

Disseminating Evidence-Based Physical Education Practices in Rural Schools: The San Luis Valley Physical Education Academy

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Background: To address childhood obesity, strategies are needed to maximize physical activity during the school day. The San Luis Valley Physical Education Academy was a public health intervention designed to increase the quality of physical education and quantity of moderate to vigorous physical activity (MVPA) during physical education class. **Methods:** Elementary school physical education teachers from 17 schools participated in the intervention. They received SPARK curriculum and equipment, workshops, and site coordinator support for 2 years. A pre/post/post within physical education teacher design was used to measure intervention effectiveness. System for Observing Fitness Instruction Time (SOFIT) and a physical education teacher survey were collected 3 times. **Results:** MVPA increased from 51.1% to 67.3% over the 2-year intervention resulting in approximately 14.6 additional hours of physical activity over a school year and 4662 kcal or 1.33 lbs. of weight gain prevention. More time was spent on skill drills and less time on classroom management and free play. **Conclusions:** The San Luis Valley Physical Education Academy succeeded in increasing rural, low-income students' physical activity. The multicomponent intervention contributed to the program's success. However, cost-effective approaches are needed to disseminate and implement evidence-based practices aimed at increasing students' physical activity during the school day.

Keywords: childhood obesity, moderate-to-vigorous physical activity (MVPA), System for Observing Fitness Instruction Time (SOFIT), Sports, Play, and Active Recreation for Kids (SPARK)

Approximately 3 out of 10 children in the United States are overweight or obese and therefore at greater risk for obesity in adulthood¹ and chronic diseases such as heart disease, diabetes, and cancer.² According to the latest published data, national childhood obesity rates are holding steady among 2- to 19-years-olds³ and are declining among low-income, preschool-aged children.⁴ However, Colorado is one of only 3 states showing a statistically significant increase in childhood obesity (9.9% in 2003 vs. 10.9% in 2011).⁴⁻⁶

Public schools are important settings for promoting healthy behaviors and reversing obesity trends,⁷ with physical education sometimes being the only structured opportunity in which rural children get physical activity.⁸⁻¹² Decreases in body mass index among low-income, rural students are associated with schools that promote better physical education and physical activity opportunities.¹³ However, for at least the past 5 years, the amount of physical education elementary school students receive has not increased in rural Colorado¹⁴ despite national and state initiatives such as the federally mandated Local Wellness Policy,¹⁵ the U.S. National Physical Activity Plan,¹⁶ and Colorado's House Bill 11 to 1069 requiring schools to provide at least 30 minutes of daily physical activity.¹⁷ Given the lack of progress in increasing physical education time, intentional efforts are needed to maximize moderate-to-vigorous physical activity (MVPA) levels during physical education class as well as to improve the quality of instruction.

The Whole School, Whole Community, Whole Child approach to education includes physical education and physical activity as one of the 10 components needed to support a child's health and academic development.¹⁸ In laying out an agenda for physical education as a public health strategy, Sallis and colleagues introduced the concept of HOPE, or "health optimizing physical education"¹⁹. In HOPE, physical education is focused on health-related physical activity and fitness, students are active at least 50% of the time, all students are engaged during physical education class regardless of ability, and students' physical education experience positively contributes to their overall physical activity levels outside of class. To date, SPARK and CATCH are 2 curricula that have been rigorously tested and demonstrated to increase MVPA and student enjoyment of physical activity.^{20,21} Sallis and colleagues call for dissemination studies to learn about program effectiveness and strategies for getting evidence-based programs such as SPARK and CATCH adopted, implemented, and sustained in high need populations.¹⁹

SHAPE America makes several recommendations that align with HOPE: (a) standards for physically educated students, (b) 150 minutes a week for elementary school students and 225 minutes a week for secondary school students, (c) appropriate instructional practices, and (d) student and program assessment.²² However, most schools do not implement these recommendations and principals need more knowledge about quality physical education so that they can help physical education teachers address barriers to implementing best practices.²³ Professional development, if delivered effectively, can help physical education teachers and principals provide HOPE and develop a physical education program reflective of SHAPE America's recommendations.

