

School factors as barriers to and facilitators of a preventive intervention for pediatric type 2 diabetes

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ABSTRACT

School-based interventions are essential to prevent pediatric obesity and type 2 diabetes. School environmental factors influence implementation of these interventions. This article examines how school factors acted as barriers to and facilitators of the HEALTHY intervention. The HEALTHY study was a cluster-randomized trial of a multicomponent intervention implemented in 21 schools. Interview data were analyzed to identify barriers and facilitators. Barriers included teacher frustration that intervention activities detracted from tested subjects, student resistance and misbehavior, classroom management problems, communication equipment problems, lack of teacher/staff engagement, high cost and limited availability of nutritious products, inadequate facility space, and large class sizes. Facilitators included teacher/staff engagement, effective classroom management, student engagement, schools with direct control over food service, support from school leaders, and adequate facilities and equipment. Contextual barriers and facilitators must be taken into account in the design and implementation of school-based health interventions.

KEYWORDS

School, Intervention, Prevention, Health behavior, Diabetes, Obesity

Type 2 diabetes is a chronic and progressive disease with complications that can include heart disease, stroke, kidney failure, loss of vision, and limb amputation [1]. The alarming prevalence of overweight and obesity among American children and adolescents and the connection with type 2 diabetes represent a serious public health concern for the twenty-first century [2, 3]. Researchers estimated that approximately one in three children born in the year 2000 in the United States will develop diabetes in their lifetime [4].

Recent findings on activity and dietary patterns of children and adolescents in the United States

Implications

Practice: School-based obesity interventions should take into account student interests and involvement, classroom skills of teachers delivering the intervention, teacher/staff attitudes, and engagement concerning intervention delivery, menu and product ordering systems, and buy-in from school leadership.

Policy: Policymakers should set higher standards and increase resources for obesity-related professional development for faculty/staff, high-tech school-wide communication systems for health messages, healthful foods and beverages in schools, PE equipment and facilities, and PE and health education programs.

Research: Process evaluation data on contextual barriers and facilitators should be collected and reviewed during the implementation of health interventions.

demonstrate the presence of problematic health behaviors. Findings from the National Survey of Children's Health and the Youth Risk Behavior Survey showed that approximately 78 % of youth did not eat fruits or vegetables five or more times per day [5], 29 % of youth drank a nondiet soda at least once per day [5], 64 % of youth did not engage in 20 min of daily vigorous physical activity for most days of the week [6], and 50 % of youth engaged in sedentary behaviors, such as playing video games or watching television for multiple hours a day [6].

In light of the prevalence of unhealthy dietary and activity patterns among youth and their connections with overweight, obesity, and type 2 diabetes, population-level approaches to improve environmental contexts by promoting physical activity and healthful diet are essential. Schools are ideal settings for basing public health interventions aimed at preventing the development of serious health conditions because of the existing resources and infrastructure, and aside from the home,

children spend most of their time in school. Thus, exposure to an intervention can be intense and continuous and occurs in a natural setting.

Existing research findings demonstrate that schools are inadequately addressing health promotion in terms of nutritional education and services as well as physical education. The School Health Policies and Programs Study, a national survey conducted by the Centers for Disease Control and Prevention to assess school health policies and practices, reported that less than half of middle schools taught a comprehensive list of nutrition, dietary behavior, and physical activity topics in health education courses [7]; one-third of middle schools did not require students in all grades to take a physical education (PE) course; and only 22 % of middle schools provided 225 min of PE per week for at least 18 weeks in the school year [8]. In terms of cafeteria standards, only a handful of states required that schools offer students multiple fruits and nonfried vegetables for lunch, offer healthful beverages like water and low-fat milk, and limit the availability of deep-fried foods [9].

A number of school-based interventions to improve dietary and activity behaviors among youth have been implemented in recent decades, including the HEALTHY study, a school-based primary prevention trial aimed at attenuating the risk factors for pediatric type 2 diabetes [10]. These types of public health interventions typically utilize an ecological systems approach [11] to modify environments and thereby actively and passively influence health behaviors among the target population. Therefore, the successful implementation and effectiveness of these types of interventions depend significantly on school environmental factors. Schools are highly complex systems, which makes the successful delivery of complex, multicomponent health interventions an extraordinary task. In order to improve the design and implementation of effective, feasible, and compatible school-based health interventions, we must better understand how school contextual factors aid or impede the implementation of school-based health intervention programs. The purpose of this article is to examine the influence of school contextual factors on the implementation of the HEALTHY intervention.

