RESEARCH ARTICLE

Adapted Intervention Mapping: A Strategic Planning Process for Increasing Physical Activity and Healthy Eating Opportunities in Schools via Environment and Policy Change

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──────────── ABSTRACT ────────────

BACKGROUND: School environment and policy changes have increased healthy eating and physical activity; however, there has been modest success in translating research findings to practice. The School Environment Project tested whether an adapted version of Intervention Mapping (AIM) resulted in school change.

METHODS: Using a pair randomized design, 10 rural elementary schools were assigned to AIM or the School Health Index (SHI). Baseline measures were collected fall 2005, AIM was conducted 2005-2006, and follow-up measures were collected fall 2006 and 2007. Outcome measures included number and type of effective environment and policy changes implemented; process measures included the extent to which 11 implementation steps were used.

RESULTS: AIM schools made an average of 4.4 effective changes per school with 90% still in place a year later. SHI schools made an average of 0.6 effective changes with 66% in place a year later. Implementation steps distinguishing AIM from SHI included use of external, trained facilitators; principal involvement; explicitly stating the student behavior goals; identifying effective environment and policy changes; prioritizing potential changes based on importance and feasibility; and developing an action plan.

CONCLUSION: The AIM process led to environment and policy changes known to increase healthy eating and physical activity.

Keywords: nutrition and diet; physical activity; program planning.

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Approximately 3 out of 10 children in the United States are overweight or obese[1] and therefore at greater risk for obesity in adulthood[2] and chronic diseases such as heart disease, diabetes, and cancer.[3] Whereas childhood obesity rates are holding steady nationally,[1] they are on the rise in Colorado (9.9% in 2003 and 14.2% in 2007)[4] with rural children having higher overweight rates than urban children (28.8% vs 20.5%).[5] Public schools are important settings for promoting health behaviors and reversing obesity trends[6] and this is perhaps even more the case in rural settings which have a unique set of public health challenges due to being low income,[7] having low population density,[8] fewer opportunities for physical activity,[9] and greater travel distances to reach activity opportunities.[10] Recess and physical education (PE) are sometimes the sole place where rural children report getting physical activity[11] and because of high poverty rates, they tend to eat both breakfast and lunch at school.

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The availability of unhealthy foods in schools combined with limited opportunities for daily physical activity continue to undermine schools' potential to promote healthy behaviors.[12,13] At the time this study was conducted (2005-2006), several intervention strategies were known to relate to students' healthy eating and physical activity during the school day. School environment and policy features associated with healthy food consumption included high availability of fruits and vegetables and low accessibility of high- fat/sugar items;[14-18] recess before lunch;[19,20] verbal encouragement to choose fruits and vegetables;[17] taste tests;[21] farm-to-school programs;[22] foodservice staff using the offer versus serve approach which allows students to choose the lunch items they prefer;[23] removing sweetened beverages and school stores;[24] not offering French fries;[24] removing à la carte, vending, snack bar, school store, and dessert items;[25] and government fruit and vegetable programs.[25] School environment and policy features associated with increased physical activity included adding or lengthening PE classes and increasing students' activity levels during PE class;[26] implementing evidence-based PE curricula;[27-30] having a policy requiring a minimum of 30 minutes of daily PE;[31] making balls available to children during recess;[32] providing organized activities and encouraging students to be active during recess;[33] providing high levels of supervision;[34] and making physical improvements to the play space such as basketball hoops and courts, baseball backstops, and volleyball nets.[34]

Several community-based initiatives have succeeded in implementing best practices in schools in both urban[35-38] and rural settings.[39] In addition, the Centers for Disease Control and Prevention (CDC) has played an instrumental role in developing tools to assist schools in addressing student health issues.[40] The CDC's School Health Index (SHI)[41] is a self-assessment and planning guide to help schools address health promotion policies and practices related to healthy eating; physical activity; and the prevention of tobacco use, unintentional injury, and violence. A nationwide study[42] showed that in using the SHI, schools were focusing on a subset of nutrition initiatives and not addressing the entire set of recommendations, particularly in the areas of health and PE, suggesting that facilitation was needed to improve the effectiveness of the SHI tool for changing policies and practices. The *Border Health ¡Sí!* Project successfully used the SHI to create environment and policy changes that reduce access to unhealthy foods and increase opportunities for physical activity.[43] Four additional studies of the SHI found mixed results but identified strong principal involvement, positive staff morale, and external facilitation as the key factors in a school's success.[44-47] However, even when those elements were in place, schools did not necessarily complete the SHI modules they originally sought to finish, nor did they choose to implement effective strategies related to increasing physical activity and healthy eating. Instead, schools chose to implement changes such as hand washing,[44,45] publishing information in parent newsletters,[44] a health fair,[46] or cardiopulmonary resuscitation training.[47] In cases where schools selected a change related to increasing healthy eating and/or physical activity, implementation did not always occur due to lack of buy-in, staff turnover, or impending school closure.[44] The SHI manual underscores the importance of garnering support from school administrators and finding a trained external facilitator to guide coordinated school health teams through the assessment and planning process. However, in 2005, the SHI did not include a facilitator's manual or a set of instructions on how to guide a group through the assessment and planning process.

