacher manual that contained scripted prompts for each session. Study staff worked with teachers to establish a regular schedule for classroom implementation and to minimize disruptions to standard instructional activities.

Teachers implementing FLASH received a small stipend at the completion of each module. Specific mechanisms to support intervention fidelity included the following: (a) encouragement to contact HEALTHY staff with questions or concerns, (b) centrally located study mailboxes for use by both study staff and FLASH teachers, (c) review of the barriers encountered and ways to handle the next session, and (d) weekly delivery of supplemental “FLASH cards” (one-page lists of preparation strategies and reminders and lesson goals and messages).

Process evaluation data collection—Process evaluation data were collected by trained study staff not involved with the intervention. The schedule for data collection was tied to the school calendar and completed per each semester of FLASH implementation. The following quantitative and qualitative measures were used.

FLASH in-class observation: A trained research assistant (RA) conducted unannounced structured observations of at least one class, per teacher, per semester, selected at random.

FLASH teacher interviews: At the end of the HEALTHY study, trained RAs conducted interviews of a randomly selected sample of participating teachers. Structured prompts were designed to elicit information about the teacher's experience with FLASH implementation, including barriers to intervention delivery and facilitators of intervention success. Teachers used a Likert-type scale (1 = *low* to 5 = *high*) to rate their perceptions of the effectiveness of the FLASH intervention on changing students' abilities to make healthier choices

HPC interviews: After each FLASH module was delivered, trained RAs conducted structured interviews with the HPCs regarding teacher receptivity to training sessions, teacher accuracy in delivering FLASH, and student interest in FLASH using a Likert-type scale (1 = *low* to 5 = *high*).

Data analysis

Descriptive statistics were used to summarize quantitative responses. Qualitative data were obtained using structured observation forms that were entered through a custom web-based data entry system and accumulated centrally at the QDC. Data obtained from interviews were summarized into a key point summary (KPS) by trained facilitators at each center. Individual KPS documents were composed for each interview and provided major points and salient respondent quotes. These and summary tabulations of forms data were provided to the QDC for full report compilation. Researchers at the QDC used the KPS documents primarily but referenced the full interview as needed. Qualitative data were analyzed using ATLAS.ti (Version 5.2; Scientific Software Development, 2004) to code the classroom teacher and HPC interviews. Codes were aggregated to identify emergent themes or salient and patterned participant responses (Patton, 1990). The analysis of aggregate data focused primarily on the strengths of and barriers of the FLASH intervention components.

RESULTS

Classroom Delivery of FLASH Modules

From the second semester of the sixth grade through the first semester of the eighth grade, four FLASH modules of 10 sessions each were delivered. Across the 21 schools assigned to receive the HEALTHY intervention program, 8,317 FLASH lessons were implemented in 854 classrooms by 311 teachers. FLASH lessons were not delivered in 32 (<1%) instances for reasons including poor student behavior, school disruptions, inadequate time, and teacher dislike of lesson. Table 1 summarizes information recorded during observation of 359 classes. Average session time was close to the targeted 30 minutes; maximum times of more than an hour indicated that some teachers chose to devote the entire class to the FLASH lesson. RAs observed that the list of specified activities occurred more than 90% of the time, indicating a high degree of program fidelity. Barriers to delivery occurred during 28% of sessions for Module 1 to 14% for Module 4. The majority (69%) were due to disruptive students.

Poststudy Interviews With Teachers

During end-of-study interviews, teachers assigned an average effectiveness rating for FLASH of 3.5 (*SD* = 0.7). Subjective comments indicated that the nondidactic, interactive, and mixed-media activities were perceived to be more effective for student engagement. Teachers indicated that students were able to recall material and information from previous FLASH modules, and by eighth grade most of the learning objectives presented in the earlier FLASH modules had been achieved. FLASH teachers remarked that students seemed more

aware of nutrition and physical activity concepts, but they did not think this was necessarily associated with lifestyle behavior change. The maturity level of students, lack of support in the larger community, and home environments that did not reinforce the HEALTHY messages were noted as key barriers. Teachers identified poor student behavior as one of the most frequent impediments to implementing FLASH. Some perceived poor behavior to be because of a lack of interest in FLASH or the social nature of student-led groups. Others perceived student misconduct as common across many subjects and classes.