METHODS

HEALTHY study design and methods

HEALTHY was a cluster-randomized trial with schools as the cluster [10]. Of the 42 participating schools, 21 received the intervention and 21 were control. Seven field centers throughout the United States administered the study, each overseeing six schools (three intervention and three control), and the field centers were assisted by a coordinating center. Institutional review board approval was obtained at each field center prior to data collection.

Student participants were recruited and assessed at the beginning of sixth grade (mean age=11.8, SD=0.6) and were assessed again at the end of eighth grade for body mass index (BMI), glucose, insulin, lipids, blood pressure, waist circumference, physical activity behavior, sedentary behavior, physical fitness, and dietary intake. The intervention began midway through cohort students' sixth grade year and continued through the end of their eighth grade year. The details of the study design and methods have been reported [10].

The HEALTHY intervention used an integrated interdisciplinary approach within the school environment to influence students' health behaviors. The targeted behaviors of the intervention included (1) increasing water consumption; (2) substituting water for added sugar beverages; (3) drinking water for health, nutrition, and hydration; (4) choosing more healthful foods and drinks for meals and snacks; (5) substituting nutrient dense, lower energy foods for low nutrient, higher energy foods; (6) self-monitoring, goal setting, and problem solving to increase intake of water, fruits, and vegetables; (7) increasing movement and accumulation of time spent being active; (8) decreasing time spent in sedentary behavior; (9) substituting physical activity for sedentary behavior; and (10) self-monitoring, goal setting, and problem solving to increase physical activity and decrease sedentary behavior [10].

The HEALTHY intervention consisted of four integrated treatment arms denoted as behavior, communications, nutrition, and PE. The behavior intervention primarily consisted of classroom-based activities involving workbooks with supplemental learning materials delivered by trained teachers. These activities were called Fun Learning Activities for Student Health (FLASH) [12]. The communications component entailed a social marketing campaign consisting of informational and promotional materials such as posters, flyers, banners, and t-shirts as well as verbal announcements delivered over the public address (PA) system and/or in class. Also, a group of students from the cohort grade called student peer communicators (SPCs) were selected to promote intervention messages and activities [13]. The nutrition intervention component modified food and beverage offerings in the total school food environment, which included meals in the cafeteria, a la carte items, and vending machines. Additionally, events were held in the cafeteria to give students an opportunity taste new offerings (i.e., Taste Tests) and to educate students about dietary health topics (i.e., Cafeteria Learning Labs) [14]. The PE intervention involved training PE teachers to deliver HEALTHY lessons across a variety of units, and each intervention school was provided ample PE equipment as well as a study teaching assistant [15].

The HEALTHY intervention was coordinated by three study interventionists at each field center who worked with school personnel to implement the program. School personnel primarily delivered the

intervention. Study interventionists included the health promotion coordinators (HPCs) who oversaw the behavior and communications components, research dietitians (RDs) who oversaw the nutrition intervention, and physical activity coordinators (PACs) who oversaw the PE intervention component. HPCs trained teachers to deliver FLASH and occasionally observed FLASH sessions and provided feedback and assistance to teachers. HPCs were also actively involved in the selection, preparation, management, and involvement of the SPCs. HPCs also worked with school administrators and staff in the execution of the communications campaign. RDs trained food service personnel at the school and district levels on the goals and rationale for the nutrition intervention. RDs also made recommendations to food service managers and directors regarding the content of recipes, menus, and items included in vending and a la carte sales. RDs often went beyond simply making recommendations and actually assisted food service personnel in making changes to recipes, menus, and product orders/bids. School food service personnel were ultimately responsible for implementing changes and recommendations. RDs also spearheaded the Taste Tests and Cafeteria Learning Labs. PACs trained teachers to implement the HEALTHY PE curriculum with students. PACs also occasionally observed PE classes and provided feedback and guidance to teachers on student, classroom, and equipment management.

Participants

Participants included students, teachers, school administrators, food service personnel, and study interventionists who were interviewed during the course of intervention implementation. These interviews were included in order to gain a comprehensive, multiperspective understanding of barriers and facilitators from the primary actors involved with the HEALTHY intervention. Interview participants included 2,129 students, 36 PE teachers, 34 FLASH teachers, 32 food service personnel, 29 school administrators, and 28 intervention coordinators. Demographic characteristics of interview participants were not collected due to concerns over identifiability and the integrity of responses.