Rural school administrators and teachers have limited time and resources to address student wellness issues due to wearing multiple hats and facing competing priorities including high-stakes testing.[48] Thus it is important to find ways to support these schools in their efforts to increase school-based healthy eating and activity opportunities. University researchers are well positioned to partner with schools to implement environment and policy changes as they possess knowledge and skills related to best practices. This paper describes such a partnership in which the Rocky Mountain Prevention Research Center (RMPRC) collaborated with schools from a rural, low income area of Colorado in the School Environment Project. The goal of the project was to implement environment and policy changes related to nutrition and physical activity using an adapted version of Intervention Mapping (AIM). AIM is a strategic planning process for evidence-based health promotion

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in school settings[49] and is based on Intervention Mapping[50-52] and principles of community-based participatory research.[53]

We previously described the extent to which AIM could be used as a community-based participatory research tool for university and elementary school partners to plan and implement an intervention aimed at making school-level environment and policy changes to increase opportunities for physical activity and healthy eating.[49] In this paper, we examine the extent to which AIM led to implementation of environment and policy changes related to increased opportunities for physical activity and healthy eating and the extent to which each school's planning process incorporated implementation steps we believe are necessary for evidence-based health promotion change to occur and be sustained in school settings. Based on Intervention Mapping,[50-52] lessons learned from studies of the SHI,[43-47] and key characteristics of evidence-based decision making and the training approach for evidence-based public health put forth by Brownson and colleagues,[54,55] these steps include hiring and training an outside facilitator; requiring and ensuring active participation from the principal; assembling and ensuring consistent participation of a school taskforce; conducting a problem analysis of student and school-level factors related to unhealthy eating and physical inactivity; explicitly stating the expected outcome of the intervention; identifying effective, promising, and emerging initiatives; selecting initiatives to implement based on importance and feasibility; developing an action plan; implementing initiatives; assessing the extent to which new initiatives are working in the school community; and planning for sustaining initiatives.

METHODS

Participants

All 13 public elementary schools in a rural intermountain valley in south-central Colorado that is roughly the size of Connecticut were invited to participate in the study. Ten agreed; mean enrollment across schools was 203 (range: 68 to 360), of whom 53% were Hispanic (range: 20% to 93%), and 69% received free or reduced lunch (range: 33% to 88%).

Procedure

Study Design. The School Environment Project used a pair randomized design, with the school as the unit of intervention and analysis. Schools were paired based on number of students, percentage of free/reduced lunch, and percentage of Hispanic. In spring 2005, schools were assigned to either AIM (N = 5) or the SHI (N = 5) by the flip of a coin. Baseline measures were collected in fall 2005 and the interventions were conducted during the 2005-2006 school year and through fall 2006. Follow-up measures were collected in fall 2006 and fall 2007. The Colorado Multiple Institutional Review Board approved the study.

Intervention Overview. The goal of the intervention was to make environment and policy changes in elementary schools in order to increase opportunities for students to be physically active and eat healthy foods during the school day.

AIM Schools. AIM consisted of 12 meetings led by trained, external facilitators. Table 1 describes each of the 12 AIM meetings. Each meeting took approximately 2 hours to complete and was held in the school building before, during, or after the school day. AIM schools formed taskforces and were asked to attend AIM meetings to evaluate their school environment and then to select and implement changes. AIM required an external facilitator to lead the taskforce through the strategic planning process. External facilitators received training on using PRECEDE[56] for the needs and assets assessment, national recommendations for children's daily diet and activity behaviors, and effective practices for increasing school-based opportunities for physical activity and healthy eating. They were equipped with third party resources and toolkits to share with taskforces (such as how to implement breakfast in the classroom and how to reverse lunch and recess). Facilitators received ongoing demonstrations, coaching and mentoring from the principal investigator and attended relevant professional development opportunities.

