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ARTICLE

Chapter 7

Effects of a Classroom-Based Physical Activity Program on Children's Physical Activity Levels

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High levels of physical inactivity are evident among many American children. To address this problem, providing physical activity (PA) during the school day within the CSPAP framework, is one strategy to increase children's PA. Thus, the purpose of this study was to examine the effects of a classroom-based PA program on children's PA. Two hundred and ten students from one school participated in TAKE 10! for 12 weeks. All students wore pedometers and a sample of 64 students wore accelerometers for 4 days during week 1 (baseline), week 8 (midintervention), and week 12 (end-intervention). Data were analyzed using repeated-measures ANOVA. The results showed that students' daily in-school step counts increased by 672 steps from baseline to midintervention ($P < .001$). Students' moderate-to-vigorous intensity PA (MVPA) increased by approximately 2 minutes from baseline to end-intervention ($P < .01$). In conclusion, participating in TAKE 10! helps children strive toward the goal of recommended daily MVPA.

Keywords: CSPAP, PA during school day, School PA promotion, PA integrated curriculum

According to the U.S. Department of Health and Human Services (2008), children should accumulate at least 60 minutes of moderate-to-vigorous physi-

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cal activity (MVPA) per day to achieve health benefits. Unfortunately, evidence indicates that many children fall well below this level. For example, in one investigation, only 42% of children and 8% of adolescents obtained the recommended 60 minutes per day of MVPA (Troiano et al., 2008). Given the alarmingly low rates of MVPA among American youths, finding opportunities to promote physical activity (PA) in this population is imperative for achieving optimal health and well-being outcomes. As schools are attended by over 95% of youths, the school environment may represent an optimal venue to promote PA and to combat the obesity pandemic (National Association for Sport and Physical Education, 2008; Wechsler, McKenna, Lee, & Dietz, 2004).

Toward this end, the Comprehensive School Physical Activity Program (CSPAP) was recently initiated to support the Let's Move! Active Schools campaign. The goal of a CSPAP is to develop a school culture conducive to promoting lifelong PA across five integral components. The components include: (1) physical education, (2) PA during school, (3) PA before and after school, (4) staff involvement, and (5) family/community involvement (Erwin, Beighle, Carson, & Castelli, 2013). Carson, Castelli, Beighle, and Erwin (2014) suggest that the CSPAP conceptual framework be used for practice and research in promoting school-based PA. Based on a social ecological perspective, the framework depicts a wheel in which Daily PA Behavior is placed in the center (i.e., axis) and the Components are the hub that moves the axis (Carson et al., 2014).

The intent of CSPAP-based research is not to exclusively examine the effectiveness of implementing all components simultaneously, but to determine the unique contributions of each CSPAP component to youth's PA (Carson et al., 2014). With regards to this paradigm, the current study examined the impact of one component, PA during the school day, on students' PA levels. A strategy to increase PA during the school day is through classroom-based PA, which includes taking a short break from academic instruction by engaging in PA or integrating PA with the academic content (Erwin et al., 2013). In this study, we used a PA integrated with academic content program as an intervention to examine whether students' PA levels increased.

Out of the 7 to 8 hours that children are in schools, approximately 6 hours are used for academic instruction, where children are required to sit quietly in the classroom (Donnelly et al., 2009). Although students spend most of their school day in the classroom, less than 5% of their daily PA occurs in the classroom setting (Brusseau et al., 2011). In general, children are spending large amounts of time sitting and being sedentary during the school day (Sturm, 2005). Reducing time spent sitting, regardless of the type of activity, may reverse the consequences of obesity (Patel et al., 2010). Moreover, increasing amounts of PA during the school day is associated with improved academic performance of children (CDC, 2010). A comprehensive review of literature provided support for a positive association between PA and academic achievement, cognition, and behaviors (CDC, 2010).

Involvement in PA during class time has been shown to increase students' PA levels and intensities. For example, students who participated in the Physical Activity Across the Curriculum (PAAC) program accumulated more MVPA compared with students in the control group who did not receive the PAAC program (Donnelly et al., 2009). In addition, it was found that students spent approximately 20% of their time in MVPA while engaged in the Texas I-CAN lessons (Bartholomew

& Jowers, 2011). Other classroom PA programs that were found to be effective in increasing students' PA include Energizers (Mahar et al., 2006), a mathematics integrated classroom PA program (Erwin, Abel, Beighle, & Beets, 2011), and TAKE 10! (Stewart, Dennison, Kohl, & Doyle, 2004). Particularly, students who participated in the TAKE 10! program were found to accumulate PA in the moderate intensity levels during the 10-minute activity (Stewart et al., 2004).

