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Impact of trained champions of comprehensive school physical activity programs on school physical activity offerings, youth physical activity and sedentary behaviors

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ABSTRACT

Objective. A quasi-experimental cluster-controlled design was used to test the impact of comprehensive school physical activity program (CSPAP) professional development on changes in school physical activity (PA) offerings, moderate-to-vigorous physical activity (MVPA) and sedentary behaviors of 9–14 year-old children during school.

Methods. Two groups of Louisiana elementary and middle school physical education teachers ($N = 129$) attended a CSPAP summer workshop (95 in 2012 = intervention, 34 in 2013 = control) and were assessed on school PA offerings (teacher-reported; pre, mid, and post). During the 2012–2013 school year, intervention teachers received CSPAP support while implementing new school PA programs. MVPA and sedentary behaviors were assessed (accelerometry; baseline and post) on a sample of 231 intervention, 120 control students from 16 different schools.

Results. Multivariate analysis of covariance indicated that intervention teachers reported significantly more PA offerings during school (3.35 vs. 2.37) and that involve staff (1.43 *vs.* 0.90). Three-level, mixed model regressions (stratified by sex) indicated that students overall spent less time in MVPA and more time being sedentary during school, but the effects were significantly blunted among intervention students, especially boys.

Conclusions. This study provides preliminary evidence for CSPAP professional development programs to influence school-level PA offerings and offset student-level declines in MVPA and increases in sedentary behavior.

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Introduction

A whole-of-school approach, such as the Comprehensive School Physical Activity Program (CSPAP), is recognized as a promising way for children to accumulate daily physical activity (PA) via five integral components: (a) physical education (PE), (b) PA during school, (c) PA before/after school, (d) staff involvement and (e) family/community engagement (American Alliance for Health, Physical Education, Recreation and Dance [AAHPERD], 2013; Institute of Medicine, 2013; Physical activity guidelines for American Midcourse Report Subcommittee of the President's Council on Fitness, Sports and Nutrition, 2012). In 2010, the National Association for Sport and Physical Education [NASPE][1] commissioned a task force to create a professional development (PD) program designed to equip PE teachers with the knowledge, skills and confidence to become a PA champion who facilitates the implementation of at least one new school PA program beyond the CSPAP component of PE (Carson, 2012). As similar teacher training efforts are unveiled nationwide (Society of Health and Physical Educators [SHAPE] America, 2014),

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[1] Until April 2013, the American Alliance for Health, Physical Education, Recreation and Dance (AAHPERD) was composed of five national associations, including the National Association for Sport and Physical Education (NASPE). In 2013, AAHPERD members voted to dissolve the five national associations and unify under the AAHPERD name. Since then, AAHPERD has renamed itself SHAPE America—Society of Health and Physical Educators.

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it is critical and timely to understand the effectiveness of CSPAP PD on preparing a PA champion to promote greater opportunities for school PA that increase the PA among the youth they serve.

Schools have been identified as a logical place to provide PA opportunities for children (Naylor and McKay, 2009; Pate et al., 2006), given that the majority of children spend most of their waking hours in and around schools (Synder and Dillow, 2011). In recent years, a proliferation of systematic reviews of large-scale studies have been performed on the effectiveness of school-based interventions on children's PA (De Bourdeaudhuij et al., 2011; Demetriou and Höner, 2012; Dobbins et al., 2013; Kriemler et al., 2011; Metcalf et al., 2012). Consistent findings across these reviews were: (a) school-based interventions generally produce positive effects on children's total PA across both self-report and objective measures, (b) effect sizes, when reported, are small (e.g., $rs = 0.10–0.17$), indicating modest gains in moderate-to-vigorous PA (MVPA) per day (e.g., 4 min), and (c) there is growing support for multicomponent school-based interventions increasing children's in-school PA over the isolated ones that mainly emphasize PA-focused curricular change (e.g., active lessons) or educational materials (e.g., behavior management skills). As a result, an important and urgent area of inquiry is the examination of the teacher-directed, multicomponent school-based intervention model currently being advocated and widely disseminated (i.e., CSPAP; SHAPE, 2014). The continued PD of PE teachers is a scalable and sustainable teacher-directed strategy for implementing multicomponent school-based PA (Castelli et al., 2013), yet few studies have examined the utility of PD to impact children's objectively measured PA (Middle School Physical Activity and Nutrition [M-SPAN], McKenzie et al., 2004; Trial of Activity for Adolescent Girls [TAGG], Webber et al., 2008). Therefore, the current study, which evaluates the impact of yearlong PE teacher PD and support in CSPAP implementation on school PA offerings and children's MVPA and sedentary behaviors during school, is warranted.

The current study was conducted in elementary and middle schools serving primarily low-income, non-white student populations with two specific aims. Study aim one was to determine the differences in teacher-reported school PA offerings across pre, mid, and post assessments between teachers receiving yearlong CSPAP PD and support in implementing new PA programs (intervention) and those waitlisted (control). We hypothesized that intervention teachers would deliver significantly more PA offerings over time than control teachers. Study aim two was to determine if students' school MVPA levels and sedentary behavior changes from baseline to post assessment when exposed to the increased number of PA offerings and the newly implemented PA programs by intervention teachers versus control teachers. We hypothesized that students of intervention teachers would spend significantly more school time in MVPA and significantly less school time being sedentary overtime (baseline to post assessment) versus students of control teachers.