Two professional research assistants (PRAs), 1 from the community and 1 who relocated to the community for this position, were trained in the AIM process and helped develop meeting agendas, scripts, and materials for each of the 12 meetings. Each PRA worked approximately half-time on the School Environment Project. The PRA from the community met with each school principal and requested that a taskforce be assembled comprising the principal, foodservice manager/director, PE teacher, classroom teacher(s), parent(s), school nurse, and other interested parties. The PRAs met with each taskforce up to 12 times over a 12-month period. At each meeting, they followed the AIM Facilitation Guide, took turns leading sections of the meeting and taking notes, and jointly completed a debriefing form at the conclusion of the session.

SHI Schools. In fall 2005, one of the PRAs contacted principals in each SHI school to review the SHI process. The principal was encouraged to invite members of the school staff such as the foodservice manager, school nurse, and PE teacher to the meeting; however this never happened. In 3 schools, the PRA met with the principal. In the other 2 schools, the PRA met with other school staff members and the principal did not attend the meeting. The PRA provided schools with

Table 1. Description of AIM Meetings

	Meeting	Topic
Assess	1	Introductions, overview of project goals, establish meeting norms, decision-making processes, and other ground rules to create healthy group functioning; select a school liaison to be the point person for the facilitator.
	2	Complete PRECEDE model Phases 3 & 4 re: behavior and environmental factors and associated determinants of inactivity and poor eating by collecting student-level behavior data, completing a school-level environment and policy assessment tool, and brainstorming the following: "What student behaviors may be contributing to poor eating and inactivity throughout the school day?" "What aspects about your school environment and policies contribute to inactivity and poor eating?" "What knowledge, attitudes, beliefs, external pressures, competing priorities, resources/lack of resources etc. does the school community have that contribute to decisions limiting activity and healthy eating?" "What student behaviors and school features contribute to healthy behaviors?" Task force members are invited to collect additional information about school environment/policies and student behavior (eg, informal survey on number of students eating breakfast).
Investigate	3&4	Decide on effective environment and policy changes to implement: 1. AIM facilitators share national dietary and physical activity guidelines and recommendations; 2. Task force brainstorms changes to help children achieve daily recommendations; 3. AIM facilitators share information from the literature about effective changes; 4. Task force members individually rate each of the proposed changes based on importance (is this an evidence-based strategy known to increase activity/healthy eating, will it affect the majority of students on the majority of school days) and feasibility (do we have the resources, will, capacity to do this); 5. Brainstorm ideas are plotted on a poster with 4 quadrants: high importance/low feasibility; high importance/high feasibility; low importance/ low feasibility; low importance/high feasibility; 6. After a discussion of the results (usually focused on ideas in the high importance/low feasibility; high importance/high feasibility quadrants), each task force member votes on his/her top 3 physical activity and top 3 nutrition changes. 7. Based on the environment/policy changes receiving the most votes, task force chooses to implement 2-3 nutrition and 2-3 activity changes.
Make it happen	5	Task force members answer the following questions for each environment/policy change: • Who needs to be involved to make this change happen? • What are the steps to implementing this change? • What are the possible barriers that might be encountered? • What would it take—inside a task force member and in that member's environment—to accomplish the steps to implement the change? Based on literature searches and knowledge of other schools' success stories, AIM facilitators provide information to help answer these questions, including an introduction to Social Cognitive Theory.
	6-10	Task force breaks into subcommittees with 2+ members overseeing each change. Timelines are set and subcommittees report on implementation progress to the task force at meetings 7-10. Subcommittees conduct pilot tests as needed. Program evaluation is considered during meeting 8; program adoption and public relations in meeting 9. Meeting 10 includes a celebration; continuation of discussions about program implementation, adoption, and evaluation; and specification of activities that need to be completed over the summer.
	11-12	In the fall of the next school year, subcommittees provide updates on implementation status of planned changes. Taskforce finalizes the Program Notebook/Toolkit to ensure sustainability of changes. Taskforce decides how/if AIM facilitators could be of service in the future, how often the group will continue to meet to ensure changes remain implemented and work well, etc.

the SHI notebook and an "Instructional Guide and Log Book" created specifically for this project. The project goal was stated on the instruction sheet: "To make environmental and policy changes to elementary schools in order to increase opportunities for students to be physically active and eat healthy foods during the school day." Schools were asked to complete all 8 modules for items marked as Nutrition or Physical Activity, document their planning process by completing the log book, get an outside facilitator to lead them through the process, and to call or e-mail if they had any questions. The PRA ended the meeting by informing the principal or other staff members that he or she would be contacted the following spring to collect the log book and set up interviews with school personnel involved in the SHI process.

School Incentives. Each of the 10 schools received $3000 over 4 years for participating in the study. There were no stipulations for how money was to be used; however, we suggested that SHI schools consider putting the money toward an external facilitator.