TAKE 10! was chosen as the intervention in this study, because the program integrates grade-specific academic learning objectives with age-appropriate PA. Consequently, more teachers may be willing to add TAKE 10! to the classroom curriculum given they do not need to sacrifice academic learning time. A review of past research has shown that children who participate in TAKE 10! experience higher PA levels (Kibbe et al., 2011). For example, teachers reported that children accumulated 26.8 minutes per week of PA during the intervention period (Williams, Kibbe, & Lombardo, 2008), and children from intervention schools experienced an increase in PA duration compared with control schools (Liu, Hu, & Ma, 2008). Although time engaged in PA is the most common unit of measurement, step count thresholds such as the President's Active Lifestyle Award standards (11,000 steps per day for girls and 13,000 steps per day for boys) are becoming increasingly important (Beighle & Pangrazi, 2006). Measuring step counts in children allows for comparison with standards and can motivate children to participate in PA (Tudor-Locke, 2002). Furthermore, it is important to examine PA intensity levels because children who participate in at least 60 minutes of moderate to vigorous intensity PA each day have been found to have beneficial changes in their skeletal health, aerobic fitness, muscular strength and endurance, and adiposity (Strong et al., 2005). Considering the importance of step counts and PA intensity, little is known about the effects of TAKE 10! on these variables. Given the poor PA levels of many youth, and the reduced time devoted to PA in many schools, it is important to evaluate the efficacy of PA programs that can be integrated into academic learning time. As TAKE 10! represents one such program, the current study will add to the literature by examining whether this particular PA program, increases students' in-school step counts and PA intensity levels. We hypothesized that students' in-school step counts and PA intensity levels would increase from baseline to the end of the intervention.

Method

Participants and Settings

A total of 219 elementary school students and nine classroom teachers from three 3rd grade, three 4th grade, and three 5th grade classes were recruited for study participation. Students were selected from one elementary school located in a large southwestern city in the United States. The final sample included 210 students (91 boys and 119 girls), as six students were unenrolled from the school during the course of the study and three students did not complete the PA measurement protocol. Initial contact was made with the principal to conduct the research and approval to conduct the study was granted by the school district research office. Approval from the university's Institutional Review Board (IRB) was also obtained to conduct this study. Total enrollment in the school is approximately 750 students ranging from K to 6th grade. The ethnic composition of the sample was 57% Caucasian/White; 35% Hispanic/Spanish; 5% Pacific Islander; and 3% Other. The specific inclusion criteria for this study were: (a) students aged 8 to 12 years; (b) students from 3rd grade through 5th grade; and, (c) teachers from 3rd through 5th grade. These grade levels were chosen because high stakes standardized testing begins at the 3rd grade in the elementary schools and the TAKE 10! program is available through the 5th grade. The exclusion criteria for this study were students who have serious health conditions, injuries, or illnesses that may limit PA participation.

The Intervention

The PA opportunities during the school day already provided at the school included two recesses per day, each 13 minutes in length. The morning recess was an unstructured free play opportunity, while the afternoon recess was a "walking recess", where students walked laps around a paved walkway under the supervision of the classroom teachers. In addition, students were provided with a 45-minute Physical Education once per week. Hence, with few PA opportunities in place, the inclusion of classroom-based PA was a potential strategy to increase students' PA.

The TAKE 10! classroom-based, PA promotion curriculum developed by the International Life Sciences Institute Center for Health Promotion (ILSI CHP) was added as an intervention program to increase students' PA during the school day. TAKE 10! is a movement-integrated activity program that teaches children the importance of PA and energy balance while integrating PA into classroom lessons (http//www.take10.net). Academic areas within TAKE 10! that integrate movement and learning include language arts, math, science, social studies, and general health. Specifically, this program consists of a variety of 10-minute activities that include an exercise, cool down period, and a series of questions related to health and nutrition.

Teachers' Training

The teachers were trained to use TAKE 10! before implementing it in the classroom. The training lasted approximately one hour, which included information about the childhood obesity epidemic and rationale for movement integration in the curriculum, followed by a hands-on experience of conducting and participating in the TAKE 10! activities. Throughout the 8-week implementation of TAKE 10!, the teachers also consulted with the researchers on additional training or information to ensure smooth implementation of the program. Teachers were given a schedule that informed them of the weeks their classes would be assessed for PA. During the intervention period, teachers chose whichever activity from the TAKE 10! program that complemented the curriculum they were teaching each day.

Measures

Students' daily PA levels was measured by pedometers (Yamax, CW-600 Digiwalker) to determine whether daily in-school step counts would differ during baseline (week 1), midintervention (week 8) and end-intervention (week 12) during the TAKE 10! program. The purpose of collecting three separate pedometer measurement points (baseline, midintervention, and end-intervention) was to track students' PA levels throughout the study. Pedometers are considered an inexpensive, valid and reliable measurement of students' PA in school settings (Crouter, Schneider, Karabulut, & Bassett, 2003; Schneider, Crouter, & Bassett, 2004). Students' daily step counts were used as the outcome variable, measured through pedometers. Students wore the pedometers for 4 consecutive days (Monday to Thursday) during the baseline, midintervention, and end-intervention periods of the study. Four days of pedometer wearing is an acceptable period to obtain a valid estimate of daily step counts among youths (Craig, Tudor-Locke, Cragg, & Cameron, 2010).

ActiGraph accelerometers (GT1M and GT3×) were used in a subsample of students to determine their in-school PA intensity levels during baseline, midintervention, and end-intervention. Seventy-two students (25 3rd grade, 23 4th grade, and 24 5th grade) wore accelerometers along with pedometers because of the limited number of accelerometers available. Placement of the accelerometers was standardized at the hip for accuracy in measurement (Nilsson, Ekelund, Yngve, & Sjostrom, 2002). Accelerometer output was interpreted using the cutpoints by Evenson, Catellier, Gill, Ondrak, and McMurray, (2008) for sedentary, light, moderate, and vigorous activity levels. These cutpoints were used because of acceptable classification accuracy for all four levels of PA intensity among children of all ages (Trost, Loprinzi, Moore, & Pfeiffer, 2011). In addition, the accelerometers were set at the 15-second epoch because periods of vigorous activity in children might be lost in longer epochs, such as the common 1-minute length (Evenson et al., 2008).