Measures and procedures

The instruments and data used in the present study were originally included as part of the process evaluation in order to examine the implementation of HEALTHY. The process evaluation was based on a conceptual framework outlined by Linnan and Steckler [16]; thus, measures assessed a variety of variables, two of which were *barriers* and *facilitators*. The process data also captured the dynamics between the HEALTHY intervention and aspects of the school environment. Process data collection spanned five semesters (spring 2007, fall 2007,

spring 2008, fall 2008, and spring 2009) in which the intervention was delivered. Interviewers from each field center were centrally trained at study group meetings on procedures for completing the structured interviews. None of the interviewers were involved with intervention delivery. At the conclusion of each semester, the interview data were transferred to the study's qualitative data core for analysis. The details about the HEALTHY process evaluation design and methods have been reported elsewhere [17].

Student interviews

At least 20 consented students were individually interviewed at each intervention school each semester (spring 2007, fall 2007, spring 2008, fall 2008, and spring 2009) using a structured interview form. Students were interviewed on site, typically during elective periods, and each interview lasted approximately 10 min. Interviewers hand-recorded verbatim responses from students during the interviews. The instrument included four open-ended questions asking students what they noticed about each intervention component: "What did you notice about HEALTHY in your FLASH classes? What did you notice about HEALTHY in the cafeteria? What did you notice about HEALTHY in your PE classes? What did you notice about HEALTHY messages around the school?" Due to the open-ended nature of the questions, students were able to mention problems they noticed during intervention delivery as well as facilitators for each intervention component. Students were selected via a semirandom procedure using a master list of consented students. If a randomly selected student was absent on the day interviews were conducted, another student was interviewed instead. Given this repeated, semirandom procedure, some students were interviewed once while others were interviewed multiple times. Students did not receive incentives for participating in the interviews. Individual student interviews for each intervention school were aggregated each semester into one key point summary. A key point summary was an aggregation of the major points from a group of about 20 interviews, and a key point summary included only salient or illustrative quotes from participants as opposed to full transcripts. The process of creating key point summaries has been previously described [17]. Thus, although 2,129 individual student interviews were completed, they were aggregated into 105 key point summaries.

Intervention coordinator interviews

The three study interventionists (HPC, RD, and PAC) at each field center who coordinated the implementation of the four intervention components were interviewed at the end of each semester (spring 2007, fall 2007, spring 2008, fall 2008, and spring 2009) using a structured interview form. These interviews included a number of questions regarding

barriers and facilitators: “Were there any barriers encountered during the implementation of [each intervention component]? Were certain intervention activities more successfully implemented than others? Why were some components more successfully implemented? Please identify any barriers to the integration of HEALTHY at this school. Were there particular qualities of the people at this school that made the implementation of activities more or less difficult? If so, what were these qualities and how did they impact implementation? Were there aspects of the school environment that made the implementation of activities more or less difficult? If so, what were these aspects and what were their effects?” These interviews were audio recorded as each interview typically lasted 45 min. Interventionists did not receive incentives for participating. Over the course of the study, a total of 231 interviews were completed with the 28 intervention coordinators.

School personnel interviews

An administrator (e.g., school principal or assistant principal) from each intervention school was interviewed at the end of each school year (i.e., spring 2007, spring 2008, and spring 2009); thus, a total of 63 school administrator interviews were completed. Also, other school personnel directly involved with delivering the intervention were interviewed once during the last two intervention semesters (fall 2008 and spring 2009). These personnel included 36 PE teachers, 34 FLASH teachers, 21 school food service managers, and 11 school district food service directors. These interviews assessed barriers and facilitators with the following questions: “Which intervention components were the easiest for your school to implement? Why? Which intervention components were the hardest for your school to implement? Why? What were some of the problems or challenges you encountered when implementing [each intervention component]?” These interviews lasted 45 to 60 min, and each participant received a \$10 gift card for participating in an interview. These interviews were audio recorded and transcribed. School personnel interviews were conducted less frequently than student and intervention coordinator interviews to minimize the burden for school personnel who were already responsible for delivering the intervention.

Data coding and analysis

We used qualitative content analysis to systematically code the text data from the 105 student interview key point summaries, 231 intervention coordinator interviews, and 165 school personnel interviews. First, two codes with definitions were developed for the process variables of barriers and facilitators. Barriers were defined as problems encountered in implementing intervention components and reaching participants, and we defined facilitators

as elements that promoted the successful implementation of intervention components and reaching participants. Moreover, barriers and facilitators had to be part of the school environment and not part of the HEALTHY intervention itself, such as a flaw or weakness of an intervention component.