Fullan²⁴ warns about the dangers of professional development programs that fail to ask the question, "Why is change needed?" and stresses the importance of continual support and follow-up

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after initial training. In addition, he emphasizes that an educational change initiative should involve teachers and principals from the beginning to ensure that their needs and interests are central. According to Fullan, effective professional development programs prompt teachers to self-reflect and take risks in implementing new methods of teaching and creating effective learning environments, and in so doing, feel a sense of ownership in the process. However, pedagogical change and learning new ideas takes place gradually and is a difficult process; thus teachers should receive a combination of pressure and support.²⁴ Support could include essential curricular resources, continuous in-service training, and on-going site-based support. Pressure could include the expectation that teachers will implement specific curricular and instructional approaches with their students.

Unfortunately, professional development programs in physical education often involve “single shot,” 1-day workshops that have been characterized as “intellectually superficial, disconnected from deep issues of curriculum and learning, fragmented, and noncumulative.”²⁵ Four conditions are needed for effective professional development: teachers must initiate and actively participate; teachers need pressure and support for change at the local level; teachers need to change their beliefs and practices; and teachers need to feel ownership in making change.²⁴

Fullan’s framework informed the San Luis Valley Physical Education Academy’s (hereafter “PE Academy”) development. Through a university-community partnership²⁶ the PE Academy’s goal was to equip teachers with the beliefs, knowledge, and skills to implement evidence-based physical education curricula and practices to increase the quality of physical education and quantity of MVPA in a rural, low-income setting. Based on 4 interdependent evidence-based components integral to improving physical education quality,²⁷ the PE Academy consisted of the following elements:

- An evidenced-based curriculum (SPARK) with common curriculum and instructional strategies, and essential equipment and curriculum materials
- Continuous (rather than one-time) professional development over 2 years in group settings (ie, SPARK workshops and booster sessions, PE Academy Booster workshops covering additional topics such as a rubric for high quality physical education, and a professional learning community)
- Ongoing, one-on-one professional development for principals and physical education teachers in school settings via master physical education teachers called Site Coordinators
- A university/K–12 school partnership enabling physical education teachers and principals to incorporate the latest physical education evidence-based practices.

This dissemination study posed 3 research questions:

1. To what extent did the PE Academy succeed in increasing HOPE for all students at all grade levels (operationalized here as increased student MVPA; increased physical education teacher time spent on knowledge, fitness, skill instruction, and promoting activity and fitness during and out-of-class time; and decreased time spent on class management, free play and games)?
2. To what extent did change in MVPA vary by physical education teacher characteristics (gender, number of years teaching physical education, certification status)?
3. Were there additional gains in MVPA after a second year of intervention?

Methods

Schools and Research Design

The San Luis Valley (SLV) is an 8188 square mile rural intermountain valley in south-central Colorado. There are 17 elementary schools across 14 school districts with approximately 3803 students (224 students per school on average): 50.6% Hispanic, 70.5% qualifying for free/reduced lunch.²⁸

In spring 2011, PE Academy staff visited principals and physical education teachers in all 17 elementary schools to explain the program and review then sign a Memorandum of Understanding (MOU). The project was referred to as Healthy Eaters, Lifelong Movers (HELM) and had 2 components: the PE Academy and Assess, Identify, Make it Happen (“AIM”), a strategic planning process used in schools to increase student opportunities for physical activity and healthy eating by implementing evidence-based environment and policy practices.²⁹ Five of the schools had already completed AIM in 2005–2006 and thus were only invited to participate in the PE Academy part of HELM. The remaining 12 schools were invited to complete both AIM and the PE Academy. Schools received \$4,000 for participating in the AIM component. For the PE Academy, each school was told they would receive SPARK curriculum manuals; equipment; workshops; and site coordinator support in which a master physical education teacher would visit physical education teachers and principals at the school up to 2 times per month to provide support with SPARK implementation, curriculum development, assessment and observation practices, and information about the link between physical activity and academic achievement. In return, schools were asked to participate in the PE Academy by having physical education teachers attend 4 SPARK workshops (principals were only required to attend 2 workshops), SPARK booster sessions, and PE Academy workshops; implement the kindergarten to 2nd grade (K–2) and/or 3rd to 6th grade (3–6) SPARK curriculum in at least 1 grade level in Year 1 and at least 1 additional grade in Year 2; host site coordinator visits at least once per month with the principal and physical education teacher; ensure physical education curriculum alignment with new Colorado state standards; and participate in annual data collection including SOFIT and surveys with both principals and physical education teachers.