To ensure and assess teacher fidelity throughout the program of study, teachers completed a weekly questionnaire during the intervention period, reporting the number of times they implemented TAKE 10! each day. Completed questionnaires were collected from the teachers at the end of the study.

Data Collection and Study Procedures

Informed parental consent forms and child assent forms were obtained in accordance with the University Institutional Review Board and school district requirements before data collection. Before data collection, the researchers went into each class and demonstrated the proper wearing of the pedometers/accelerometers. Students were given hands-on experience in wearing the pedometers/accelerometers, while the researchers walked around to check that students had securely attached the pedometer/accelerometer to their pants or belts.

Data collection spanned a 12-week period in fall 2012. Weeks 1 to 4 was the baseline period where the classroom teachers did not implement TAKE 10!. Weeks 5 to 12 was the intervention period where the teachers implemented TAKE 10!. Baseline PA levels were collected over 4 consecutive days in week 1, midintervention PA levels were collected over 4 consecutive days in week 8, and end-intervention PA levels were collected over 4 consecutive days in week 12. Mondays to Thursdays was designated as the PA data collection days because the school had shorter hours on Fridays. During the PA data collection period, the researchers assigned a pedometer and/or an accelerometer to each student. Each pedometer and accelerometer had a number that matched the students' ID number. The students were outfitted with the same device across each time point. At the beginning of the school day, the researchers handed each classroom teacher boxes that contained the pedometers and/or accelerometers. Instructions were provided for teachers to supervise the students on the proper wearing of the pedometers/accelerometers on their pants or belt securely at the midline of their thigh.

At the end of the school day, the researchers collected the pedometers and accelerometers from the classroom teachers. Students' step counts were recorded from the returned pedometers. Data from the returned accelerometers were downloaded and analyzed with ActiLife software version 6.0 (ActiGraph, Pensacola, FL). All data were recorded using anonymous confidential identification numbers, and students were not identified by name after the data had been collected.

Data Analysis

Data were entered and results generated using SPSS (Version 18.0, Chicago, IL). Daily in-school PA levels were quantified as the average number of steps recorded, average time spent in moderate intensity PA, average time spent in vigorous intensity PA, and average time spent in MVPA during the school day at baseline, midintervention, and end-intervention. Step counts of students who wore the pedometers for at least one day out of the four days at baseline, midintervention, and end-intervention were kept for analysis. One day of pedometer wearing provides a good representation of steps per day relative to the whole week in terms of both reliability and validity (Craig et al., 2010; Prewitt, Hannon, & Brusseau, 2013). Consistent with other research examining students' step counts using pedometers, values below 1,000 and above 30,000 were treated as outliers and deleted (Rowe, Mahar, Raedeke, & Lore, 2004). Similarly, students with at least one day of accelerometer wearing during baseline, midintervention, and end-intervention were considered to be in compliance with the accelerometer protocol and hence were used in the data analysis. A repeated-measures ANOVA was used to determine differences in the students' in-school PA levels (step counts and intensity levels) between the baseline, midintervention, and end-intervention period of the study. An alpha level of 0.05 was used for the statistical tests. Effect sizes (*ES*) were calculated for all analyses and *ES* magnitudes of 0.10, 0.30, and 0.50, were interpreted as small, medium, and large effects, respectively (Field, 2009). Data from the teachers' questionnaires were tabulated to provide the average number of times teachers implement the TAKE 10! activity per school day.

Results

Data from the questionnaires indicated that the teachers conducted on average one TAKE 10! activity per school day during the 8-week intervention period. The number of times teachers implemented the TAKE 10! activities ranged from one to three times per day.

In-school Step Counts

A total of 210 students completed at least one day out of the four days of pedometer wearing during baseline, midintervention, and end-intervention. Descriptive data for the students in 3rd through 5th grades are displayed in Table 1. There was a significant effect of time on students' daily in-school steps ($P < .001$, $ES = .20$). Overall, students accumulated approximately 672 more daily in-school steps during midintervention (week 8) compared with baseline (week 1), and the difference was statistically significant ($P < .001$). There was however, a decrease in students' daily in-school steps of approximately 152 from baseline to end-intervention (week 12), although the difference was not statistically significant ($P = .22$).

Table 1 Mean Daily In-School Steps Taken by Students (n = 210)

	Baseline	Mid-Intervention	End-Intervention
Mean	5629	6301*	5477
Standard deviation	1232	1500	1417
Minimum	2526	1901	2138
Maximum	8808	10479	9376

* Steps at midintervention significantly higher than at baseline ($P < .001$)

Daily in-school steps taken during baseline, midintervention, and end-intervention were evaluated by grade level. Table 2 displays the mean values of daily in-school steps per grade level. Across the three grade levels, there was a general pattern of an increase in daily in-school steps from baseline to midintervention and a decrease in daily in-school steps from midintervention to end-intervention. The 4th and 5th grade students accumulated approximately 685 and 697 more daily in-school steps, respectively compared with 3rd grade students across the three periods, and the difference was statistically significant ($P = .001$).

Daily in-school steps taken during baseline, midintervention, and end-intervention were also evaluated by sex. Table 3 displays the mean values of daily in-school steps for male and female students. Both male and female students displayed an increase in daily in-school steps from baseline to midintervention and a decrease in daily in-school steps from midintervention to end-intervention. Male students accumulated approximately 728 more daily in-school steps compared with female students across the three periods, and the difference was statistically significant ($P < .001$).