Due to the nature of HEALTHY, the ecological systems framework [11] guided the conceptualization of the school environment for coding and analysis purposes. The ecological systems perspective posits that individuals are nested in various ecological contexts but individuals also play a role in shaping these systems. Systems include various actors, resources, structures, relationships, processes, and outcomes. Systems are often permeable—they are influenced by factors within and outside the system. Therefore, we decided to consider the multiple environments of a school, the sociocultural, organizational, and physical environments. We also decided to consider the individuals and groups involved with the schools as part of the school environment as well as the characteristics of and interactions between these individuals and groups. We also kept the goals and functions of schools in mind when conceptualizing the school context. The school environment was broadly defined to include physical, organizational, and psychosocial elements. Physical components included school facilities, materials, and resources. Organizational components included school programs and services, policies and laws governing the school, and relationships between the school and other organizations. Finally, psychosocial components included knowledge, skills, attitudes, interests, and behaviors of school members (i.e., students, teachers, administrators, staff, and parents) as well as interactions between school members.

The data were coded by eight research assistants who were collectively trained on the coding system and protocol by the first author. To assess consistency, prior to coding, the coders independently coded a passage selected from an interview. Comparison of the coded passages showed that 87.5 % of the coders had coded the passage the same, which suggested good intercoder agreement. Furthermore, questions about how to code certain segments of text data were addressed as needed during the coding process between the coders and the first author. ATLAS.ti (version 5.2) assisted with data coding and analysis. During coding, relevant segments of text were labeled as either a barrier or facilitator. Then, the coded data were systematically sorted into one of five intervention categories (behavior, communications, nutrition, PE, or HEALTHY program overall) based on which aspect of the intervention the factor aided or impeded. Structuring the coded data in this manner allowed for a thematic content analysis of the different barriers and facilitators for each intervention category based on the known universe of responses. Finally, the first author reviewed the coded and categorized data to aggregate themes and determined their frequency, which is the

number of times the theme was mentioned. Based on the number of interviews conducted, the different types of participants included, the specificity of the research objectives, and the emergence of themes from the data, we concluded that themes reached saturation.

RESULTS

The findings are summarized in Table 1, which shows (1) the barriers and facilitators for each intervention component as well as the HEALTHY program overall, (2) the frequency or number of times the barrier or facilitator was mentioned in the interviews, and (3) illustrative quotes from participants that correspond to the more frequently mentioned barriers and facilitators. Certain barriers and facilitators represent different sides of a common factor (e.g., acceptance and support of the intervention from teachers versus a lack of support and resistance to the intervention from teachers). Other barriers and facilitators were independent, unique factors (e.g., pressure for teachers to use class time to prepare students for standardized testing).

DISCUSSION

These findings provide a comprehensive description of the constraining and facilitating roles that school environmental factors played during the HEALTHY study. The barriers and facilitators documented during the HEALTHY study are similar to those reported in similar school-based intervention studies promoting physical activity and/or nutrition, including Lifestyle Education for Activity Program (LEAP), Middle-School Physical Activity and Nutrition (M-SPAN), Pathways, Peers Running Organized Play (PROPS), Physical Activity Across the Curriculum (PAAC), and Trial of Activity for Adolescent Girls (TAAG) [18–25]. Common facilitators reported include interest and support from various school members (i.e., school board member, school administrators, school office staff, teachers, students, and parents), schools that had made physical activity and nutrition a priority prior to study, schools already implementing practices and strategies similar to intervention components, teachers collaborating with one another during implementation, and teachers and food service staff who were motivated and actively engaged in intervention implementation [18–22].

Many of the barriers reported by these studies also emerged during HEALTHY. These barriers include financial constraints in the school food service system, inadequate facility space to implement activities or store equipment, lack of school personnel to deliver intervention components, and faculty and staff turnover [18–20, 22–24]. Other barriers related to logistical issues in terms of food and beverage ordering problems, school districts with highly centralized food service systems imped-

ing individual school nutrition changes, school scheduling problems, and teacher time constraints [18–20, 22–25]. Some teachers reported being unable to implement intervention components due to school prioritization of nonhealth-related curricula and standardized testing requirements. A number of barriers related to teachers or food service staff, including resistance to change, lack of motivation and participation in intervention delivery, lack of compliance in intervention delivery, and lack of communication and cooperation among teachers and staff in intervention implementation [18, 20, 22, 25]. Finally, student barriers related to decreases in student interest in intervention activities over time [19, 22].