The Colorado Multiple Institutional Review Board approved the study protocol and the MOU, a contract describing the roles and responsibilities of the school and university. All 17 elementary schools agreed to participate in the PE Academy and all 12 schools eligible for AIM agreed to participate in that component as well. During the summer before the intervention began, schools received an average of \$3,953 in equipment (min: \$2,518; max: \$5,191 based on the largest number of students in a physical education class).

A pre-post within teacher design was used to address the research questions posed in this study. Baseline data were collected in spring 2011, Year 1 post data were collected in spring 2012, and Year 2 post data were collected in spring 2013. The intervention began in fall 2011 with 22 physical education teachers in 17 schools and ended in spring 2013.

PE Academy Intervention

Table 1 describes the chronology of PE Academy events.

To increase students’ MVPA through higher quality physical education instruction (defined as more time spent on knowledge, fitness, skill instruction, and small-sided, modified game play

Table 1 Physical Education Academy Intervention and Evaluation Activities in Elementary Schools

Activity	
Awareness raising and recruitment activities	
Oct 2009–Nov 2009	Focus groups with PE teachers, principals, superintendents, and school board members The goal of the focus groups was to solicit input on the proposed PE Academy and in the process, it raised awareness that a professional development program was being planned.
December 2009	“Healthy Students + Healthy Schools = Academic Success” Conference The goals of this 1-day conference were to provide school administrators, staff, and wellness committees with the latest data, tools, and resources to increase opportunities for physical activity and healthy eating as well as to inform school stakeholders of the contents and timing of the PE Academy grant proposal.
October 2010	E-mail A notification was sent to principals and PE teachers informing them that the PE Academy grant proposal was funded.
March 2011	“Happy Visits” Site coordinators visited PE teachers at school sites to share information about the PE Academy, gain support, and ask permission to meet with principal to explain program.
February 2011–April 2011	School Recruitment and Memorandum of Understanding Site coordinators met with principals and PE teachers in each school to explain details of the program and expectations of each party, and sign memorandum of understanding.
Intervention activities	
April 2011–May 2011	Baseline SOFIT and PE Teacher Survey Data Collected
May 2011	Orientation 1/2 day session in which principals and physical educators learned about the PE Academy’s purpose, programs and services, and participation requirements.
August 2011	Distribution of SPARK Equipment to Schools Each school received a standard SPARK equipment package based on the largest PE class. On average, schools received \$3,953 in equipment.
August 2011	SPARK Workshop Day 1 (K–2 & 3–6) In this 2-day workshop, a SPARK trainer provided day 1 instruction and demonstration on the SPARK K–2 & 3–6 curricula (one curriculum per day).
September 2011–May 2012	Year 1 Site Coordinator Visits to PE Teachers Master PE teachers completed 11 mentoring visits to each of the 22 elementary school PE teachers and worked systematically through the “Rubric for High Quality PE”
September 2011–May 2012	Year 1 Site Coordinator Visits to Principals Master PE teachers completed 4 visits to each of the elementary school principals and discussed components of high quality PE, advocating for PE on the district level, and supporting the delivery of high quality PE.
November 2011	SPARK Workshop Day 2 (K–2 & 3–6) In this 2-day workshop, a SPARK trainer provided day 2 instruction and demonstration on the SPARK K–2 & 3–6 curricula (one curriculum per day).
March 2012–May 2012	Year 1 Follow Up SOFIT and PE Teacher Survey Data Collected; PE Teacher Key Informant Interviews
September 2012	SPARK Booster Session and PE Academy Workshop (K–5) In this 2-day session, a SPARK trainer provided a booster training on the SPARK curriculum on day 1 and the PE Academy staff led a workshop on the “Rubric for High Quality PE” on day 2.
September 2012–May 2013	Year 2 Site Coordinator Visits to PE Teachers Master PE teachers completed an average of 7 additional mentoring visits to each of the 22 elementary school PE teachers. For this set of visits, a tailored approach was used in which PE teachers selected areas of the “Rubric for High Quality PE” on which to focus.
September 2012–May 2013	Year 2 Site Coordinator Visits to Principals Master PE teachers completed an average of 3 additional visits to each of the elementary school principals to continue discussions on components of high quality PE, advocating for PE on the district level, and supporting the delivery of high quality PE.
March 2013–May 2013	Year 2 Follow Up SOFIT and PE Teacher Survey Data Collected
June 2012	Collaboration with Adams State University (ASU) Physical Education Department for preservice training of physical educators Site coordinator worked with ASU faculty to encourage the use of SPARK for preservice PE teacher education and assisted ASU faculty in the development of a lesson plan template that adhered to Colorado requirements and included curricular planning components of the HELM “Rubric for High Quality PE”
April 2013	In-service courses for physical educators “Teaching Strength & Conditioning in Secondary School” and “Personal & Physical Wellness: Focusing on K–12 Fitness”—These 1-credit skill building courses were designed for in-service elementary and secondary PE teachers, and satisfied requirements for credit toward licensure.