Table 2 Mean Daily In-School Steps Taken by 3rd, 4th, and 5th Grade Students

	Baseline	Mid-Intervention	End-Intervention
3rd Grade (n = 73)	5175 ± 1198*	6039 ± 1631*	4839 ± 1373*
4th Grade (n = 69)	5695 ± 1272	6615 ± 1396	5799 ± 1308
5th Grade (n = 68)	6048 ± 1068	6263 ± 1415	5835 ± 1349

* Steps taken by 3rd grade students significantly lower than 4th and 5th grade students ($P = .001$)

Table 3 Mean Daily In-School Steps Taken by Male and Female Students

	Baseline	Mid-Intervention	End-Intervention
Male (n = 91)	6098 ± 1376*	6710 ± 1761*	5837 ± 1600*
Female (n = 119)	5270 ± 971	5988 ± 1180	5202 ± 1194

* Steps taken by male students significantly higher than female students ($P < .001$)

In-school PA Intensity Levels

Of the 72 students who wore accelerometers from the beginning of the study, 64 students (36 females and 28 males; 25 3rd grade, 20 4th grade, and 19 5th grade) were in compliance with the accelerometer protocol guidelines. The missing data consisted of one student who became unenrolled during the course of the study, one student who was injured during the midintervention period, two students who were not in compliance with the accelerometer protocol guidelines (i.e., absent for four days during the midintervention data collection), and four ActiGraph accelerometers that malfunctioned during data collection. Students with at least one day of accelerometer data at baseline, midintervention, and end-intervention were used in the data analysis.

Descriptive data for the students in 3rd through 5th grades are displayed in Table 4. Results indicated that there was no significant change ($P = .880$) in students' average time spent in moderate intensity PA from baseline (18.6 ± 4.4) to end-intervention (18.7 ± 4.1). Students' average time spent in MVPA increased significantly ($P = .008$) from baseline (33.4 ± 8.8) to end-intervention (35.4 ± 7.6).

Students' average time spent in vigorous intensity PA also increased significantly from baseline (14.8 ± 5.5) to midintervention (15.2 ± 4.9), and to end-intervention (16.7 ± 5.0). The difference of average time spent in vigorous intensity PA between baseline and end-intervention was statistically significant ($P < .001$), and the effect size is considered medium ($ES = .24$; Field, 2009). In addition, the difference of average time spent in vigorous intensity PA between midintervention and end-intervention was statistically significant ($P = .01$), and the effect size is considered small ($ES = .13$; Field, 2009). Overall, students accumulated approximately 2 minutes more of vigorous intensity PA at end-intervention compared with baseline.

Results also indicated that students accumulated approximately 12894 more daily in-school activity counts during end-intervention (week 12) compared with baseline (week 1). The difference of in-school activity counts accumulated

Table 4 Average Daily In-School PA Intensity Levels of Students (n = 64)

	Baseline	Mid-Intervention	End-Intervention
MI PA (min)	18.6 ± 4.4	17.2 ± 4.8	18.7 ± 4.1
MVI PA (min)	33.4 ± 8.8	32.5 ± 8.0	35.4 ± 7.6[a]
VI PA (min)	14.8 ± 5.5	15.2 ± 4.9	16.7 ± 5.0[b, c]
Activity Counts	223762 ± 53813	219328 ± 45956	236656 ± 46401[d, e]

Note: MI PA = Moderate intensity PA; VI PA = Vigorous intensity PA; MVI PA = Moderate-to-vigorous intensity PA.

[a] MVI is significantly higher at end-intervention than at baseline ($P = .008$)

[b] VI is significantly higher at end-intervention than at baseline ($P < .001$)

[c] VI is significantly higher at end-intervention than at midintervention ($P = .01$)

[d] Activity counts is significantly higher at end-intervention than at baseline ($P = .012$)

[e] Activity counts is significantly higher at end-intervention than at midintervention ($P = .001$)

between baseline and end-intervention was statistically significant (*P* = .012). Furthermore, results revealed that students accumulated approximately 17328 more daily in-school activity counts during end-intervention (week 12) compared with midintervention (week 8). The difference of in-school activity counts accumulated between midintervention and end-intervention was statistically significant (*P* = .001). Though there was a decrease in students' daily in-school activity counts of approximately 4434 from baseline to midintervention, the difference was not statistically significant.

Further analysis of the data indicated that the difference in average time spent in vigorous intensity PA between the 3rd grade and 4th grade students was statistically significant (*P* = .017), as well as between the 3rd grade and 5th grade students (*P* < .001). Furthermore, female students demonstrated an increase of approximately 3 minutes of average time spent in vigorous intensity PA from baseline, whereas boys had an approximate 1-minute increase in vigorous intensity PA. The difference in average time spent in vigorous intensity PA between male and female students was not statistically significant.

Discussion

Findings from this study provided partial support for our hypothesis that elementary school students would have significant increases in their in-school PA levels from baseline to midintervention and to the end-intervention of TAKE 10!. Students' in-school vigorous intensity PA levels increased significantly from baseline to midintervention, and to end-intervention, whereas students' daily in-school step counts increased significantly from baseline to midintervention, but decreased at end-intervention. While students' in-school vigorous intensity PA levels increased significantly from baseline to midintervention, and to end-intervention, no increases were observed for moderate intensity PA across the three time periods. Results from the study also demonstrated that teachers implemented on average one TAKE 10! activity per day. This result is consistent with other classroom-based PA intervention studies, in which a majority of the teachers were able to conduct one classroom-based PA session per day (Kohl et al., 2001; Mahar et al., 2006).