Instruments

The outcome and process evaluation attempted to capture the environment and policy changes implemented in AIM and SHI schools and the extent to which implementation steps were followed during the planning process. A triangulation approach was used to verify implementation of school environment and policy changes. It consisted of (1) principals, foodservice managers, and PE teachers completing a School Environment and Policy Survey; (2) Project

staff conducting direct observations of the school; and (3) Project staff conducting key informant interviews with school personnel in both AIM and SHI schools.

School Environment and Policy Survey.[48,49] A 3-module questionnaire was designed to assess and track changes in physical activity and nutrition features of a school (eg, number of minutes of recess per week, minutes of PE, playground features, total number of fruit and vegetable offerings at breakfast and lunch, recess before lunch, foods available outside the lunchroom, presence and enforcement of policies on physical activity and nutrition content of items sold in schools). Comparison of survey data with direct observation findings suggests minimal reporting bias. For example, independent observers found that minutes spent in PE classes were less than 1 minute shorter on average than the duration reported by PE teachers on the survey. For the complete survey, see http://www.ucdenver.edu/academics/colleges/Public Health/research/centers/RMPRC/resources/Pages/SEPS.aspx. The survey was administered annually in fall (2005-2008).

Direct Observations. One year after the intervention (fall 2007), pairs of data collectors spent 1 day in the school building observing and recording school playground features, cafeteria lunch offerings, PE and regular classes, and the interior of the school building including vending machines. Data collectors were given a list of environment and policy changes each school reported making in fall 2006 and were instructed to verify the extent to which each change had been implemented.

Key Informant Interviews. Following the intervention year (2005-2006), pairs of data collectors conducted individual interviews with school principals 2 years in a row (fall 2006, 2007). One AIM school had a new principal in 2006 and 4 AIM schools had new principals in 2007 (however, one of those new principals had been part of the AIM process). There were no new principals in SHI schools in 2006; however, there were 2 new principals in 2007. In schools with new principals who did not participate in the planning process, we separately interviewed both the new principal and a staff member who was involved in the planning process such as a classroom or PE teacher.

Interviews in 2006. Information about the 2006 AIM key informant interview methods, questions, and protocol are described elsewhere (pp. 446-447).[49] A similar semistructured interview protocol consisting of 16 questions was used for interviewing the SHI principals. These interviews examined the process schools used to complete the SHI, including the level of facilitation, fidelity to the SHI process, extent to which the SHI was completed, barriers and facilitators to the process, and specific changes schools made as a result of going through the SHI process.

Interviews in 2007. Principals from all 10 schools were interviewed again in fall 2007. For AIM schools, the interview consisted of 37 semistructured questions; for SHI schools, the interview consisted of 29 questions. The overarching purpose of these interviews was the same: to follow up on the status of changes made at the school as a result of the planning process.

To rate the extent to which each school's planning process incorporated implementation steps thought to be necessary for evidence-based health promotion change to occur and be sustained in school settings, we reviewed transcripts from key informant interviews. In addition, we reviewed information from 3 sources described below as well as other written products completed throughout AIM meetings. For the SHI schools, we reviewed information collected in schools' SHI Log Book.

Written Products Completed Throughout AIM Process. These included a member roster, the PRECEDE model describing behavior and environment factors contributing to unhealthy eating and physical inactivity at the school, importance by feasibility ratings for each environment and policy change being considered for implementation, a list of possible barriers to implementation and resources needed, and implementation action plans and timelines.

AIM Meeting Debriefing Forms. This 2-page form was completed by the AIM facilitators after each AIM meeting and included questions about the meeting objective, what worked well and what could have worked better, next steps, other comments, who attended the meeting, assignments, and whether and when assignments were completed.

SHI Log Book. This 2-page form was completed by one of the meeting attendees (usually the meeting leader) and included questions such as who attended the meeting and the position or group they represented; what happened during the meeting including the purpose, topics covered, decisions made, and other comments; whether the SHI notebook was used and if so, in what way and which parts; and the date of the next meeting.

Data Analysis

To assess the number, type, and level of implementation (fully, partially, or not implemented) of environment and policy changes made in each school, the first 3 authors reviewed and discussed meeting records from AIM and SHI meetings, information from the key informant interviews, answers on the School Environment and Policy Survey, and notes from the direct observations. Based on a review of research published in 2005 or earlier, the first author used Brennan et al's[57] "Evidence Typology" to classify each environment and policy change as either *effective* (ie, producing significant, positive health or behavioral outcomes as described in systematic reviews,

syntheses, or meta-analyses [first tier] or high-quality, peer-reviewed studies and evaluation reports [second tier]), *promising* (ie, showing meaningful, plausible positive behavioral outcomes as described in published or unpublished evaluation studies or exploratory evaluations), or *emerging* (ie, newly implemented, untested innovations, with some face validity). As of 2005-2006, there were no school-based environment or policy interventions that met the criteria for being "first tier effective." Thus, we tracked the number and type of "second tier effective" interventions that were implemented.