Materials

Study design and setting

A quasi-experimental, cluster-controlled design was conducted with 129 certified full-time PE teachers from 96 elementary and middle schools across 22 parishes (i.e., districts) in Louisiana between May 2012 and May 2013. Teacher participants were from an average of 4 schools per parish (maximum 18) with an average of one teacher per school (maximum 5). A total of 779 public schools located in 39 parishes with a demographic composition exceeding the 2010–2011 statewide averages in both (a) student poverty level - eligibility for the free or reduced-priced lunch program (>67%), and (b) minority (non-white) student population (>53%) were targeted for participation (Louisiana Department of Education, 2014), of which 225 high schools were excluded for not meeting grade level criteria (serving 9–14 year old students).

Recruitment and allocation procedures

The study was approved by the Institutional Review Board at Louisiana State University. Refer to Fig. 1 for the participant flow diagram.

Teachers

Certified, full-time elementary and middle school PE teachers teaching 9–14 year-old students within the remaining 554 eligible schools were invited to participate in this study via email invitations distributed by parish health and PE coordinators per the request of the Louisiana Department of Education. This process was initiated in spring 2012 and repeated throughout summer 2012, along with several follow-up efforts resulting in an overall total of 174 registered PE teachers. From this sample, 129 PE teachers (74% of the registered teachers) attended one regional CSPAP training workshop. Independent t tests indicated that the 45 registered PE teachers who did not attend the workshops were comparable to the 129 who attended the workshops in both targeted parish level criteria (student eligibility for free/reduced lunch, $p = .21$; student minority population, $p = .08$), and Pearson $\chi^2_{(1, N = 120)}$ confirmed the distribution of elementary and middle school levels ($p = .29$) and teachers' sex ($p = .26$) did not differ across groups.

Based on summer availability, 95 PE teachers who attended a regional workshop in summer 2012 were allocated to the intervention group, and 34 PE teachers who attended a regional workshop in 2013 were allocated to a waitlisted control group. The workshops were free to teachers ($100 value[2]) and qualified for continuing education units. The subsequent 12-month follow-up of the PD program, including online support, mentorship and consultation, was also available to workshop attendees free of charge (an additional $200 value[2]). A total of 110 PE teachers (77 intervention, 33 control) initiated the 12-month follow-up by completing a CSPAP pre-assessment. Using equivalence t tests and χ^2 analyses, these 110 PE teachers did not significantly vary from the 19 PE teachers who opted out of the 12-month follow-up in either parish level criteria (student eligibility for free/reduced lunch, $p = .26$; student minority population, $p = .26$) or school level distribution ($p = .09$), but did include comparably more female teachers than expected (71% pre-assessment females vs. 42% no pre-assessment females, $p < .05$). The pre-assessment intervention teachers, when compared to the pre-assessment control teachers, taught in parishes with a higher percentage of student eligibility for the free/reduced lunch program (71% intervention vs. 61% control, $p < .01$) and a higher minority student population (63% intervention vs. 50% control, $p < .01$), but both groups were comparable in the representation of school levels ($p = .67$) and teachers' sex ($p = .35$). Reasons teacher opted out of the 12-month follow-up ranged from perceived workload to technological challenges (Carson et al., 2014b).

A sample of 16 PE teachers from separate schools (8 = elementary, 8 = middle) within 9 high poverty ($M = 73\%$ free/reduced lunch) and minority school districts ($M = 64\%$ nonwhite students) were participants for study aim two (11 intervention, 5 control). Equivalence analyses indicated that both groups were comparable, consisting of mostly female teachers (64% intervention, 80% control, $p = .50$) with similar mean years of teaching experience (16.8 intervention vs. 17.1 control, $p = .97$), who taught in parishes with significantly similar levels of student poverty (74% intervention, 71% control, $p = .48$) and student minority population (67% intervention, 57% control, $p = .30$). The majority of middle school teachers were in the intervention group ($n = 7$), but this count was in alignment with the expected distribution, likelihood ratio $\chi^2_{(1, N = 16)} = .45$, $p = .50$.

Students

All 129 PE teacher workshop attendees were invited via email to be participants for study aim two until a recruitment goal of 10% consented from each group (11/95 = intervention, 5/34 = control). These 16 PE teachers were instructed to recruit from 1 to 2 intact homeroom classes or ~10% of their 9–14 year old student rosters. This enrollment process estimated 24.1 students per teacher for a total of 386 consenting students who provided written parental permission and child assent prior to participation. The 9–14 year old age range was purposely chosen because of its key period of development when reductions in PA begin, particularly in minority populations (Gordon-Larsen et al., 2004).

[2] Prices for the PD workshop and 12-month follow-up were pre-set by NASPE.