One purpose of the study was to examine whether students' in-school step counts increased upon the implementation of TAKE 10!. A closer look at the pedometer data indicated that students accumulated approximately 672 more daily in-school steps during midintervention compared with baseline. Consistent with past research, students' daily in-school steps in the Energizers intervention classes increased approximately by 782 (Mahar et al., 2006). Other research has shown that classroom PA breaks of about 10 minutes provide students with approximately 1000 more steps per day (Bartholomew & Jowers, 2011; Erwin, Abel, et al., 2011; Erwin, Beighle, Morgan, & Noland, 2011).

Students' step counts in this study were found to decrease from midintervention to end-intervention. Although there was a decrease in students' mean in-school steps of approximately 152 from baseline to end-intervention, the difference was not significant. Several explanations may account for the decrease in step counts from midintervention to end-intervention. One possible reason is that teachers started out more enthusiastically at the beginning than at the end, and thus more PA promotion occurred at the beginning of the study. Baranowski, Anderson and Carmack (1998) suggested that interventions for promoting PA have worked primarily when participants were motivated enough to participate. Another possible reason is that there was testing that occurred at the end of the semester, which may have taken time away from PA programs. One other possible explanation is the change in seasonal climate. Baseline (week 1) and midintervention (week 8) pedometer data were collected during the fall season months of September to November, whereas end-intervention (week 12) pedometer data were collected during the winter season month of December. There were several days in week 12 where students were kept in-class playing sedentary computer games during recesses because of the snow and cold weather. Having the opportunity to participate in outdoor recesses is important because an extra 15 minutes of outdoor recess can provide students with 1,250 steps (Beighle et al., 2006). The physical education teacher also reported that students were more active during outdoor physical education lessons in the fall season compared with indoor physical education lessons in the winter season, which could provide an explanation for the changes in step counts from mid to end-intervention (i.e., between the two seasons). In particular, elementary school students have been found to spend more time sitting, and less time standing, walking and engaged in MVPA during indoor physical education (McKenzie et al., 1995). In general, students are more active during the fall season when the weather is suitable for outdoor PA and less active during the winter season when the temperatures are much lower (Beighle, Erwin, Morgan, & Alderman, 2012; Brusseau, Kulinna, Kloeppel, & Ferry, 2012). Besides providing classroom-based PA programs, such as TAKE 10!, other alternative sources of indoor PA should be provided in school to help students maintain or increase their PA levels during the winter season.

To examine whether students' in-school PA intensity levels increased upon the implementation of TAKE 10!, a subsample of students from one 3rd, one 4th, and one 5th grade class was asked to wear accelerometers along with pedometers to determine their in-school PA intensity levels. Overall, there was an increase in students' average time spent in MVPA and vigorous intensity PA from baseline to end-intervention. Particularly, there was a significant increase of approximately 2 minutes of MVPA and vigorous intensity PA at end-intervention (week 12) compared with baseline (week 1). Though the PA intensity among the subsample of students increased from baseline to end-intervention, their step counts dropped. One possible explanation is that the subsample of students engaged in vigorous activity through the participation of TAKE 10! in the classrooms to compensate for the lack of outdoor recesses and outdoor physical education during the end-intervention period. In support of this interpretation, it has been found that students' activity levels during TAKE 10! were higher than those during PE (Moore, Solmon, & Tuuri, 2007). Having limited opportunities for outdoor recesses and physical education could have contributed to the decrease in step counts at end-intervention.

Further examination of the data indicated that the 4th and 5th grade students demonstrated an increase in vigorous intensity PA across the three periods compared with the 3rd grade students. Female students also demonstrated an increase in vigorous intensity PA when compared with male students. One explanation for the difference in PA levels between the 3rd and the 4th/5th grade students could be because the 4th/5th grade students were developmentally and physically more mature than the 3rd grade students, and hence able to move more intensely.

Past research on the effectiveness of TAKE 10! on children's PA demonstrated that students' PA levels were in the moderate intensity levels during the 10-minute activity (Stewart et al., 2004), and students' PA increased by 0.5 hours in the intervention school when compared with control school (Liu et al., 2008). The current study adds to previous literature by demonstrating that students' in-school MVPA increased from baseline after students participated in the TAKE 10! program. Helping children increase their daily MVPA is one goal of the CSPAP and the TAKE 10! program is a potential PA opportunity that can be added to the school day. Furthermore, children involved in MVPA have demonstrated the greatest benefits in academic performance. For example, elementary school students who performed vigorous activity during physical education had significantly higher academic grades ($P < .05$) than students who performed no vigorous PA or moderate PA (Coe, Pivarnik, Womack, Reeves, & Malina, 2006).