To assess the extent to which each school engaged in the 11 implementation steps during their planning process, 2 reviewers examined each school's meeting records. Schools were rated on the extent to which the implementation steps were in place (fully, partially, or not in place) and a justification was written for each rating including references to specific meeting documents. Two of the 5 SHI schools did not complete the SHI and therefore received "unknown" ratings across all 11 steps and were not included in the analysis. A third rater was one of the AIM facilitators who reviewed the ratings and suggested modifications. Out of 55 ratings for AIM schools (11 ratings × 5 schools), there was 87% agreement between the first 2 reviewers and the third reviewer. There were 7 disagreements and in all instances, the first 2 reviewers' rating was lower (eg, the first 2 reviewers rated a step as partially implemented whereas the third reviewer rated the step as fully implemented). After discussion with the third reviewer, an agreement was made to use the more conservative, lower rating.

RESULTS

Numbers of Planning Meetings and Taskforce Members

AIM schools met an average of 11.4 times (range: 11-12) and had an average of 8.4 people on the taskforce (range: 7-11). All 5 AIM schools completed the planning process. Three of the 5 SHI schools worked on the SHI. The other 2 schools did not use the planning process. The 3 participating schools met an average of 5.3 times (range: 4-7) and had an average of 3 people attend at least 1 meeting (range: 2-6).

School Environment and Policy Changes

Using Brennan et al's[57] "Evidence Typology," Table 2 shows the types of effective environment and policy changes made in each of the 10 schools. A total of 25 changes were made: 22 in AIM schools; 3 in SHI schools. The most common nutrition changes across schools included reversing lunch and recess so that recess came first, making healthy foods more available outside the lunchroom, and making unhealthy foods less available outside the lunchroom. To increase physical activity, 2 schools increased PE time and 4 schools implemented changes to the playground and recess period.

AIM schools made an average of 4.4 effective changes (range: 4-6) with an average of 90% of changes still in place 1 year later (range: 50%-100% by school). AIM schools implemented the following effective changes to increase healthy eating: more fruits and vegetables and fewer desserts in the school lunch program, daily healthy snacks, establishing a "Healthy Food Zone" with nutrition guidelines for foods sold at school and foods brought from home,[14-18] implementing the Integrated Nutrition Education Program curriculum,[58-60] and reversing lunch and recess so that recess came first.[19,20] AIM schools made the following changes to increase physical activity: increasing PE class time either by hiring an additional PE teacher, changing the schedule for daily PE, and/or scheduling smaller PE classes;[26] implementing the SPARK PE curriculum,[30] launching recess campaigns that included organized activities (eg, 4-square, walking program, indoor activities on cold days) and adding new playground equipment/facilities (eg, balls, an outdoor half-size basketball court, walking tracks, and playground markings for hopscotch and 4-square).[32,34] The 2 schools that increased PE time did so by hiring a second PE teacher who taught newly added PE classes part time and provided other types of instruction part time (eg, computer, literacy). Salaries were paid from 2 sources (eg, a Reading First grant to cover the literacy coach functions and the district to cover the PE responsibilities). In 4 of the 5 schools, 100% of the changes were still in place 1 year later; the fifth school was only able to sustain half (50%) of its changes due in part to lack of buy-in from the teaching and foodservice staff, principal turnover, and other priorities such as academic achievement.

Three of the 5 SHI schools reported using the tool in some fashion; however, only 1 school made environment or policy changes. SHI schools made an average of 0.6 effective changes (range: 0-3) with 66% of changes still in place 1 year later. It is unclear the extent to which the changes made in the 1 school were due to the SHI process or to other factors such as the principal's involvement on the School Environment Project Steering Committee, a community advisory board that oversaw the project. In key informant interviews with the principal, she reported learning about effective practices through attending the monthly steering committee meetings. For example, she reversed recess before lunch prior to the start of the official intervention because of steering committee discussions that took place as the intervention was being planned. Once she received the SHI, she met with other school personnel on 7 occasions to discuss school health and safety issues. The principal reported using the SHI as a resource guide initially. Decisions were made in the early

Table 2. Number and Type of Tier 2 Effective Environment/Policy Change Strategies Made by School