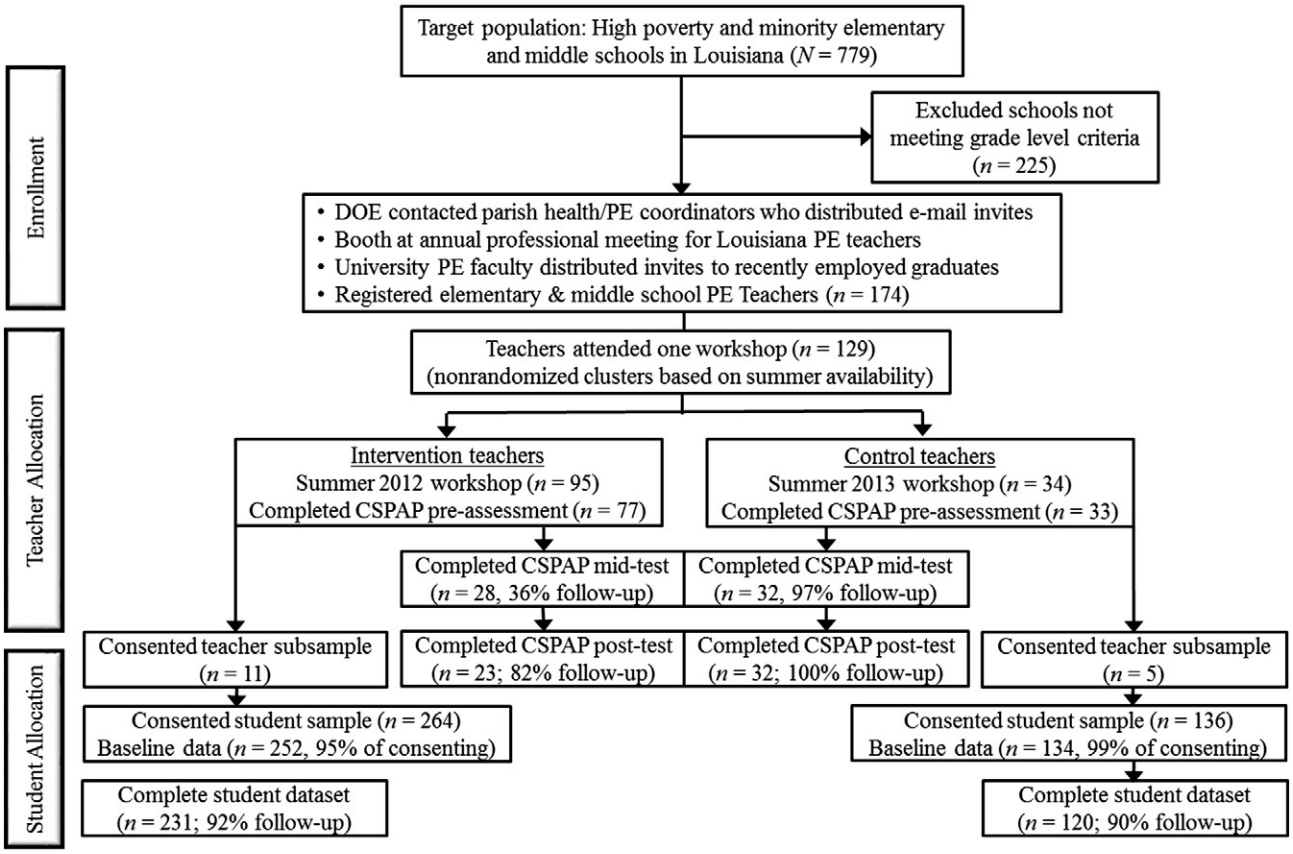

Fig. 1. Participant flow diagram. CSPAP = comprehensive school physical activity program; DOE = Department of Education; PE = physical education. Study took place in Louisiana.

CSPAP teacher training and implementation intervention

Guided by ecological systems theory (Bronfenbrenner, 1989), the CSPAP PD program was constructed as a multiple step, yearlong process for PE teachers to develop a school culture conducive to promoting and providing school PA opportunities beyond PE. At the time this study was conducted,[3] the program commenced with an onsite 6-hour experiential workshop where PE teachers received information and skill-based training pertaining to the planning and implementation of each CSPAP component. Workshop attendees developed an action plan to implement a new and achievable PA opportunity pertaining to one CSPAP component, beyond PE (e.g., to provide PA before/after school, PE teacher organizes a weekly PA morning club for students) within 12 months post workshop. During the yearlong follow-up period, CSPAP support was available to the trained PE teachers in the form of resources and learning modules accessible on a website and technical assistance and consultation from an assigned mentor. Teachers earned a certificate after the newly implemented PA program was documented with the stepwise submission of representative evidence (i.e., artifacts), and a CSPAP self-assessment, referred to as the CSPAP index, was completed near the beginning and end of the PD program. Complete details of the CSPAP PD program have been published elsewhere (Carson, 2012). Initial process evaluations have confirmed the effectiveness of the PD program in increasing PE teacher readiness, knowledge, and advocacy for CSPAP implementation and potential for school policy change (Carson et al., 2014b; Centeio et al., in press).