Limitations

The present study has several limitations. First, demographic characteristics of participants were not collected. Although certain participants may have felt more comfortable and willing to disclose genuine responses due to the anonymous and unidentifiable nature of the interviews, demographic data would have been valuable. Second, the interview data collection schedule was not standardized across participants—certain interviews were administered each intervention semester (e.g., student interviews), whereas others were only administered during the last two semesters of the study (e.g., teacher interviews). Also, some participants were interviewed multiple times (e.g., study intervention coordinators), whereas others were interviewed only once (e.g., teachers). Although the data collection schedule was intentionally based on concerns of respondent burden, this may have favored certain participants and biased responses in the data. This lack of data collection consistency also precludes a comprehensive analysis of trends in barriers and facilitators over the course of the study.

Implications

The barriers and facilitators identified during HEALTHY have implications for school-based health promotion in terms of nutrition and physical activity. Our findings suggest that classroom-based health behavior interventions are best suited to be included in health courses as opposed to language arts, science, and social studies courses. Intervention trainings with implementors should incorporate classroom management strategies as poor classroom management was a common barrier. Behavior intervention activities may need to be developed or revised with input from youth in order to maximize developmental appeal and avoid a drop in interest over time. Having the same set of teachers deliver a behavior intervention through the course of a school year may maximize consistency and accuracy of implementation.

Table 1 | Barriers to and facilitators of HEALTHY

Barrier or facilitator	Frequency	Illustrative quotes
Barriers to the behavior intervention component		
Teacher frustration that FLASH took time away from regular course content and standardized test preparation	21	School administrator: "Teachers are reluctant to give up their instructional time. No matter how great or fun or what the benefits are, they feel so pressured to get in all of their standard curriculum."
Student misbehavior during FLASH	16	
Teachers who poorly prepared for FLASH or lacked classroom management	12	
Lack of student interest and participation	9	HPC: "[As some students became older,] they act like they're too cool for school and don't participate."
Students who developed negative attitudes toward FLASH over time	7	
FLASH was not a good fit in certain classes (e.g., English and social studies)	4	
Facilitators of the behavior intervention component		
Teacher interest and engagement in preparing for and implementing FLASH	17	HPC: "[These FLASH teachers were] always excited to be involved and to learn about what they will be doing and how they can enhance the lessons we provide them to make the best experience possible for the kids. They're excited about it—their enthusiasm is definitely infectious. The kids pay attention and get what we're trying to teach them and really absorb the material."
Teachers effectively managing their FLASH classes	14	
Student interest and engagement in FLASH activities	11	
Teachers delivering FLASH according to protocol	7	
Barriers to the communications intervention component		
PA announcements that were "garbled" and "hard to hear" or students simply did not pay attention to the announcements	17	HPC: "We have limited time where we can meet with the SPCs outside of their classes to train them and fully utilize them in the activities. Trainings were often rushed, and sometimes the teachers would not allow them to come down for trainings due to their behavior."
Students who defaced or tore down HEALTHY posters	8	
HEALTHY posters falling down due to adhesion problems	6	
Lack of time during the school day to prepare and effectively use SPCs for HEALTHY events and activities	6	
Facilitators of the communications intervention component		
Student interest in student generated media (i.e., creating HEALTHY posters using images and messages from real students in intervention schools)	11	HPC: "Students were very willing to participate and enjoyed seeing themselves on the posters."
Positive attitudes and social skills of SPCs	9	HPC: "The SPCs are a really good group of kids. They are really outgoing and are willing to do whatever we ask them to do. They are always willing to help us."
Support from school administrators and staff in hanging communications materials and coordinating HEALTHY events	4	
Barriers to the nutrition intervention component		
Lack of availability of high fiber and low fat foods to bring into schools	53	Student: "They changed our lunches—took away the good stuff!"
Student resistance to food and beverage changes	46	School food service manager: "The hardest thing at our school was just trying to get the kids used to new items."
Resistance to changing menus because of budgetary concerns	40	
Rising costs of healthful and nutritious foods	32	
Vending machines operated by outside parties who would not comply with HEALTHY requirements	22	RD: "Healthier items are at a higher cost and it's difficult to get those items within the school nutrition budget."
Lack of cooperation from school food service personnel in implementing nutrition changes	19	
Limited variety of nutritious, healthful products in order to vary menus	17	

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Table 1 | (continued)