(continued)

Table 1 (continued)

Activity	
August 2012–February 2013	<p>Professional Learning Communities</p> <p>5 full-day professional learning community days were scheduled (bimonthly) by San Luis Valley Superintendents Advisory Council (SAC) and included teachers from all 14 districts organized into content areas. HELM PEA organized agenda related to both SAC initiatives and HELM “Rubric for High Quality PE.” Goals for the PLC days included increasing PE teacher’s knowledge and skills related to effective teaching strategies, curriculum requirements related to current legislation (Colorado SB-10-191), and support using the SPARK PE curricular materials.</p>
April 2013–present	<p>Community of Practice</p> <p>PE teachers from several districts and PEA site-coordinator created a community of practice to provide direction to the Professional Learning Community and to plan the 5 meeting days for the 2013-14 school year. Representatives met with superintendents at a SLV SAC meeting to announce the formation of the group and obtain support for leading PE professional development days during 2013-14 school year. The group established a Facebook page called PE4SLV.</p>

and less time spent on class management and free play), a rubric was developed and used in the PE Academy to build physical education teachers’ knowledge, skills, and self-efficacy in the following areas:

1. Planning: effectively plan curriculum and lessons that intentionally reflect state and national standards and use a variety of teaching styles and best practice strategies to accommodate students’ diverse learning styles
2. Management: effectively manage student behavior to maximize instruction time and promote positive social behavior
3. Communication: effectively communicate with students to promote efficient content learning, improved student focus, and increased on-task behavior
4. Learning Environment: promote positive student self-concept by establishing a success-oriented environment that is inclusive of all students and cultures
5. Movement: achieve a high level of moderate to vigorous physical activity during physical education class by integrating whole body movement in class activities and management procedures as well as by encouraging physical activity in and out of class
6. Skill Instruction and Assessment: promote the advancement of student skills, fitness, and knowledge by providing appropriate skill instruction, practice, assessments, and goal-setting
7. Program and Professional Development: advocate for and improve the quality of the physical education program by integrating and collaborating with colleagues, seeking resources and professional development, and promoting the benefits of physical education on building, district, state, and/or national level.

The 2 site coordinators visited each physical education teacher in their school 11 times in Year 1 and 4 to 8 times in Year 2 to provide support with SPARK implementation, information on the latest physical education evidence-based practices, and coaching on instructional practices. During each of those visits, site coordinators observed 1 to 3 physical education classes and then met with the physical education teacher for approximately 30 to 45 minutes to provide feedback, discuss instructional practices, and set goals related to the 7 areas. Each site coordinator also met with each principal 6 times over the 2 years to discuss the link between physical activity and academic achievement, provide information about the characteristics of high quality physical education, and to give principals skills to conduct assessments of physical education teacher effectiveness.