Main outcomes

Teacher reported school physical activity offerings

To address study aim one, teachers in both intervention and control schools completed the CSPAP index, which contains questions from the valid and reliable school physical activity policy assessment (S-PAPA; Lounsbery et al., 2013) and questions derived from previous studies (Centeio et al., in press) that asked PE teachers to self-report the number of PA promoting practices currently offered at their school for each CSPAP component. These included: (a) PE (5-items; e.g., spend 50% of time in moderate-to-vigorous PA, teach recess games), (b) PA during school (16-items; e.g., provide equipment bags for recess, classroom PA lessons, classroom PA breaks), (c) PA before/after school (13-items; e.g., open gym, activity clubs, athletics), (d) staff involvement (7 items; e.g., walking/jogging groups for staff, incentives for staff engaging in PA) and (e) family/community engagement (9 items; e.g., family fun nights, PA homework assignments). An open-ended "other (please supply)" item was available for each CSPAP component section, and responses were tallied as separate PA offerings if they did not replicate pre-existing items. PE teachers were requested to complete the CSPAP index via an online survey on three separate occasions throughout the 12-month PD program, pre (in summer 2012 before the workshop and start of the school year), mid (after the workshop and toward the end of the fall 2012), and post (in the spring 2013 toward the end of the school year), and were compensated $25 for every CSPAP index completed ($75 maximum).

Student physical activity and sedentary behaviors during school

To address study aim two, baseline (October–November 2012) and post (February–April 2013) weeklong accelerometry data were collected to assess the student MVPA and sedentary behaviors during school. On the first day of each assessment week, students were outfitted with accelerometers (GT3XE-Plus/GT1M, ActiGraph, Pensacola, FL, USA) using standard protocol by trained research assistants. Students were instructed to wear the monitor on their right hip using a fitted belt during waking hours except when bathing, showering or swimming for 5 consecutive school days representing a single school week (Monday through Friday). Raw intensity counts were collected in 5-second epochs. Evenson cut points were used to estimate activity levels (Evenson et al., 2008). For the analysis this paper, a valid day consisted of 10 or more hours of wear time (data analyzed from 6 am to 10 pm), inclusion criteria similar to that used in field-based evaluations of children (Magnusson

[3] This program was known as the Director of Physical Activity (DPA) certification program until August 2013 when it was transformed and used to guide the creation of the *Let's Move!* Active Schools Physical Activity Leader (PAL) learning system (SHAPE, 2014).

Table 1
Estimated group *M* results for teacher-reported CSPAP practices by time point and overall.

CSPAP component	Intervention ($N = 128$)			Control ($N = 97$)			Total ($N = 225$)	
	Pre ($n = 77$)	Mid ($n = 28$)	Post ($n = 23$)	Pre ($n = 33$)	Mid ($n = 32$)	Post ($n = 32$)	Intervention ($n = 128$)	Control ($n = 97$)
PA during PE	2.06 (0.14)	1.94 (0.23)	2.43 (0.25)	1.84 (0.21)	2.29 (0.21)	2.36 (0.21)	2.14 (0.12)	2.16 (0.12)
PA during school	2.93 (0.23)	3.65 (0.38)	3.46 (0.42)	2.21 (0.35)	2.50 (0.36)	2.39 (0.36)	3.35[a] (0.21)	2.37[b] (0.21)
PA before/after school	1.60 (0.16)	2.10 (0.26)	1.62 (0.29)	2.12 (0.24)	2.51 (0.25)	2.13 (0.25)	1.77[a] (0.14)	2.25[b] (0.14)
Staff involvement	1.21 (0.12)	1.46 (0.20)	1.61 (0.22)	0.91 (0.18)	0.95 (0.19)	0.84 (0.19)	1.43[a] (0.11)	0.90[b] (0.11)
Family/community	1.91 (0.18)	2.13 (0.30)	2.13 (0.33)	1.64 (0.28)	1.92 (0.28)	2.12 (0.28)	2.06 (0.16)	1.89 (0.16)
Total PA offerings	9.70 (0.58)	11.29 (0.94)	11.25 (1.04)	8.72 (0.87)	10.17 (0.89)	9.84 (0.89)	10.74 (0.51)	9.58 (0.51)

Note. Estimates in the same row with dissimilar superscripts differ at $p < .05$ in Bonferroni's comparison technique. Study took place during 2012–2013 school year in Louisiana. CSPAP = comprehensive school physical activity program; PA = physical activity; PE = physical education.

Table 2
Submitted action plans and artifacts of newly implemented PA programs by intervention teachers ($N = 11$).