Lengthy and difficult process to add new healthful items to food service department bids and to change recipes	17	RD: "Pizza was very difficult to replace—difficult to find a healthy pizza that the kids liked at a price the district was willing to pay."
Healthful meals that were time- and labor-intensive to prepare	13	
Small or noisy cafeterias that were not conducive to Taste Tests and Cafeteria Learning Labs	13	
State policies that were counter to HEALTHY goals (e.g., serving 2 % milk or serving meals with high calorie requirements)	11	RD: "It just takes a while for the district to want to actually make all of the changes and work with you to make the changes. It takes time to build those relationships and for them to buy into it."
Facilitators of the nutrition intervention component		
School food service managers who accepted and supported the nutrition intervention, were open to food service changes, collaborated with the RDs, and took the initiative in making changes	24	RD: "[This food service manager and her staff] are a lot more open to recommendations, new products, new recipes, new ways of cooking, new ways of presenting items, new ways of preparing food."
School district food service directors who encouraged and supported food service managers in making changes, were responsive to RD requests to change recipes, and added more healthful products to bids	18	
Schools that had already made some changes to their food and beverage service prior to the study	18	RD: "Having a nutrition supervisor and food service manager that were 200 % on board, who went above and beyond was so helpful."
Students who were open and receptive to nutrition changes	14	
Food service managers who had authority and direct control over what products were ordered and what got on school menus	7	
District- or state-level policies prohibiting certain unhealthful foods and beverages being served (e.g., candy or whole milk)	7	Teacher: "There were a lot of kids who were trying to do what they were supposed to do and actually interested in making those changes."
Availability of healthful products to replace unhealthful items	6	
Barriers to the physical education intervention component		
Lack of teacher preparation for and engagement in implementing HEALTHY PE lessons and activities	29	Teacher: "You're gonna have the same ones that never want to participate and always just want to be in their little social group."
Students who do not want to participate in PE activities	14	
Teachers with poor classroom management skills	12	
Inadequate gym space for HEALTHY PE activities	12	Teacher: "It was just difficult sometimes to get things done or keep the kids real active cause the space was so limited."
PE classes with too many students	11	
Teachers who were resistant to the HEALTHY PE intervention	10	
Poor use and management of PE equipment	10	Teacher: "[Some of my colleagues] would not really take to it because they don't want to change their old techniques and their old lesson plans."
School administrators who did not value or support PE compared to other courses	9	
PE teachers who were "burned out" and "don't care anymore"	8	
Students who is behaved during PE	8	PAC: "Some of the teachers had bad attitudes or apathy. It's hard to change. And those attitudes tend to translate to bad results in the classroom."
Students who became bored with repetitive PE activities	4	
Lack of coordination and teamwork of team-taught PE classes	4	
Facilitators of the physical education intervention component		

Table 1 | (continued)

Teachers who prepared for and were engaged in implementing the HEALTHY PE lessons	42	PAC: “[Two teachers at this school] are very engaged in implementing the units. They take their jobs very seriously and they read over each lesson plan ahead of time.”
PE teachers who were “highly skilled” in classroom management, content areas, and classroom instruction	20	
Teachers who modified the HEALTHY PE lessons and activities to better fit their students and settings	20	
PE teachers who were receptive to constructive feedback from the PACs	16	PAC: “One of the teachers was very creative with making adjustments to the lessons. She would often make them better. She came up with very creative ways to use the space so that the students would keep up with MVPA.”
Schools with ample PE equipment and adequate PE facilities (i.e., gym space or outdoor fields)	13	
Students who were willing to participate in the HEALTHY PE activities	9	
Schools with mandated in-service days for PE teachers aided in training HEALTHY PE teachers	9	Teacher: “Students usually want to engage in the games—they want to play and be active so they participate.”
Barriers to the HEALTHY intervention program overall		
Resistance from students and teachers to HEALTHY changes	15	School district food service director: “I think it's resistance to change on the student level or with the adults that work with us—when you come in with any new concept, you are going to have some resistance.”
Lack of support for and acceptance of the program by teachers and school administrators	11	
Decrease in student motivation for HEALTHY due to an attitude change during the latter part of the study	9	
Facilitators of the HEALTHY intervention program overall		
Students being interested in and liking HEALTHY	30	HPC: “This school is much less difficult than our other schools. The principal is easygoing. She lets us do what we need to do. We are actually appreciated at this school.”
Support for the HEALTHY program from teachers	17	
Support for the program from school administrators	16	
Teachers collaborating with one another	3	

In terms of social marketing-based communication interventions, our findings suggest that messages should be delivered through contemporary audiovisual formats as outdated PA systems may not be effective in reaching youth growing up in a digital age. In addition, SPCs who represented the HEALTHY program to their fellow students should be chosen carefully. Ideal candidates would be students who are respected and influential among their peers and cooperative with adults in delivering activities.