Data Collection: Outcome Measures

SOFIT (System for Observing Fitness Instruction Time). Moderate-to-vigorous physical activity and lesson context were obtained through observations of physical education lessons using the System for Observing Fitness Instruction Time (SOFIT) instrument.^{30,31} The same data collectors were used for pre and post data collection and received training before baseline data collection from the SPARK School Specialty organization. The SPARK trainer established interrater reliability by requiring data collectors to code live and prerecorded samples with a minimum of 80% reliability. In the field, data collectors conducted interrater reliability on 13% of all SOFIT data collection events at baseline, 6.3% at Year 1 post, and 7.4% at Year 2 post. Interrater reliability was 89.9% at baseline, 91.1% at Year 1 post, and 92.4% at Year 2 post. Lesson observations were conducted in each school on 2 to 3 days. Observation days were selected based on the teacher’s class schedule, avoiding observing the same group of students on multiple days, and avoiding observing classes on consecutive days. A total of 13 observations were removed before data analysis either because the instructor being observed was a substitute teacher ($n = 5$), the physical education teacher was asked to teach something that did not involve physical activity ($n = 4$), or because the physical education class observed was not at least 16 minutes long ($n = 4$). After removing the 13 observations, a total of 532 lessons were retained for analyses (199 at baseline; 181 at Year 1 post; 152 at Year 2 post). The number of lessons observed per K–5 grade level ranged from 11 to 38 with an average of 25 lessons per grade. One school had 6th graders in their elementary school comprising 5 of the 532 observed lessons. In addition, 73 mixed grade physical education lessons were observed. The average number of lessons observed per teacher was 11.7 at baseline, 10.6 in Year 1 post, and 8.9 in Year 2 post. The total number of lessons observed per teacher over the 3 time periods was 31.7 with a range of 7 to 55.

Data collectors simultaneously coded children’s activity levels (lying down, sitting, standing, walking, vigorous) and lesson context (management, knowledge, fitness, skill practice, game play, free play). Student gender and class grade level(s) were also recorded. Summary measures included: number of minutes in vigorous physical activity (VPA), % of lesson time spent in VPA, number of minutes in MVPA, % of lesson time spent in MVPA, % of time spent in MVPA during the first 5 minutes of class, and total estimated energy expenditure rate (kcal/kg/min). The latter is an overall index summary score that takes into account relative energy costs

of lesson minutes observed in which children are lying down, sitting, standing, walking, and being very active. It accounts for both lesson length and physical activity intensity.³²

Data Collection: Physical Education Teacher Measures

Physical Education Teacher Survey. Each spring, physical education teachers completed a survey. At baseline (May 2011), paper and pencil surveys were completed at the HELM orientation session. At Year 1 and 2 follow-up, surveys were completed using Survey Monkey (<http://www.surveymonkey.com>). Questions covered physical education teacher characteristics, job position, classroom characteristics as well as perceptions about the school's physical education program.

Data Analyses

Data analysis was conducted using SAS/STAT software, Version 9.3 of the SAS System for Windows (SAS Institute Inc). Descriptive statistics were used to determine means and standard deviations of physical education teacher characteristics.

Each outcome measure was examined with a linear mixed-model regression analysis that compared student activity levels and lesson context over time with teacher as the unit of analysis. The time variable included baseline, Year 1 post and Year 2 post. Since only 1 school had more than 1 physical education teacher, no random school effect was included; however, teacher was included as a random effect. This model not only allowed us to account for the repeated measures on teachers but also allowed us to include the 2 teachers who were no longer teaching physical education during Year 2 post data collection. Dependent variables included: (1) average number of minutes and percentage of lesson time students were vigorously active (VPA%), (2) average number of minutes and percentage of lesson time students spent in MVPA (MVPA%), (3) average % of time students were engaged in MVPA in the first 5 minutes of class and (4) average estimated energy expenditure, a summary variable (kcal/kg/min) that combined lesson length and student activity levels to estimate relative energy expenditure during the lesson. Average proportion of class time allocated to each of the lesson contexts was also analyzed. Effect size was calculated for differences between baseline and

Year 1 post and then again for Year 1 post vs. Year 2 post using Cohen's *d* for dependent samples.³³ Because Cohen's *d* requires matched observations across time points, the 2 teachers without data in Year 2 post were not included in the Year 1 versus Year 2 post *d* calculation.

To compare percentage of lesson time students spent in MVPA with teacher characteristics, we used a linear mixed-model regression analysis, with teacher as the unit of analysis. A time variable (baseline; Year 2 post) was included in both models as was teacher as a random effect. To test whether a difference in MVPA over time varied by a characteristic, the interaction of time (baseline; Year 2 post) and the characteristic was included in the model.