Poststudy Interviews With Health Promotion Coordinators

In structured interviews, HPCs reported that many teachers expressed satisfaction with the scripted workbook materials provided by the study and appreciated the minimal preparation time needed to facilitate FLASH. Table 2 gives HPC average ratings for different aspects of program implementation. Teacher receptivity to training and to program delivery was consistently rated highly (at least 4). Student interest was rated slightly lower (3.4-3.7). Consistent with teacher ratings, HPCs noted that student interest appeared highest in those sessions that were interactive and involved game play (e.g., charades) or creative activities such as songs, skits, and artwork. In contacts with teachers, HPCs heard the teachers note that classroom implementation was not as difficult as anticipated and that they thought the program would help students. The HPCs reported that barriers to training and implementation of FLASH included additional burden on teacher time, staff turnover, and concerns regarding disruption to required curriculum and scheduling. HPCs noted that behavior management of students was sometimes a challenge, as was class size and setting, teacher interest, and occasional lack of clarity in the FLASH materials. Teachers varied as to whether they would prefer short FLASH sessions with an immediate return to the standard curriculum lesson or extending FLASH sessions to fill a complete class period. HPCs pointed to the strength of the relationship with teachers and administrators as the major facilitator of FLASH implementation. HPCs highlighted the important role of a key communications person, either a school staff person or a study staff member embedded in a school, who helped ensure ease of implementation.

DISCUSSION

Process evaluation results from FLASH revealed key findings that may be useful for school systems and personnel who are interested in developing health promotion curricula for young adolescents. First, FLASH was implemented as designed with high fidelity and moderately high teacher acceptance; in-class observational data mirrored positive self-reported data from teachers. The average FLASH delivery time of approximately 30 minutes per activity, 10 times per half year, was feasible for most teachers in a variety of classroom settings. Structured interviews with FLASH teachers and study staff documented teacher satisfaction with the training and preparation they received, as well as the scripted manuals and materials at all grade levels.

Second, despite acknowledgment of barriers during FLASH implementation, teachers also reported that they believed the materials were developmentally appropriate to the learning objectives, and that by eighth grade, students had good understanding of key concepts. These findings are consistent with previous research reporting that teachers were more likely to complete all lessons in a classroom-based drug prevention program “if the curriculum was of high quality, flexible, and easy to use” (Mihalic, Fagan, & Argamaso, 2008). Teachers were also consistent in their reports that student misconduct was the primary challenge to intervention delivery. Some teachers noted they would have liked to use grades as an incentive for managing student behavior and participation. Teachers and study personnel also clearly indicated that group-interactive projects appeared to be the most engaging for students. However, this format also required that teachers have adequate group facilitation

skills and the ability to manage classroom behavioral problems and transitions. The classroom setting or subject in which FLASH was administered appeared to matter less than recruiting teachers who were motivated by the subject matter and adept facilitators of small-group student interaction.

Third, in addition to satisfaction with the quality of training and materials, guidance from study staff members was viewed as a key facilitator of intervention fidelity. Previous research has also shown that consistent monitoring and support is associated with high fidelity for classroom-based nutrition education interventions whereas programs relying on teacher implementation alone were not well maintained over time, when training, support, and other resources were removed (Lytle et al., 2003; Story et al., 2002; Webber et al., 2008). FLASH was developed in the context of a primary prevention trial intervention and not community-based participatory research. Thus, unlike the Planet Health curriculum (Gortmaker et al., 1999; Wiecha et al., 2004), mechanisms for diffusion to the school system following the study were not anticipated.

Nonetheless, the feasibility/acceptability ratings for FLASH across a variety of classroom contexts and a diverse sampling of U.S. schools suggest that such activities have potential for dissemination with sufficient community-based methodologies. School districts do have teacher training and continuing education mechanisms in place that can be accessed to insure fidelity (e.g., in-service or continuing education credits, major subject area lead teachers who can provide guidance and support districtwide). Although the high levels of in-school guidance and support are not likely to be replicated in the real world, many of the training, monitoring, and support functions for teachers that were provided by an HPC could potentially be provided as web-based support.