CSPAP component[a] (School level)	PA Program(s)	Action plan steps[b] † (Representative artifacts)				
		1	2	3	4	5
During school 1 (middle)	Classroom brain breaks & after lunch walking recess	Contact principal for approval	Design brain break program	Design walking recess program	Recruit classroom teachers for brain breaks	Recruit activity bag student managers for walking recess
		(Faculty meeting agenda & photos of brain breaks)	(Activity description)	(Activity description)	(Classroom photos of participants)	(Photos of student participants)
During school 2 (elementary)	Classroom brain breaks	Receive principal approval	Organize materials	Recruit classroom teachers	Distribute materials to teacher participants	Program survey
		(Program plan with principals' signature)	(Photos of activity cards)	(Program plan with teachers' signatures)	(Photos of teachers' packet)	(Program calendar, log sheet)
During school 3 (elementary)	Classroom brain breaks	Create brain break exercises	Teach exercises to faculty at faculty meeting	Classroom teachers implement breaks	Verify exercisers are integrated during class	
		(None)	(None)	(None)	(None)	
During school 4 (middle)	After lunch drop–in PA period	Get program ideas/feedback from PE teachers & administration	Select PA offerings (i.e., table tennis, volleyball games)	Find incentives	Start program	
		(Principal approval)	(Student–generated list of activities)	(Incentive list –PE extra credit, school discounts)	(Sign–in log, program photos & survey)	
During school 5 (middle)	PA curriculum integration inEnglish Language Arts	Brainstorm program ideas	General program development	Collect videos	Activity–specific development	Implementation
		(Notes)	(Data notes)	(Recorded commercials)	(Directions to participants)	(Log sheet, program photos)
During school 6 (middle)	School day pedometer challenge	Receive principal approval	Identify start date	Advertise	Post sign–up sheet for students	Begin program
		(Approval letter)	(Program calendar)	(Program flyer)	(Sign–up sheets)	(Photos, pedometer mileage logs)
Staff involvement 1 (elementary)	Student/teacher post exam yoga class	Select event date	Receive principal approval	YMCA coordinator event agreement	Notify faculty & students of event date	
		(Overview of event details)	(E–mail correspondence)	(Confirmation letter)	(Flyer)	
Family/Community 1 (elementary)	Family wellness night	Principal approval of event details	Determine event program	Contact local presenters/speakers	Collect door prizes & snacks	Publicize event
		(Signed letter)	(Presentation topic, room rotations)	(Contact list of presenters)	(List of door prizes & snacks, photos)	(Event flyer)

Note. Three intervention teachers (middle school) did not submit an action plan nor artifacts. Parenthetical text in shaded columns indicate artifacts submitted by teachers. Study took place during 2012–2013 academic year in Louisiana. PA = physical activity; CSPAP = comprehensive school physical activity program; PE = physical education.
[a]Component determined by assigned CSPAP mentor.
[b]Number of steps determined by teachers.

Table 3
Descriptive statistics of students samples at baseline.

	Intervention ($N = 120$)				Control ($N = 231$)			
	Girls ($n = 62$)		Boys ($n = 58$)		Girls ($n = 132$)		Boys ($n = 99$)	
Variable	*M*	(*SD*)	*M*	(*SD*)	*M*	(*SD*)	*M*	(*SD*)
Student race (non-white) (percent)	62.4		52.6		64.0		70.4	
Student BMI for overweight (percent)	24.0		20.6		21.2		26.7	
Student BMI for obese (percent)	15.5		13.6		9.0		14.8	
Student age (years)	9.9	(0.9)	10.2	(1.0)	11.8	(1.3)	11.7	(1.4)
Teacher years of experience (years)	13.1	(13.7)	15.5	(13.8)	16.8	(10.0)	19.8	(9.2)
Parish free or reduced lunch program (percent)	70.2	(5.6)	69.9	(6.2)	77.1	(8.5)	76.4	(8.7)
Parish minority student population (percent)	53.5	(10.4)	55.0	(10.7)	70.8	(18.2)	70.8	(18.1)
Accelerometry data (minutes/day)								
In-school								
Sedentary	264.9	(49.8)	260.9	(53.0)	250.7	(72.1)	261.9	(67.9)
Moderate-to-vigorous physical activity	22.2	(8.9)	23.8	(12.4)	18.0	(10.1)	21.7	(12.5)
In-school wear time	378.8	(61.0)	377.3	(71.3)	341.9	(95.7)	362.4	(96.7)
Daily								
Sedentary	469.9	(81.8)	458.7	(85.2)	475.4	(72.8)	482.0	(86.0)
Moderate-to-vigorous physical activity	44.7	(18.0)	49.2	(21.7)	39.9	(17.5)	50.9	(23.3)
Total daily wear time	696.3	(114.6)	689.1	(115.8)	683.5	(101.9)	709.5	(113.8)

Note. BMI = body mass index. Study took place during 2012–2013 school year in Louisiana.

et al., 2011; Mattocks et al., 2008). A valid school wear time was defined as having 3 or more hours of wear during school time (school time was determined using first bell and last bell for individual school). None wear time was defined as a period of 30 min of consecutive zeroes and was removed from the analysis. Weekly PA logs were distributed to students on the first day of each assessment week for self-monitoring purposes and to encourage compliance. Weight (by scale) and standing height (by wall growth chart) were measured at baseline and students' body mass index (BMI) percentile were calculated for overweight (85th to <95th) and obese status (≥95th). Data collectors asked each PE teacher to perform daily check-ups on the monitored students and obtained their master schedule to verify PE offerings and duration. Students were rewarded with an item of their choice from a treasure bag when both the accelerometer and week PA log were returned at the end of the assessment week.