Overall, this study demonstrates that classroom-based PA is effective in increasing children's in-school PA. Though only one of five components of a CSPAP (i.e., PA during school) was examined in this study, classroom-based PA is a viable strategy to begin the process of implementing the entire CSPAP. Since children spend most hours of every school day in general education classrooms, classroom teachers are in an ideal position to influence children's PA behavior. Adding PA in the classroom is one way to galvanize adaptive changes in school/community wide PA promotion. Furthermore, given the reality of school scheduling restrictions and personnel budget constraints, including classroom teachers for any changes in school PA opportunities appear feasible (Kulinna, Brusseau, Cothran, & Tudor-Locke, 2012). The vast majority of the workforce in elementary schools is composed of classroom teachers; hence, the beliefs and practices of these individuals can play a crucial role in shaping school culture. If classroom teachers adopt PA promotion, then it may be easier to diffuse widespread efforts across other CSPAP components (i.e., PA before and after school, staff involvement, and family/community involvement) and build a strong school PA structure that maximizes PA opportunities for children and adults who are involved in the school system. As classroom-based PA becomes more the norm than the exception and teachers embrace a more active classroom, the culture of the entire academic setting is likely to shift to one that encourages and expects movement throughout the day. Such a cultural shift may allow for more positive experiences implementing other components of CSPAP.

Limitations and Future Directions

The results of this study may not be generalizable to elementary school students outside of this school because of differences in students' demographic variables across schools. It was also assumed that the students had adhered to instructions regarding proper wearing of the pedometers/accelerometers and not tampered with the instruments for measuring their PA levels during the school day. Although results of this study indicated the effectiveness of the TAKE 10! program on students' in-school PA levels, it is not without limitations. One limitation is that a repeated measures design with one intervention group was used in this study. Future research could include a control group to further examine the effectiveness of the TAKE 10! program on students' in-school PA levels. Furthermore, the lack of consensus on accelerometer cut points (Sasaki, John, & Freedson, 2011) may have had implications for making correct determinations regarding moderate and vigorous thresholds for PA levels in the current study. Weather changes may have also influenced the PA levels of the students. Therefore, researchers should consider implementing the program during the spring semester to minimize the impact of a seasonal effect on students' PA. In future, researchers could also examine the sustainability of the program by investigating whether students' PA levels would be maintained after the study has ended. Future researchers could also explore and measure possible mediators, such as students' motivation and behavior that could influence students' PA (Baranowski et al., 1998; Webster et al., 2013).

Implications for Practice

There are several implications for practice based on the results of this study. First, the addition of a classroom-based PA, such as TAKE 10! to the school's existing PA opportunities was effective in increasing students' PA levels during the school day. Classroom-based PA is a relatively inexpensive source of PA and classroom teachers can be easily trained to implement them in their classes. When considering PA opportunities to be included in a school's CSPAP, it is also important to assess the PA opportunities in place and introduce new ideas to help increase students' PA levels in schools. Second, when planning for a CSPAP in schools, it is important to consider the effects of seasonal climate on students' PA. In particular, other PA opportunities should be provided in place of outdoor recesses during the winter months. One suggestion would be for teachers to implement more classroom-based PA during the winter months. Alternatively, teachers could be trained to implement suitable indoor activities during recesses to maintain or increase students' PA during colder climates. Other constraints that need to be considered in planning and implementing CSPAP in schools include school's testing schedules and students' enthusiasm in the PA activities. Third, though there was an increase in students' PA intensity levels at end-intervention, a modest 2-minute increase may not make a huge impact on students' overall PA levels. A comprehensive review of literature by Bassett et al. (2013) indicated that within school settings, the average minutes of MVPA gained per school day through classroom activity breaks is approximately 19 minutes. Though MVPA was the primary target in the study (Bassett et al., 2013), focusing on reducing sedentary behavior (i.e., reducing time spent sitting) is as important. In addition, perhaps classroom PA programs that focus on simply taking a short break from academic instruction by engaging in PA would increase students' PA in the classroom as opposed to integrating PA with the academic content.

In this study, students' average in-school step counts (6301 ± 1500) were approximately 50% of the recommended 11,000 steps per day for girls and 13,000 steps per day for boys that children should accumulate within a day. This implies that out-of-school PA is an important component to consider when planning for a CSPAP in schools. Other components, such as staff and family involvement, as well as before/after school activities need to be considered as important aspects in CSPAP to help our children increase their PA levels. It is also important to designate a CSPAP-trained facilitator in schools who are competent to implement all the components of the CSPAP. Having an influential leader, such as a CSPAP champion to spearhead the CSPAP efforts and serve as the school's primary coordinator and contact for PA promotion could ensure the successful promotion of the CSPAP (Carson et al., 2014). Carson et al. (2014) also suggested that the best person to take on the role as a CSPAP champion is the PE teacher who is uniquely positioned as the professional in schools with expertise in PA promotion and access to the necessary resources and facilities to promote PA. Webster et al. (2013) suggested strategies, such as increasing school support (eg, principal buy-in and provision of relevant resources/materials), and rewarding teachers for trying new ideas and practices for PA promotion may promote the adoption of PA promotion among elementary classroom teachers. These strategies may be worth considering in supporting the CSPAP champion to adopt CSPAP promotion in schools.