Results

Seventeen schools participated in the intervention. Of the 22 physical education teachers in those schools, 21 completed the intervention. However, 4 of the 21 physical education teachers were not included in the analyses because of incomplete data (eg, there was no baseline SOFIT or baseline physical education teacher survey data in spring of 2011 either because the physical education teacher had not yet been hired or designated as a physical education teacher by the school; in one case, there was no post SOFIT data because the teacher did not complete the intervention). Thus, data analyses were limited to 17 physical education teachers in 15 schools for whom there was a complete set of data.

Physical Education Teacher and Classroom Characteristics

Table 2 shows demographic information about physical education teachers who participated in the PE Academy along with facts about their job and classroom.

Health Optimizing Physical Education Outcome Measures

Table 3 presents unadjusted means and standard deviations for lesson length, estimated energy expenditure, minutes and percent of time spent in MVPA, and lesson context. Lesson length was similar across years.

Table 2 Elementary School Physical Education (PE) Teacher Characteristics, 2011–12

	Mean	SD	N
Total years teaching PE	9.9	7.6	17
Number of students in elementary PE classes	21.3	11.3	13
Number of responsibilities at school, including teaching PE	2.4	1.0	16
% of the day spent teaching elementary PE	56.4	32.0	16
Number of K–12 grades you teach PE	5.1	2.1	16
	%		N
% PE certified	76.5		17
% female	58.8		17
% Master's degree	35.3		17
% member of Colorado Association for Health Physical Education, Recreation, and Dance	17.7		17
% meets vigorous activity recommendations (at least 20 min/day for at least 3 days/week)	68.6		16

Note. Data are presented for teachers with baseline PE teacher survey data and baseline/year 1 post System for Observing Fitness Instruction Time (SOFIT) data.

Table 3 Observed Student Physical Activity and Lesson Context Among PE Teachers

	Baseline (n = 17)		Year 1 post (n = 17)			Year 2 post (n = 15)		
	Mean	SD	Mean	SD	<i>d</i>	Mean	SD	<i>d</i>
Lesson factors								
Lesson length	33.4	10.3	33.2	9.4	0.06	32.2	8.6	0.05
Energy expenditure								
Estimated energy expenditure rate kcal/kg/min	0.083	0.007	0.086*	0.006	0.59	0.094***	0.006	1.14
Total energy expenditure	2.79	0.98	2.87	0.82	0.36	3.02	0.82	0.85
Student activity								
% lesson time spent in vigorous activity	20.0	5.2	19.5	5.0	0.11	27.7***	4.7	1.96
% lesson time spent in MVPA	51.1	11.2	58.4**	8.1	0.69	67.3**	8.8	0.79
Boys	53.7	12.6	61.5**	8.3	0.89	68.8*	8.4	0.71
Girls	48.8	12.7	55.1	9.8	0.37	66.1**	9.4	0.70
% of time doing MVPA in first 5 minutes of class	49.7	16.4	62.0**	14.1	0.83	72.3*	12.4	1.40
Number of minutes in MVPA	17.5	7.6	19.5	6.1	1.00	21.5	6.6	0.86
Lesson context								
% lesson time spent in management	23.6	13.5	25.8	9.2	0.16	19.6*	9.3	1.0
% lesson time spent in knowledge	11.3	7.0	12.3	5.3	0.14	12.4	7.1	0.06
% lesson time spent in fitness	19.0	10.4	24.4*	9.5	0.47	17.7**	8.2	1.33
% lesson time spent in skill drills	9.7	11.1	23.8**	13.1	0.86	22.6	15.2	0.05
% lesson time spent in game play	35.1	20.7	13.5***	11.6	1.27	27.5**	23.6	0.79
% lesson time spent in free play	1.3	2.5	0.2*	0.6	0.49	0.1	0.4	0.18
% lesson intervals spent promoting activity and fitness during and out-of- class time	31.7	14.2	33.2	13.7	0.18	28.3	10.0	0.93

Note. * $P < .05$, ** $P < .01$, *** $P < .001$; Asterisks in the Year 1 post column compare baseline to year 1 post; asterisks in the Year 2 post column compare year 1 post to year 2 post. Effect size Cohen's *d* under Year 1 post compare baseline to year 1 post; *d* under Year 2 post compare year 1 post to year 2 post.