Statistical analyses

To test the first hypothesis that intervention teachers report significantly more PA offerings in their school overtime compared to control teachers, we analyzed data from the 112 PE teachers of the 129 workshop attendees (spanning 73 elementary and 32 middle schools) who completed the CSPAP index during at least one time point (pre, mid, or post). A group × time multivariate analysis of covariance (MANCOVA) test with student level covariates (grade level), teacher-level covariates (years of experience) and school-level covariates (student socioeconomic status) was calculated to determine whether the number of school PA offering PE teachers reported across the five CSPAP components differed by the two teacher groups or the three assessment time points. This analysis was performed using IBM SPSS Statistics for Windows, Version 22.0 (IBM Corp., Armonk, NY).

To test the second hypothesis that children in the CSPAP schools engage in a significantly more minutes per day (min d^{-1}) in MVPA and spend significantly less minutes per day being sedentary, a series of mixed-model regressions (stratified by students' sex) were performed in Stata v12. In the first model, minutes in MVPA were regressed on the empty, three-level model with observations nested within student, which were nested within teacher. In the second model, MVPA was regressed on condition, time (baseline/post), demographic covariates (race, body mass indices of overweight and obese at baseline, baseline age), teacher-level covariates (years of experience), parish-level covariates (percentage students receiving free or reduced lunch, percentage of minority population), and baseline minutes in MVPA. Additionally, all models controlled for the amount of monitor wear time. Models were repeated with time spent in sedentary behavior as the dependent variable, and estimated for boys and girls separately and for in-school PA and total daily PA.

Results

Teacher reported school physical activity offerings

The MANCOVA yielded a significant group effects, $F_{(5, 211)} = 6.78$, $p < .01$, but no time ($p = .33$) nor group × time interaction ($p = .74$) effects for the following CSPAP components: During school ($F_{[1,215]} = 10.76$, $p < .01$), before/after school ($F_{[1,215]} = 5.82$, $p < .01$), and staff involvement ($F_{[1,215]} = 11.66$, $p < .01$). Bonferroni's adjustment technique for multiple comparison presented in Table 1 indicates intervention teachers reportedly provided a significantly more PA offerings during school (3.35 vs. 2.37) and that involve staff (1.43 vs. 0.90), whereas control teachers reportedly provided significantly more before/after school PA offerings (2.25 vs. 1.77). Inspection of the group mean trajectories over time indicates some degree of change from pre to mid to post that was not consistent across groups (see Table 1). No significant group differences were found for the PA offered during PE ($p = .90$), family/community engagement in PA ($p = .50$), or total number of PA opportunities offered across all five CSPAP components ($p = .12$).

A follow-up group × time MANCOVA, adjusting for the same student, teacher, and school-level covariates, was conducted with the 16 PE teachers sampled for study aim two. Results only yielded a group effect in staff involvement PA (intervention = 1.42 vs. control = 0.46; $p < .05$), indicating that the number of PA offerings provided to students was similar across four of the five CSPAP components in both the 11 intervention schools and 5 control schools.

Student physical activity and sedentary behavior during school

Out of the 11 intervention teachers sampled for study aim two, 8/11 submitted multi-step action plans to implement a new PA program during the 2012–2013 school year (CSPAP component addressed: 6 during school, 1 staff involvement, 1 family/community engagement), of which 7/8 submitted representative artifacts to document the completion of each step. The teacher-submitted action plans ($n = 8$) and artifacts ($n = 7$) presented in Table 2 indicated that classroom brain breaks and/or after lunch PA programs ($n = 5$) were the most commonly implemented during school PA programs, while both the staff involvement and family/community engagement PA programs were onetime events.

Of the 400 sampled children, 351 had complete accelerometry data on both outcomes (MVPA and sedentary behavior) for at least 2 school days during each assessment week (overall follow-up rate of 88%). Table 3 presents the descriptive statistics of the student sample at baseline and post assessment. Results of the mixed-model regressions revealed that 6.8% of variance in MVPA and 12.4% of variance in sedentary behavior was explained at the teacher level. For in-school MVPA and time spent sedentary, a significant condition-by-time interaction effect was observed indicating the control boys and girls spend less

time in MVPA by 2.2 min d^{-1} (95% CI 0.5 to 3.8) and 3.4 min d^{-1} (95% CI 1.2 to 5.6), as well as, spend more time being sedentary during school from baseline to post by 10.3 min d^{-1} (95% CI 5.9 to 14.6) and 12.9 min d^{-1} (95% CI 7.9 to 18.0), respectively, compared to boys and girls attending intervention schools (see Figs. 2.A, B). These data represent an overall in-school decline of ~3 min d^{-1} in control boys and girls compared to a decline of ~1 min d^{-1} for girls and no change for boys attending intervention schools. For in-school sedentary behavior, intervention girls increased by ~4 min d^{-1}, while intervention boys decreased by ~3 min d^{-1} compared to a 10 to 14 min d^{-1} increase in both boys and girls attending control schools. No changes were observed for total daily MVPA and time spent sedentary for either boys or girls.