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References

Baranowski, T., Anderson, C., & Carmack, C. (1998). Mediating variable framework in physical activity interventions. How are we doing? How might we do better? *American Journal of Preventive Medicine, 15*(4), 266–297. doi:10.1016/S0749-3797(98)00080-4

Bartholomew, J.B., & Jowers, E.M. (2011). Physically active academic lessons in elementary children. *Preventive Medicine, 52*(Suppl 1), S51–S54. doi:10.1016/j.ypmed.2011.01.017

Bassett, D.R., Fitzhugh, E.C., Heath, G.W., Erwin, P.C., Frederick, G.M., Wolff, D.L., . . . Stout, A.B. (2013). Estimated energy expenditures for school-based policies and active living. *American Journal of Preventive Medicine, 44*(2), 108–113. doi:10.1016/j.amepre.2012.10.017

Beighle, A., Erwin, H., Morgan, C.F., & Alderman, B. (2012). Children's in-school and out-of-school physical activity during two seasons. *Research Quarterly for Exercise and Sport, 83*(1), 103–107. doi:10.1080/02701367.2012.10599830

Beighle, A., Morgan, C.F., Le Masurier, G., & Pangrazi, R.P. (2006). Children's physical activity during recess and outside of school. *The Journal of School Health, 76*(10), 516–520. doi:10.1111/j.1746-1561.2006.00151.x

Beighle, A., & Pangrazi, R.P. (2006). Measuring children's activity levels: The association between step counts and activity time. *Journal of Physical Activity and Health, 3,* 221–229.

Brusseau, T.A., Kulinna, P.H., Kloeppel, T., & Ferry, M. (2012). Seasonal variation of American Indian children's school-day physical activity. *Biomedical Human Kinetics, 4,* 82–87. doi:10.2478/v10101-012-0015-z

Brusseau, T.A., Kulinna, P.H., Tudor-Locke, C., Ferry, M., van der Mars, H., & Darst, P.W. (2011). Pedometer-determined segmented physical activity patterns of fourth- and fifth-grade children. *Journal of Physical Activity and Health, 8*(2), 279–286.

Carson, R.L., Castelli, D.M., Beighle, A., & Erwin, H. (2014). School-based physical activity promotion: A conceptual framework for research and practice. *Childhood Obesity, 10*(2), 100-106. doi:10.1089/chi.2013.0134

Centers for Disease Control and Prevention [CDC]. (2010). *The association between school based physical activity, including physical education, and academic performance.* Atlanta, GA: US Department of Health and Human Services.

Coe, D.P., Pivarnik, J.M., Womack, C.J., Reeves, M.J., & Malina, R.M. (2006). Effect of physical education and activity levels on academic achievement in children. *Medicine and Science in Sports and Exercise, 38*(8), 1515–1519. doi:10.1249/01.mss.0000227537.13175.1b

Craig, C.L., Tudor-Locke, C., Cragg, S., & Cameron, C. (2010). Process and treatment of pedometer data collection for youth: The Canadian Physical Activity Levels among Youth study. *Medicine and Science in Sports and Exercise, 42*(3), 430–435. doi:10.1249/MSS.0b013e3181b67544

Crouter, S.E., Schneider, P.L., Karabulut, M., & Bassett, D.R. (2003). Validity of 10 electronic pedometers for measuring steps, distance, and energy cost. *Medicine and Science in Sports and Exercise, 35*(8), 1455–1460. doi:10.1249/01.MSS.0000078932.61440.A2

Donnelly, J.E., Greene, J.L., Gibson, C.A., Smith, B.K., Washburn, R.A., Sullivan, D.K., . . . Williams, S.L. (2009). Physical Activity Across the Curriculum (PAAC): A randomized controlled trial to promote physical activity and diminish overweight and obesity in elementary school children. *Preventive Medicine, 49*(4), 336–341. doi:10.1016/j.ypmed.2009.07.022

Erwin, H., Beighle, A., Carson, R.L., & Castelli, D.M. (2013). Comprehensive school-based physical activity promotion: A review. *Quest, 65*(4), 412–428. doi:10.1080/00336297.2013.791872

Erwin, H., Abel, M., Beighle, A., & Beets, M. (2011). Promoting children's health through physically active math classes: A pilot study. *Health Promotion Practice*, *12*(2), 244–251.

Erwin, H., Beighle, A., Morgan, C., & Noland, M. (2011). Effect of a low-cost, teacher-directed classroom intervention on elementary students' physical activity. *The Journal of School Health, 81*(8), 455–46. doi:10.1111/j.1746-1561.2011.00614.x

Evenson, K. R., Catellier, D. J., Gill, K., Ondrak, K. S., & McMurray, R. G. (2008). Calibration of two objective measures of physical activity for children. *Journal of Sports Sciences, 26*(14), 1557-1565. doi:10.1080/02640410802334196

Field, A. (2009). *Discovering statistics using SPSS*. Los Angeles: SAGE.

Kibbe, D. L., Hackett, J., Hurley, M., McFarland, A., Schubert, K. G., Schultz, A., & Harris, S. (2011). Ten years of TAKE 10!: Integrating physical activity with academic concepts in elementary school classrooms. *Preventive Medicine, 52 Suppl 1,* S43-50. doi:10.1016/j.ypmed.2011.01.025

Kohl, H.W., III, Moore, B.M., Sutton, A.W., Kibbe, D.L., & Schneider, D.C. (2001). A curriculum-integrated classroom physical activity promotion tool for elementary schools: Teacher evaluation of TAKE 10!TM. *Medicine and Science in Sports and Exercise, 33*(5, Supplement) S179. doi:10.1097/00005768-200105001-01015

Kulinna, P.M., Brusseau, T., Cothran, D., & Tudor-Locke, C. (2012). Changing school physical activity: An examination of individual school designed programs. *Journal of Teaching in Physical Education, 31,* 113–130.