A number of school environmental factors need to be considered in terms of a planned nutrition intervention. To minimize resistance from students and school personnel to cafeteria changes, nutritional education should be used proactively in anticipation of food service changes. Findings also suggest a need for more affordable, nutritious alternatives to unhealthful menu items. Even during the course of the HEALTHY study, new options came on the market, and vendors continue to expand their

healthful alternatives in response to public demand for better nutritional offerings at school. These expanded offerings are making it easier for schools to replace unhealthful items with better alternatives within a given budget. In these times of financial strain within the public school system, it is to be expected that food service staff may resist adding to their workload by putting more labor into preparing fresh foods. Consequently, food service interventions should follow a principle of minimizing the additional preparation time required to offer more healthful alternatives. A critical element to success is securing buy-in from school food service managers and school district directors when making extensive changes to school food environments.

In terms of PE interventions, PE teacher trainings should cover classroom management skills, effective use of PE equipment, and preparation for class as these were prominent barriers. Although lower teacher-to-student ratios (e.g., 1 to 25) would likely maximize

student activity levels and instructional effectiveness, in the absence of this possibility, teachers should be instructed in innovative methods for managing large class sizes. In addition, effective PE teachers are invaluable and should be recognized, rewarded, and held up as models for less effective PE teachers. Another implication for practice relates to modifying PE lessons. Although manualized PE interventions usually call for high fidelity in terms of implementing lessons and activities exactly according to protocol, flexibility in allowing teachers to modify activities for their particular student population and setting may facilitate student activity. Finally, having sufficient PE equipment and facilities is essential to for implementing PE activities and maximizing student engagement in MVPA. Without adequate equipment, a PE intervention faces a very high likelihood of being poorly implemented.

Finally, when considering the overall HEALTHY intervention, the importance of acceptance and support from students, teachers, staff, and administrators cannot be emphasized enough. Support for the intervention from leaders at the school and district levels was crucial to the implementation of the HEALTHY study. This support can be cultivated by demonstrating respect for the school administration, faculty, and students by structuring an intervention to be a positive contribution to the school experience and by integrating the intervention into ongoing school activities and priorities. The HEALTHY study accomplished these goals by providing personnel to assist school staff in their daily jobs, by seeking input from faculty and administration at all points in the study, and by participating in school events when invited.

CONCLUSION

The outcome results for HEALTHY were recently reported [26]. Statistically significant differences between intervention and control schools were found for BMI z-score, waist circumference at or above the 90th percentile, and fasting insulin levels. Marginally significant differences were found between intervention and control schools in the percentage of students with BMI at or above the 95th percentile. Recent and forthcoming reports on the implementation of HEALTHY components indicate moderate to high fidelity [27–29]. However, one could speculate that more successful implementation and, consequently, more pronounced differences could have been attained if school-related barriers had been minimized and facilitators maximized during the study.

Additional research on contextual factors that aid or constrain health promotion efforts will inform the design and implementation of effective interventions. Researchers and evaluators need to consistently collect process data concerning the strengths and limitations of interventions as well as the

barriers and facilitators related to the context of interventions. Intervention settings play a significant role in shaping the success or failure of an intervention.

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- Centers for Disease Control and Prevention. National diabetes fact sheet: national estimates and general information on diabetes and prediabetes in the United States, 2011. U.S. Department of Health and Human Services; 2011.
- Ogden CL, Carroll MD, Flegal KM. High body mass index for age among U.S. children and adolescents 2003–2006. *JAMA*. 2008;299:2401–2405.
- Hannon TS, Rao G, Arslanian SA. Childhood obesity and type 2 diabetes mellitus. *Pediatrics*. 2005; 116: 473–480.
- Venkat Narayan KM, Boyle JP, Thompson TJ, Sorensen SW, Williamson DF. Lifetime risk for diabetes mellitus in the United States. *JAMA*. 2003; 290: 1884–1890.
- Centers for Disease Control and Prevention. Youth risk behavior surveillance—United States, 2009. *MMWR Morb Mortal Wkly Rep*. 2010; 59: 1–148.
- Child and Adolescent Health Measurement Initiative. National Survey of Children's Health, Data Resource Center for Child and Adolescent Health (on-line). Available at: www.nschdata.org. Accessed January 5, 2012.
- Kann L, Telljohann SK, Wooley SF. Health education: results from the School Health Policies and Programs Study 2006. *J Sch Health*. 2007; 77: 408–434.
- Lee SM, Burgeson CR, Fulton JE, Spain CG. Physical education and physical activity: results from the School Health Policies and Programs Study 2006. *J Sch Health*. 2007; 77: 435–463.
- O'Toole TP, Anderson S, Miller C, Guthrie J. Nutrition services and foods and beverages available at school: results from the School Health Policies and Programs Study 2006. *J Sch Health*. 2007; 77: 500–521.
- HEALTHY Study Group. HEALTHY study rationale, design and methods: moderating risk of type 2 diabetes in multi-ethnic middle school students. *Int J Obes*. 2009; 33: S4–S20.
- Sallis JF, Owen N, Fisher EB. Ecological models of health behavior. In: Glanz K, Rimer BK, Viswanath K, eds. *Health Behavior and Health Education: Theory, Research, and Practice*. 4th ed. San Francisco: Jossey-Bass; 2008:465–486.