Discussion

CSPAP is the whole-of-school approach endorsed today by leading national organizations and initiatives as having great potential for increasing the PA levels of youth during school. However, for CSPAP to meet its fullest potential, every school must be equipped with an individual trained to spearhead and coordinate implementation (Heidorn et al., 2010). PE teachers are the most logical person to assume this role (Castelli and Beighle, 2007), but often require additional training that is specific to CSPAP implementation (Beighle et al., 2009). Using school PA outcome data collected at both the teacher and student level, this study was the first to evaluate a CSPAP-specific PD program for PE teachers. Accordingly, the PD program was purposely built to reflect an adaptable CSPAP model, rather than a "one size fits all" approach, that can be molded into achievable PA interventions by PE teachers and across school context (Carson, 2012; Castelli et al., 2013).

Findings partially supported hypothesis one. PE teachers participating in the 12-month PD program reported offering significantly more PA opportunities in two of the five CSPAP components – PA during school and staff involvement PA – that could potentially reflect some of the observed changes in index score trajectories overtime (see Table 1). These findings should be interpreted with caution due to the non-randomization of teacher groups with unequal pre CSPAP index scores, but do provide initial signs of CSPAP PD success. Conclusions from several literature reviews to date recommended the study of implementing of school-based PA programs that maximize PA during school and broaden their reach to adults (De Bourdeaudhuij et al., 2011; Erwin et al., 2013; Kriemler et al., 2011). Our study findings suggest that schools equipped with a CSPAP-trained PE teacher are adopting PA opportunities during school and for staff with greater frequency as might be expected. Understanding the rationale behind the elevated uptake of during school and staff involvement PA programs may illuminate component-specific implementation strategies that can be integrated in a CSPAP PD program. Further, it appears that PE teachers already have some familiarity with offering before/after school PA programs without additional CSPAP PD, albeit the before/after school PA programs could be a reflection of the coaching duties commonplace to the expectation or desire of many PE teachers (55% in the current study sample). Future work might benefit from considering how PE teachers' draw to coaching (i.e., money, fame, joy) could be channeled to leading CSPAP before/after school programs.

Hypothesis two was not supported. Students of both intervention and control groups spent significantly less amount of time in MVPA and significantly more amount of time in sedentary behavior from baseline to post assessments. However, these changes, especially in the in-school MVPA minutes for boys attending the intervention schools, were blunted. The blunted reduction in MVPA minutes and blunted elevation in sedentary minutes found across the school year could be explained by the implementation of new PA programs in the interventions schools that were largely geared toward immediately impacting the PA levels *during* school. The blunting effects observed in this study, coupled with some support for the reduction of objective