School Change	AIM Schools' Implementation Status by Year (2006-2007, 2007-2008)										SHI Schools' Implementation Status by Year (2006-2007, 2007-2008)									
	School 1		School 2		School 3		School 4		School 5		School 1		School 2		School 3		School 4		School 5	
	2006-7	2007-8	2006-7	2007-8	2006-7	2007-8	2006-7	2007-8	2006-7	2007-8	2006-7	2007-8	2006-7	2007-8	2006-7	2007-8	2006-7	2007-8	2006-7	2007-8
Food Environment																				
Increase availability of fruits and vegetables and decrease availability of high-fat/sugar items in lunchroom							●		●		○	○								
Increase availability of fruits and vegetables and decrease availability of high-fat/sugar items outside lunchroom			○				○		○		○	○								
Remove vending machine									●											
Scheduling																				
Reverse the order of recess and lunch (recess comes first)	●		○		●		●		●	○										
Nutrition Education																				
Provide health/nutrition classes for elementary kids	●																			
Physical Education (PE)																				
Increase amount of PE time	●				●															
Use evidence-based PE curriculum (Catch, Spark) to increase activity during PE class								○												
Recess																				
Provide additional equipment for students to use during recess (eg, balls)					●				●											
Recess Campaign:																				
• Encourage or require students to be active at recess			○						●		○									
• Provide organized activities at recess (eg, car races, 4-square)										○	○									
Enhance playground features such as painted courses, hopscotch, walk track on playground			●						●	●										
Total number of changes made across both years	**4**		4		4		4		6		3		0		0		0		0	
Percentage of changes made in 2006 at least partially in place in 2007	100%		50%		100%		100%		100%		66%		NA		NA		NA		NA	

●, fully implemented; ○, partially implemented.

meetings about which changes to make and the SHI modules were not completed until the final meeting. The 3 schools that used the SHI had representatives serving on the School Environment Project Steering Committee, whereas the 2 schools that did not use the SHI were not represented on the steering committee. In key informant interviews, school representatives stated that membership on the steering committee made them feel accountable for completing the SHI.

Implementation Steps for Evidence-Based Health Promotion in School Settings

Table 3 shows the extent to which each school followed the 11 implementation steps of evidence-based health promotion in their planning process. On average, AIM schools had 4.4 partially and 5.6 fully in place whereas SHI schools had 2.0 and 0.2, respectively. Implementation steps that distinguished the AIM processes from the SHI processes included having a trained and paid external facilitator, explicitly stating the expected outcome of the intervention, identifying effective initiatives, prioritizing and selecting initiatives to implement using the importance by feasibility rating process, and developing an action plan. Among the AIM schools, school #5 implemented the highest number of changes with all changes still in place 1 year later. They also had the highest number of implementation steps fully completed, including but not limited to active participation by the principal and consistent participation of taskforce members.

DISCUSSION

In rural areas where childhood obesity rates tend to be high, income levels tend to be low and both the landscape and built environment can pose unique challenges for healthy eating and physical activity, schools are an important setting for promoting health. AIM is a strategic planning process that successfully led to implementation of school environment and policy strategies known to relate to healthy eating and physical activity. In contrast, the SHI only led to effective school-based change in 1 school of the 5 schools assigned to the process.

Several implementation steps distinguished the AIM and SHI planning processes including use of external, trained facilitators; principal involvement; school teams explicitly stating the student behavior goals; identifying effective environment and policy changes; prioritizing potential changes based on importance and feasibility; and developing an action plan. AIM facilitation was focused on implementing strategies to accomplish specific student behaviors each school day: eating 1 cup of fruit and 1.5 cups of vegetables and getting 30-60 minutes of physical activity. AIM facilitators guided task force members towards choosing effective strategies that could affect most of the student population most days of the school year (eg, enhancements to daily recess) as opposed to changes that only could affect some of the students some of the time (eg, policies about food items sold in the fourth grade school store during the 2 weeks the store is open to fourth and fifth graders). Both planning processes were weak in regards to assessing the extent to which new initiatives were working in the school community and planning for sustaining initiatives. Assessing initiatives could be used a strategy to keep health in the forefront of the school community's consciousness and/or to sustain environment and policy changes over time. However, whereas assessment is an important aspect to any planning process, schools already have many high-priority demands and perhaps the community-based participatory research pendulum should swing to the university partner taking on this activity. With regard to AIM and SHI falling short on planning for sustainability, it is noteworthy that AIM schools had 90% of their changes in place 1 year after the intervention ended.