12. Venditti EM, Elliot DL, Faith MS, et al. Rationale, design and methods of the HEALTHY study behavior intervention component. *Int J Obes.* 2009; 33: S44-S51.
13. DeBar LL, Schneider M, Ford EG, et al. Social marketing-based communications to integrate and support the HEALTHY study intervention. *Int J Obes.* 2009; 33: S52-S59.
14. Gillis B, Mobley C, Stadler DD, et al. Rationale, design and methods of the HEALTHY study nutrition intervention component. *Int J Obes.* 2009; 33: S29-S36.
15. McMurray RG, Bassin S, Jago R, et al. Rationale, design and methods of the HEALTHY study physical education intervention component. *Int J Obes.* 2009; 33: S37-S43.
16. Linnan L, Steckler A. Process evaluation for public health interventions and research: an overview. In: Steckler A, Linnan L, eds. *Process Evaluation for Public Health Intervention and Research.* San Francisco: Jossey-Bass; 2002:1-23.
17. Schneider M, Hall WJ, Hernandez AE, et al. Rationale, design and methods for process evaluation in the HEALTHY study. *Int J Obes.* 2009; 33: S60-S67.
18. Bowes D, Marquis M, Young W, Holowaty P, Isaac W. Process evaluation of a school-based intervention to increase physical activity and reduce bullying. *Health Promot Pract.* 2008; 10: 394-401.
19. Gibson CA, Smith BK, DuBose KD, et al. Physical activity across the curriculum: year one process evaluation results. *Int J Behav Nutr Phys Act.* 2008; 5: 1-11.
20. Gittelsohn J, Merkle S, Story M, et al. School climate and implementation of the Pathways study. *Prev Med.* 2003; 37: S97-S106.
21. Saunders RP, Ward D, Felton GM, Dowda M, Pate RR. Examining the link between program implementation and behavior outcomes in the lifestyle education for activity program (LEAP). *Eval Program Plann.* 2006; 29: 352-364.
22. Steckler A, Ethelbah B, Martin CJ, et al. Pathways process evaluation results: a school-based prevention trial to promote healthful diet and physical activity in American Indian third, fourth, and fifth grade students. *Prev Med.* 2003; 37: S80-S90.
23. Sallis JF, McKenzie TL, Conway TL, et al. Environmental interventions for eating and physical activity. *Am J Prev Med.* 2003; 24: 209-217.
24. Ward DS, Saunders R, Felton GM, Williams E, Epping JN, Pate RR. Implementation of a school environment intervention to increase physical activity in high school girls. *Health Educ Res.* 2006; 21: 896-910.
25. Young DR, Steckler A, Cohen S, et al. Process evaluation results from a school- and community-linked intervention: the Trial of Activity for Adolescent Girls (TAAG). *Health Educ Res.* 2008; 23: 976-986.
26. HEALTHY Study Group. A school-based intervention for diabetes risk reduction. *N Engl J Med.* 2010; 363: 443-453.
27. Hall WJ, Zeveloff A, Steckler A, et al. Process evaluation results for the HEALTHY physical education intervention. *Health Educ Res.* 2012; 27: 307-318.
28. Mobley CC, Stadler DD, Staten MA, et al. Effect of nutrition changes on foods selected by students in a middle school-based diabetes prevention intervention program: The HEALTHY experience. *J Sch Health.* 2012; 82: 82-90.
29. Schneider M, DeBar L, Calingo A, et al. The effect of a communications campaign on middle school students' nutrition and physical activity: results of the HEALTHY study. *J Health Commun.* 2013; 18: 649-667.