Future dissemination research would do well to consider multiple avenues for including interactive health learning activities during the course of a school day, consider how best to recruit teachers with a willingness to conduct these types of interactive lessons, and include such individuals in implementation planning. We noted that there was a decrease in implementation difficulty and observed barriers over the course of the four modules evaluated, which may reflect the fact that teacher feedback was incorporated and improvements made to streamline the procedures across semesters. Teachers and study staff concurred that implementation was enhanced by allowing flexibility as to where and when FLASH sessions could be delivered. The variability in delivery time was largely attributable to teacher preference, and many commented that this level of flexibility was important. Prior classroom-based nutrition intervention studies have focused on science class (Contento, Kock, Lee, & Calabrese-Barton, 2010; Singh, Chin, Paw, Brug, & van Mechelen, 2009) or used multiple major subjects and teachers per year to complete delivery of the lesson units (Gortmaker et al., 1999); HEALTHY FLASH was designed to be delivered in virtually any school classroom setting based on school preference, using one teacher per semester.

Limitations

FLASH was one of four integrated components that comprised the HEALTHY intervention program; it was not possible to collect outcome or process data to evaluate FLASH as a stand-alone intervention. There was no direct measurement of the theory-based social learning objectives (e.g., peer influence, specific behavioral skills). Qualitative evaluation relied heavily on teacher self-report. Because teachers had flexibility, in some cases they may have deviated from the intended script, thus affecting outcomes. Although teacher-reported data were consistent with observational data, RAs observed only a small percentage of total sessions delivered (fewer than 5%).

CONCLUSIONS

With adequate training and support, it is feasible for classroom teachers to implement brief interactive activities in 10-session modules per semester to enhance student learning for healthy eating and physical activity. Our experience with FLASH implementation has several implications for school health promotion. First, HEALTHY FLASH intervention materials are available for use by educators at no cost (http://www.healthystudy.org/). Second, although many states and school systems have health teaching programs and personnel already in place, our findings suggest that it is not necessary for health specialists to deliver FLASH. Finally, schools can use the FLASH intervention to help meet state and national teaching standards for the middle school grades or incorporate these materials as part of more comprehensive efforts to change the school food service and physical activity environments.

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Table 1
FLASH In-Class Observations Across Modules 1-4

	Module			
	1	***2***	***3***	***4***
Theme	Water and You	Activity and You	Let's Eat Healthy	Let's Be Balanced
Semester	Spring 2007	Fall 2007	Spring 2008	Fall 2008
Grade	6	7	7	8
Number of observations	82	91	94	92
Session time (minutes)[a]	28 (13-58)	28 (10-60)	35 (14-74)	34 (15-66)
Activities performed (%)				
"FLASH time" announced	93	88	98	98
Workbooks handed out	100	99	100	100
Teacher read instructions	98	99	100	100
Activity reviewed	94	91	97	98
Student groups formed	95	91	91	NA
Class encountered a barrier[b]	28	15	18	14

NOTE: FLASH = Fun Learning Activities for Student Health.

[a] Mean (minimum-maximum)

[b] Barriers were the following: not enough time to complete activity, disruptive student behavior, student confusion over instructions, inadequate materials provided, language or grammar issues, schoolwide interruption (e.g., fire drill).

Table 2

Health Promotion Coordinator Ratings Related to FLASH Implementation[a]

Aspect of Program Implementation	*Spring 2007*	*Fall 2007*	*Spring 2008*	*Fall 2008*
Teacher receptive to FLASH training	4.0 (0.8)	4.0 (0.9)	4.2 (0.8)	4.0 (0.5)
Teacher receptive to delivering FLASH	4.0 (0.9)	4.6 (0.5)	4.5 (0.7)	4.2 (0.7)
FLASH implemented accurately according to teacher manual	4.0 (0.8)	4.4 (0.5)	4.5 (0.6)	4.3 (0.5)
Students interested in FLASH activities	3.4 (0.7)	3.6 (0.7)	3.7 (0.5)	3.7 (0.4)

NOTE: FLASH = Fun Learning Activities for Student Health.

[a] Mean (SD) from Likert-type scale where 1 = *not* and 5 = *very*.