Unless a rural school district has a wellness grant, most districts do not have a wellness coordinator. PE teachers might be ideal staff members to spearhead efforts related to physical activity opportunities in the classroom and recess as long as they are properly trained. As the ''Physical Activity Director,''[61] they could convene a wellness committee in the school, point out connections between physical activity and academic achievement and coordinate physical activities across the curriculum, help with goal setting each year, monitor continued implementation of changes, address new barriers, and regularly convene the school task force. Similarly, the school foodservice director or lunchroom manager could be a ''Healthy Eating Director,'' working with the wellness committee to implement changes related to foods both in and outside of the lunchroom (eg, policies about snacks brought from home). If PE teachers and lunchroom managers are not available, then principals could identify a staff person with enthusiasm and credibility to spearhead these efforts and serve as champion.

The field of implementation science provides a useful lens for interpreting the relative successes and failures of school-based change efforts to increase opportunities for physical activity and healthy eating. External facilitation is key to translating research into practice.[62,63] In particular, the following facilitation tasks are considered to be important for creating change: knowledge and data management; project management; and administrative and project-specific support. Fixsen et al[64] described ''implementation

Table 3. Steps to Evidence-Based Health Promotion in School Settings and the Extent to Which They Were Included in the Adapted Intervention Mapping (AIM) and School Health Index (SHI) Planning Process

Key Step	Extent to Which Key Step Was Addressed in Planning Process									
	AIM Schools					SHI Schools				
	1	2	3	4	5	1	2	3	4	5
1. *Hire and train an outside facilitator* knowledgeable and skilled in evidence-based practices, program planning, and group facilitation who is considered to be part of the community but external to the school	●	●	●	●	●	X	X	X	X	X
2. *Require and ensure active participation by the principal*	○	●	●	○	●	●	X	X	X	○
3. *Assemble and ensure consistent participation of a school taskforce* to include the principal, foodservice manager, PE teacher, and school nurse and any of the following: mental health counselor, secretary, janitor, classroom teacher(s), parents, and students (depending on age)	○	○	○	○	●	○	○	X	X	○
4. *Conduct a problem analysis of student and school-level factors related to unhealthy eating and physical inactivity* including student behaviors related to inactivity and unhealthy eating along with determinants for those behaviors and school environment features, policies and practices related to students' inactivity and unhealthy eating along with determinants for those school level factors	○	○	○	○	○	○	○	X	X	○
5. *Explicitly state the expected outcome of the intervention* (eg, each day at school, students will eat 1 cup of fruit and 1.5 cups of vegetables and get 30-60 minutes of physical activity)	●	●	●	●	●	X	X	X	X	X
6. *Identify effective, promising, and emerging initiatives* through a literature search	●	●	●	●	●	X	X	X	X	X
7. *Selecting initiatives to implement based on importance and feasibility*. For each potential environment/policy change, consider the importance: Is it an evidence-based practice? Will it reach a few, some, or all students? Will the change be in effect for a little, some, or all of the school year?) and feasibility: ease/difficulty of getting stakeholder buy in; ease/difficulty of implementing the change; financial requirements	○	●	○	○	●	○	X	X	X	X
8. *Develop an action plan* including steps to address barriers and secure stakeholder support for interventions	○	●	●	●	●	X	X	X	X	○
9. *Implement initiatives*	●	○	●	○	●	○	X	X	X	X
10. *Assess the extent to which new initiatives are working in the school community* in terms of potential impact on student behavior and how the change is working with regards to day to day operations of the school	X	○	○	X	X	X	NA	X	X	NA
11. Plan for *sustaining* initiatives, considering funding and financial resources	X	○	X	○	○	X	NA	X	X	NA
Number of key elements partially in place	5	5	4	6	2	4	2	0	0	4
Number of key elements fully in place	**4**	**6**	**6**	**4**	**8**	**1**	**0**	**0**	**0**	**0**
Total number of key elements partially or fully in place	**9**	**11**	**10**	**11**	**10**	**5**	**2**	**0**	**0**	**4**

●, fully in place; ○, partially in place; X, not in place; NA, not applicable.

drivers'' thought to be core components of implementation: staff selection, pre-service and in-service training, ongoing coaching and consultation, staff evaluation, decision support data systems, facilitative administrative support, and systems interventions. As mentioned earlier, rural school staff wear multiple hats (eg, a principal may also serve as the superintendent and director of transportation for the school district) and face high-stakes testing pressures that make it difficult for them devote time and energy to school wellness initatives.[48] Consistent, external support could be key to implementation success. However those providing external support need to be carefully selected: they need to be perceived to have credibility by the internal organization and they need to possess skills in the areas of developing strong interpersonal relationships and empowering users to make independent evaluative decisions.[65] They must also be trained in group facilitation and be knowledgeable of evidence-based practices. Leaders (eg, principals) need to be actively involved and frequently consulted for implementation to occur.[65,66] Involvement of staff at all levels, availability of funds, communication within the organization about the change, and timely feedback about the change's impact all serve to facilitate successful implementation.[65]