Liu, A., Hu, X.Q., & Ma, G. (2008). Evaluation of a classroom-based physical activity promoting programme. *Obesity Reviews, 9*(Suppl 1), 130–134. doi:10.1111/j.1467-789X.2007.00454.x

Mahar, M.T., Murphy, S.K., Rowe, D.A., Golden, J., Shields, A.T., & Raedeke, T.D. (2006). Effects of a classroom-based program on physical activity and on-task behavior. *Medicine and Science in Sports and Exercise, 38*(12), 2086–2094. doi:10.1249/01.mss.0000235359.16685.a3

McKenzie, T.L., Feldman, H., Woods, S.E., Romero, K.L., Dahlstrom, V., Stone, E.J., . . . Harsha, D.W. (1995). Children's activity levels and lesson context during third-grade physical education. *Research Quarterly for Exercise and Sport, 66*(3), 184–193. doi:10.1080/02701367.1995.10608832

Moore, D.S., Solmon, M., & Tuuri, G. (2007). A comparison of children's physical activity levels during school and out-of-school activities. *Medicine and Science in Sports and Exercise, 39,* S490. doi:10.1249/01.mss.0000274949.30346.1e

National Association for Sport and Physical Education. (2008). *Comprehensive school physical activity programs*. Reston, VA: National Association for Sport and Physical Education. [Position statement].

Nilsson, A., Ekelund, U., Yngve, A., & Sjostrom, M. (2002). Assessing physical activity among children with accelerometers using different time sampling intervals and placements. *Pediatric Exercise Science, 14,* 87–96.

Patel, A.V., Bernstein, L., Deka, A., Feigelson, H.S., Campbell, P.T., Gapstur, S.M., . . . Thun, M.J. (2010). Leisure time spent sitting in relation to total mortality in a prospective cohort of US adults. *American Journal of Epidemiology, 172*(4), 419–429. doi:10.1093/aje/kwq155

Prewitt, S.L., Hannon, J.C., & Brusseau, T. (2013). Children and pedometers: A study in reactivity and knowledge. *International Journal of Exercise Science, 6*(3), 230–235.

Rowe, D.A., Mahar, M.T., Raedeke, T.D., & Lore, J. (2004). Measuring physical activity in children with pedometers: Reliability, reactivity, and replacement of missing data. *Pediatric Exercise Science, 16*(4), 343–354.

Sasaki, J.E., John, D., & Freedson, P.S. (2011). Validation and comparison of ActiGraph activity monitors. *Journal of Science and Medicine in Sport, 14*(5), 411–416. doi:10.1016/j.jsams.2011.04.003

Schneider, P.L., Crouter, S.E., & Bassett, D.R. (2004). Pedometer measures of free-living physical activity: Comparison of 13 models. *Medicine and Science in Sports and Exercise, 36*(2), 331–335. doi:10.1249/01.MSS.0000113486.60548.E9

Stewart, J.A., Dennison, D.A., Kohl, H.W., & Doyle, J.A. (2004). Exercise level and energy expenditure in the TAKE 10! in-class physical activity program. *The Journal of School Health, 74*(10), 397–400 doi:10.1111/j.1746-1561.2004.tb06605.x

Strong, W.B., Malina, R.M., Blimkie, C.J., Daniels, S.R., Dishman, R.K., Gutin, B., . . . Trudeau, F. (2005). Evidence based physical activity for school-age youth. *The Journal of Pediatrics, 146*(6), 732–737 10.1016/j.jpeds.2005.01.055. doi:10.1016/j.jpeds.2005.01.055

Sturm, R. (2005). Childhood obesity - What we can learn from existing data on societal trends, part 1. *Preventing Chronic Disease, 2*(1), 1–9.

Troiano, R.P., Berrigan, D., Dodd, K.W., Mâsse, L.C., Tilert, T., & McDowell, M. (2008). Physical activity in the United States measured by accelerometer. *Medicine and Science in Sports and Exercise, 40*(1), 181–188. doi:10.1249/mss.0b013e31815a51b3

Trost, S.G., Loprinzi, P.D., Moore, R., & Pfeiffer, K.A. (2011). Comparison of accelerometer cut points for predicting activity intensity in youth. *Medicine and Science in Sports and Exercise, 43*(7), 1360–1368. doi:10.1249/MSS.0b013e318206476e

Tudor-Locke, C. (2002). Taking steps toward increased physical activity: Using pedometers to measure and motivate. *President's Council on Physical Fitness and Sports, 3*(17), 1–8.

U.S. Department of Health and Human Services. (2008). *2008 Physical Activity Guidelines for Americans*. Washington, DC: U.S. Government Printing Office.

Webster, C. A., Caputi, P., Perreault M., Doan, R., Doutis, P., & Weaver, R. G. (2013). Elementary classroom teachers' adoption of physical activity promotion in the context of a statewide policy: An innovation diffusion and socio-ecologic perspective. *Journal of Teaching in Physical Education, 32,* 419–440.

Wechsler, H., McKenna, M., Lee, S.M., & Dietz, W. (2004). The role of schools in preventing childhood obesity. *State Education Standard, 5*(2), 4–12.

Williams, S., Kibbe, D. L., & Lombardo, M. A. (2008). Delta H.O.P.E. Tri-State Initiative, August 2003 to June 2007: Final report to the Mississippi Alliance for Self-Sufficiency and the W.K. Kellogg Foundation.