Abbreviations: MVPA, moderate-to-vigorous physical activity.

Change in Student Physical Activity and Lesson Context After the First Year of the Intervention.

At the end of the first year of the PE Academy, estimated energy expenditure rates increased among students [$F(1,30) = 4.2, P \leq .05$, Effect Size (ES) $d = 0.59$]. There was a 14% gain in MVPA (51.1% at baseline; 58.4% at Year 1 post) [$F(1, 30) = 7.8, P \leq .01, ES d = 0.69$]. In addition, physical education teachers increased the amount of time students were in MVPA during the first 5 minutes of class [$F(1, 30) = 9.9, P \leq .01, ES d = 0.83$]. There was no change in vigorous physical activity. Physical education teacher time spent on fitness [$F(1, 30) = 5.2, P = .03, ES d = 0.47$] and skills drills [$F(1, 30) = 11.5, P \leq .01, ES d = 0.86$] increased while time spent in game play [$F(1, 30) = 20.2, P \leq .001, ES d = 1.27$] and free play [$F(1, 30) = 4.8, P = .04, ES d = 0.49$] decreased. There were no changes in time spent on management, or knowledge. It is important to note that the quality of game play cannot be ascertained via SOFIT because the protocol does not prompt the data collector to track factors such as small-sided, modified games or the numbers of students waiting on the side lines.

Additional Change in Student Physical Activity and Lesson Context After the Second Year of Intervention.

Additional gains in estimated energy expenditure were observed from Year 1 post to Year 2 post [$F(1,30) = 19.4, P \leq .001, ES d = 1.14$]. Moderate to vigorous physical activity also significantly increased (58.4% at Year 1 post; 67.3% at Year 2 post) [$F(1,30) = 9.6, P \leq .01, ES d = 0.79$] resulting in a 1-year additional increase of 15% and an overall increase of 32% from baseline. In addition, time spent in vigorous activity significantly

increased (19.5% at Year 1 post; 27.7% at Year 2 post) [$F(1,30) = 36.4, P \leq .001, ES d = 1.96$], a 39% increase since baseline. This gain in vigorous activity was seen for both boys (21.1% at Year 1 post; 28.5% at Year 2 post) [$F(1, 30) = 6.1, P = .02, ES d = 1.78$] and girls (17.8% at Year 1 post; 26.8% at Year 2 post) [$F(1, 30) = 9.1, P \leq .01, ES d = 1.40$]. In addition, physical education teachers continued to increase the amount of time students were in MVPA during the first 5 minutes of class [$F(1,30) = 6.5, P = .02, ES d = 1.40$].

The gains made in quality instruction from baseline to Year 1 post were maintained in Year 2 for time spent on skill drills and free play. Less time was spent on classroom management from Year 1 post to Year 2 post (25.8% versus 19.6%) [$F(1, 30) = 6.4, P = .02, ES d = 1.0$]. However, improvement in Year 1 post for time spent on fitness did not persist in Year 2. Physical education teachers spent less time on fitness after the second year of intervention. There continued to be no change in time spent on knowledge.

Change in HOPE by Physical Education Teacher Characteristics

Analyses were run to examine whether change in MVPA from baseline to Year 2 post varied depending on physical education teacher gender, certification/licensure status, and number of years teaching PE. There were no statistically significant interaction effects (data not shown). However, this could be due to low statistical power (eg, 3 uncertified physical education teachers and 12 certified physical education teachers at Year 2 post).

Discussion

Rural schools are an important setting to prevent childhood obesity. However, given the lack of progress in increasing the amount of time students can spend in physical education classes, it is important to maximize opportunities for students to be moderately to vigorously active during class time. Finding ways to improve physical education is especially timely given its prominent role in the Whole School, Whole Community, Whole Child model put forth by the Centers for Disease Control and Prevention and the Association for Supervision and Curriculum Development.¹⁸ The PE Academy was designed to increase rural, low-income elementary school students' MVPA during physical education class and to increase physical education teachers' quality of instruction.