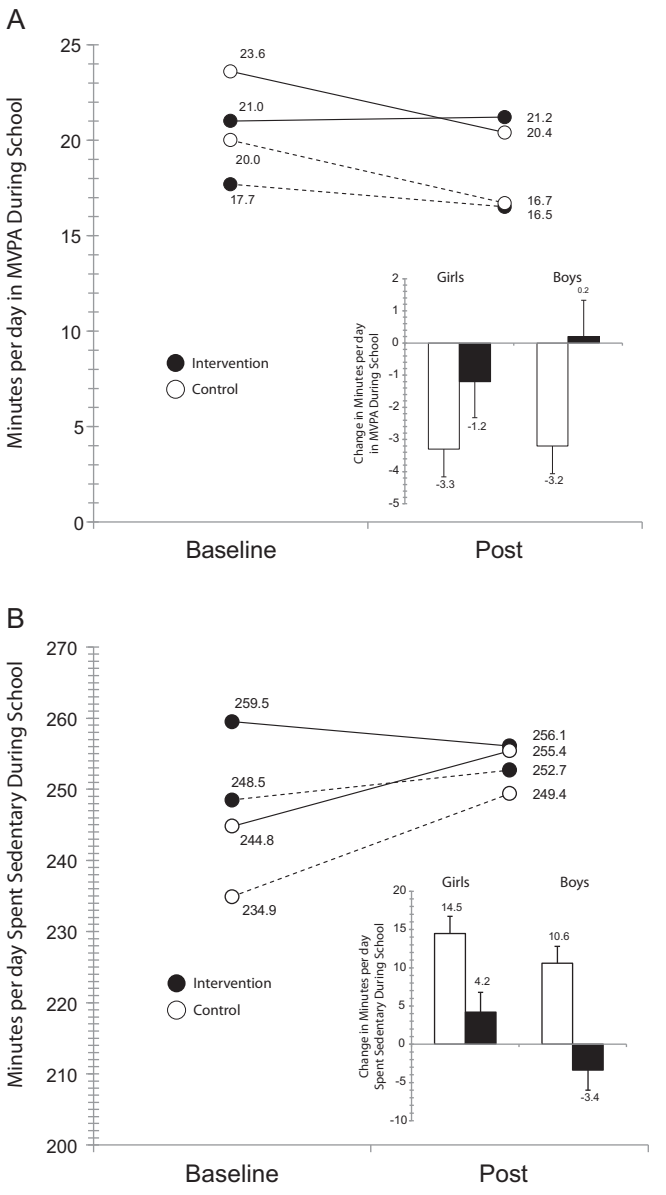

Fig. 2. A. Condition-by-time interaction effect for during school minutes per day in MVPA with covariates at the student (race, baseline age and body mass indices of overweight and obese), teacher (years of experience), and parish levels (percentage students receiving free or reduced lunch, percentage of minority population). Solid lines represent boys; dashed lines represent girls. Study took place during 2012–2013 school year in Louisiana. B. Condition- by-time interaction effect for during school minutes in sedentary behavior with covariates at the student (race, baseline age and body mass indices of overweight and obese), teacher (years of experience), and parish levels (percentage students receiving free or reduced lunch, percentage of minority population). Solid lines represent boys; dashed lines represent girls. Study took place during 2012–2013 school year in Louisiana.

and self-reported measures of student PA from school-based PA interventions (Demetriou and Höner, 2012) and specifically in the latter half of the school year (Bruner et al., 2009), provide an opportunity for researchers and practitioners to pause and reflect critically about the scope and expectations of a CSPAP PD program for two reasons.

First, Table 2 suggests that the PD program successfully provided PE teachers with plenty of choice in the kind of new PA programs that could be implemented in their school context; however given the range of action plans and artifacts submitted, it is possible that the PD program was too flexible and generic. Teachers varied greatly in the breadth and depth of the newly implemented PA programs (e.g., school-wide pedometer challenge vs. a wellness night), the proposed implementation

steps—even within similar programs (e.g., step 5 for classroom brain breaks varied from recruitment to conduct a post-survey), and the submitted artifacts to document implementation (e.g., none vs. photos of student participation). Altogether, these inconsistencies and the teacher-dependent nature and burden of the implementation process are limitations of the PD program that could have impacted the effectiveness of the newly created PA programs and teacher participation in the study (e.g., three intervention teachers did not submit action plans or artifacts). We recommend future research to determine a menu of fine-tuned applications and implementation measures across each CSPAP component that result in the implementation of *daily* PA programs that contribute to the immediate and lasting influence on children's PA levels. The multi-step process of the CSPAP guide (Centers for Disease Control and Prevention, 2013) and the CSPAP framework (Carson et al., 2014a) may provide some direction to this inquiry.

Second, the yearlong length of implementation for a new PA program may simply be unrealistic to have an immediate impact on the in-school MVPA and sedentary behaviors of youth. It is likely that the CSPAP interventions resulting from the PD program may need more time than one school year to take effect and readjust procedures and policies that impart change. Plus, for many workshop attendees, CSPAP was an entirely new concept that many participating PE teachers have not yet or fully witnessed or experienced in action. A recent study found that PE teachers who attended the CSPAP workshop reported significantly higher efficacy to overcome barriers associated with implementing PA in the school setting compared to PE teacher of the year recipients (Centeio and Castelli, 2013). In all likelihood, intervention teachers spent a large proportion of the PD program understanding how CSPAP best fits within their school context and discovering ways to jump start a new PA program. As the CSPAP concept and related implementation efforts gain momentum and national visibility, the focus of the CSPAP PD program could evolve its emphasis from "what CSPAP is and could look like" to "implementation strategies that create more opportunities for children to be active in school."

The results of this study should be considered in light of its limitations. First, the absence of randomization and small sample sizes of both the teacher and student groups limit the generalizations that can be drawn from the study. Second, despite that the PD program was endorsed by several national and state entities (e.g., professional organizations for PE teachers, state's Department of Education, parish health and PE coordinators) and externally funded to incentivize PE teachers, the PE teacher recruitment and retention processes yielded relatively few enrolled teachers ($N = 129$) from 22 parishes across the state, of which 43% ($n = 55$) completed the post assessment one year later. Strategic recruitment and retention efforts are necessarily ingredients for any successful PD, and immediate consideration should be given to understanding and documenting sustainable approaches to get and keep PE teachers and schools to "buy into" CSPAP PD beyond being a study participant or compensated. In addition, recent work suggests that this PD program may be attracting highly passionate and high achieving PE teachers who identify with the role of CSPAP champion (Carson et al., 2014b; Centeio et al., in press), potentially introducing selection bias and limiting generalizability. Future research is needed to understand how to recruit and retain current and future PE teachers to embrace their critical role in the promotion and provision of public health goals (McKenzie and Lounsbery, 2013, 2014).

Taken together, the study provides preliminary evidence for the potential of a CSPAP PD program to influence the number of PA opportunities offered, and offset declines in students' MVPA and increases in students' sedentary behaviors. While this study was being conducted, a national school PA coalition was formed, led by the First Lady's LMAS initiative, to mobilize schools to endorse a CSPAP approach and become equipped with a PA champion (Carson, 2013), referred to as a Physical Activity Leader (PAL[§]) (SHAPE, 2014). With the national rollout of an accompanying in-person training effort well underway, this work provides evidence to guide its development and impact on the reach of CSPAP implementation. Consequently, it is our expectation that this research will inform policy decisions related to sustainable and scalable CSPAP implementation and its implications for evidence-based PD that amount to increased student PA levels in schools.

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