Conclusion

A university-school partnership brings an ideal blend of talents for implementing school-based changes. Universities bring the latest research, resources, and evidence-based practices to schools,

and school staff members bring knowledge of the culture and climate of their community and what changes will have the greatest chances of success. Whether the person spearheading the change initiative is internal or external to the school, ongoing training and mentoring is needed so that schools choose changes that will result in increased physical activity and healthy eating.

Limitations

This study was only conducted in rural settings; thus, it is unclear if study findings can be generalized to urban settings. In addition, AIM schools received a high level of external facilitation that required substantial financial resources. As most schools do not have discretionary funds to provide this type of facilitation, study findings will be difficult to replicate in the absence of financial resources. It is also possible that the changes made in AIM schools were partially due to a Hawthorne Effect.[67] Minor contamination of the SHI group is another limitation. Specifically, this study used a community-based participatory research approach in which a steering committee comprised of school personnel across a large geographic region was formed to oversee the project. That group met monthly for approximately 5 years to decide on the research design, school recruitment strategies, intervention plans, evaluation and dissemination plans, and other matters related to the study. Approximately 18 months after the group was assembled, schools were randomly assigned to either the AIM or SHI condition. Most steering committee members' schools decided to participate in the study. Some steering committee members were in schools assigned to the SHI condition whereas others were in schools assigned to the AIM condition. Prior to randomization, all steering committee members were exposed to general discussions about AIM and effective environment and policy changes (eg, recess before lunch). In one instance, those discussions led a principal whose school would eventually be assigned to the SHI to make a change prior to the intervention beginning. Thus, in some ways, participation on the steering committee could be seen as contaminating the research design. During the intervention year, the steering committee decided not to hold meetings due to the possibility of contamination. They reconvened as soon as the intervention ended. Despite some contamination in the months leading up to the intervention, the committee's contributions to decisions about research design, data collection, and methods for sharing data findings were quite positive and important for ensuring that the study was meaningful and appropriate for the community. Another limitation is the fact that no data were collected on student-level physical activity or eating behaviors; thus, it is unclear if the environment and policy changes led to increased healthy eating and physical activity. Finally, data came largely from school employees who were actively involved in the intervention, which could have biased results.

IMPLICATIONS FOR SCHOOL HEALTH

Several school environment and policy changes have been shown to increase physical activity and healthy eating. The challenge now is to help schools implement the latest research-based practices given the realities of their limited resources and multiple pressures. External facilitation by highly trained individuals is helpful for change to happen. AIM offers a step-by-step process to evidence-based health promotion in school settings as well as materials to assist schools in making this happen such as a menu of effective environment and policy changes and a worksheet for determining highly important and feasible changes.

To ensure that usual care schools (ie, those assigned to the SHI) receive the same benefits as the intervention schools, we applied for and received funding from the Colorado Health Foundation in 2010 to expand AIM to 14 schools in the San Luis Valley (5 schools that were in the usual care condition for the School Environment Project as well as the 9 schools who were either ineligible to participate or declined to participate). In 2011-2012, half of those schools went through the AIM process with similar results (about 4 evidence-based changes implemented per school). In 2012-2013, the remaining schools are receiving AIM. We are also testing AIM in the southeastern quadrant of Colorado with 9 rural, low-income schools.

Several enhancements have been made to the AIM process[49] and research will focus on the extent to which the 11 implementation steps (Table 3) are present, adherence to community-based participatory research principles, and AIM's ability to generate practice-based evidence.[68] The new version of AIM is slightly scaled down in 2 respects: first, it involves school taskforces in 10-11 rather than 12 meetings; and second, to improve the likelihood of sustainability, a school staff person is designated as an AIM co-facilitator (with specific responsibilities and concomitant remuneration) to work alongside the university facilitator. The menu of effective practices has been updated based on the latest research. For example, after this study was completed the CDC released a report citing additional school practices correlated with healthy eating and physical activity (eg, availability of working water fountains, healthy food options on the breakfast line, serving fruits and vegetables from school gardens, and classroom activity breaks).[69] Finally, university partners[70] and the public health community have important roles to play in assisting schools implement effective environment and

policy changes related to increased healthy eating and physical activity.

Human Subjects Approval Statement

This study was approved by the Colorado Multiple Institutional Review Board.

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