Sallis and colleagues¹⁹ call for dissemination research to understand what is needed to scale up evidence-based programs. This paper provides evidence that SPARK can be successfully disseminated to rural, low-income schools districts and that schools demonstrate additional gains from a second year of intervention. However, significant resources were needed. Teachers received equipment, curriculum materials, professional development trainings by elite SPARK trainers, and site coordinator support for 2 years. Thus, achieving "HOPE" is an expensive proposition. The PE Academy cost approximately \$1.2M. This figure included middle and high school components not discussed in this paper as well as significant personnel time to develop the approach and evaluate the program. Nevertheless, cost-effective approaches are needed to respond to the call for HOPE. Future iterations of the PE Academy (currently being implemented in another rural area—southeast Colorado) are expected to cost less due to a reduction in the number of site coordinator visits and the incorporation of social media to build a "virtual" professional learning community among teachers.

At the time the intervention began, students were already active at least 50% of the time they were in physical education class. However, after 1 and then 2 years of intervening with physical education teachers, MVPA levels increased to 58% and then 67%. This translated to an additional 4.9 minutes of MVPA. When standardized to a 30-minute physical education period at both baseline and Year 2 post, this amounts to 4.6 additional minutes in MVPA. These gains were achieved without lengthening the physical education period. Using the same calculations presented in McKenzie et al³⁴ this translates to 14.6 more hours of physical activity over a school year and 4662 kcal or 1.33 lbs. of weight gain prevention for a 41-kg student.

Gains in MVPA exceeded other SPARK-based interventions that also included site coordinator support. For example, the PE Academy produced a 32% increase in MVPA whereas The Middle School Physical Activity and Nutrition intervention (M-SPAN) resulted in an 18% increase after the second full year of intervention. In M-SPAN teachers attended workshops and received site coordinator visits every 2 weeks in Year 1 and every month in Year 2.³⁴ The PE Academy's results are on par with a 2.5-year CATCH intervention that also provided physical education teachers with curriculum, workshops, and on site coaching every 2 weeks.²⁰

The PE Academy had mixed success in changing lesson context. After the intervention was completed, SOFIT results were presented to a small group of physical education teachers who participated in the intervention. They thought that the lack of change in time spent on classroom management from baseline to Year 1 followed by a decrease in Year 2 reflected teachers' initial struggles to implement SPARK strategies followed by more mastery over time.

Strategic investments are needed to sustain gains. For example, a 5-year follow up study of the CATCH physical education

curriculum found that gains in moderate activity were maintained but vigorous activity levels sharply declined.³⁵ School support and teacher training were positively associated with using the evidence-based curricula 5 years later.

The PE Academy team received a second grant to sustain gains and institutionalize professional development activities in the community. A 2-fold approach is planned to shift responsibility from PE Academy staff to community members such as SLV school districts, master physical education teachers, and the local higher education institution, Adams State University (ASU). First, a physical education advocacy campaign for school boards, superintendents, principals and community will be implemented to increase knowledge about the link between academic achievement and physical activity and the value of physical education. School districts will be encouraged to increase the amount of physical education students receive, establish policies requiring 150 minutes of physical education per week for elementary and 225 minutes for secondary schools, require health optimizing physical education (HOPE) be implemented, increase funding of HOPE in schools for purchasing new equipment, hire high quality physical education teachers, and support professional development. Second, a physical education teacher sustainability intervention consisting of workshops and a professional learning community will be implemented over a school year to maintain knowledge and skills related to HOPE.

At a time when childhood obesity rates are on the rise in Colorado, strategies are needed to increase daily physical activity and healthy eating. The PE Academy succeeded in increasing physical activity during physical education class. This study provides important information about what it takes to successfully disseminate and implement SPARK, an evidence-based physical education curriculum shown to increase MVPA. While costly, site coordinator support and equipment proved essential in ensuring that physical educators had the support and resources needed to implement the curriculum. This study supports Fullan's contentions that continual support and follow-up are needed after initial training.²⁴ Because of the high cost involved with implementing the PE Academy, additional studies are needed to test the effectiveness of smaller interventions designed to increase MPVA in which the amount of site coordinator support and equipment are decreased.

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