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Research article

Objectively Measured Physical Activity Levels among Ethnic Minority Children Attending School-Based Afterschool Programs in a High-Poverty Neighborhood

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Abstract
Ethnic minority children living in high poverty neighborhoods are at high risk of having insufficient physical activity (PA) during school days and, thus, the importance of school as a place to facilitate PA in these underserved children has been largely emphasized. This study examined the levels and patterns of PA in minority children, with particular focus on the relative contributions of regular physical education (PE) and school-based afterschool PA program in promoting moderate- and vigorous-intensity PA (MVPA) during school days. PA data were repeatedly measured using a Polar Active accelerometer across multiple school days (M = 5.3 days per child), from seventy-five ethnic minority children attending a Title I public elementary school in a high-poverty neighborhood in the US. The minutes and percentage of MVPA accumulated during school, PE, and afterschool PA program were compared to the current recommendations (≥30-min of MVPA during school hours; and ≥50% of MVPA during PE or afterschool PA program) as well as by the demographic characteristics including sex, grade, ethnicity, and weight status using a general linear mixed model that accounts for repeated observations. On average, children spent 41.6 mins (SE = 1.8) of MVPA during school hours and of those, 14.1 mins (SE = 0.6) were contributed during PE. The average proportion of time spent in MVPA during PE was 31.3% (SE = 1.3), which was significantly lower than the recommendation (≥50% of MVPA), whereas 54.2% (SE = 1.2) of time in afterschool PA program were spent in MVPA. The percentage of monitoring days meeting current recommendations were 69.5% (SE = 0.03), 20.8% (SE = 0.02), and 59.6% (SE = 0.03) for during school, PE, and afterschool PA program, respectively. Our findings highlighted that school-based afterschool PA, in addition to regular PE classes, could be of great benefit to promote PA in minority children during school days. Further research and practice are still needed to increase MVPA during school hours, particularly during PE classes.

Key words: Exercise, accelerometer, moderate and vigorous physical activity, physical education.

Introduction

The importance of physical activity (PA) in promoting healthy growth and development in school-aged children has been well documented (Pate et al., 2006a). Growing evidence demonstrates that children who are physically active show lower risk of having or developing chronic diseases, and better physical fitness, body composition, psychological health, and academic achievement (Howie and Pate, 2012; Janssen and LeBlanc, 2010; Strong et al., 2005). Despite well-established PA benefits, few school-aged children engage in adequate PA during school days (Troiano et al., 2008). Particularly, racial/ethnic minority children from families classified in the low socio-economic status (SES), compared to their counterparts, generally show lower levels of PA and higher levels of sedentary behaviors (e.g., watching television, playing a video or computer game) (Eisenmann et al., 2008; Trost et al., 2013), which may be linked to the higher prevalence of overweight and obesity observed in this high-risk group (Miech et al., 2006; Ogden et al., 2012).

Over many decades, there have been continuous efforts to develop and implement intervention strategies to reduce disparities in PA for minority children (Kumanyika and Grier, 2006; Madsen et al., 2009; Vander Ploeg et al., 2014). Of those, the school environment has received a great deal of attention as the primary venue for promoting PA in this population (Hillier-Brown et al., 2014; Pate et al., 2006a; Strong et al., 2005). School is a place where children spend more than half of their waking hours during school days (Story et al., 2006; Story et al., 2009), and has been shown to have great potential to reduce the gap in achieving the recommended levels of PA (Bassett et al., 2013; Pate et al., 2006a). As a result, the Institute of Medicine (IOM) recommends at least 30 minutes of moderate- and vigorous-intensity PA (MVPA) be accumulated within the school day (Institute of Medicine, 2005). Further, the specific recommendation for physical education (PE), the largest contributing factor influencing PA during the school day, has suggested that at least 50% of regular PE times should be devoted to MVPA (US Department of Health Human Services, 2010).

In addition, there has been growing interests in providing afterschool PA programs for increasing PA in children (Beets et al., 2012; Pate et al., 2006a), with a recommendation that at least 50% of time in afterschool PA programs should be in MVPA (Weaver et al., 2015; Wiecha et al., 2011). Particularly for minority children who have limited access to PA resources outside of school hours due to factors such as lacks of transportation and suitable recreational facilities or park, and unsafe neighborhood for walking (Ding et al., 2011), school-based afterschool PA programs would be of great benefit in providing further opportunity to participate in PA in a safe environment (Kumanyika and Grier, 2006; Madsen et al., 2009). Yet, data are limited on the relative contributions of both PE and school-based afterschool PA programs in increasing daily PA (Chen et al., 2014; Pate et al., 2006a), especially for ethnic minority children of low

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SES.

This investigation is a single-group repeated measures observational study examining the objective levels of PA in multiple school days among minority children. We particularly aimed to examine 1) the levels of PA during school, scheduled PE, and afterschool PA program; 2) accumulating patterns of MVPA and the comparisons with the current PA recommendations; and 3) variations in the levels of PA by sex, grade level, ethnicity and weight status.

Methods

Study participants and setting

The participants were recruited from a public elementary school located in a low SES neighborhood in a mid-size city of the west Texas region in the US. The school is considered a high-poverty school (Kena et al., 2016), with a high proportion of students (≥98%) receiving free or reduced-price lunch, and federally funded by Title I of the Elementary and Secondary Education Act of 1965 (P.L. 89-10) to support educational needs of disadvantaged students. The school offers a regular PE on a daily basis for duration of 45 minutes for each grade. The class sizes varied by grade levels (generally ranged from 35 to 45), and were instructed primarily in the school-gym by two certified PE teachers.

A total of 89 children between 3rd and 5th graders who signed up for school-based afterschool programs participated in the study. Of those, 14 children did not comply with the instruction to collect PA data during the measurement periods, and therefore, were excluded from the study. Based on teacher's reports on child's demographic characteristics, the final sample of 75 children was, on average, 10.1 years old (SD = 0.2; Range = 9 and 11 years old), and consisted of non-Hispanic Black (54.7%), other Hispanic (29.3%) and other races (16.0%). Before the beginning of data collection, standing height and weight were measured by trained staff in a standardized way using a stadiometer (SECA, Seca Co, Hamburg, Germany) and mechanical scale (Health-O-Meter Professional, Sunbeam Products Co, Boca Raton, FL, USA) to calculate body mass index (BMI). 56% of children were at ≥85th BMI percentile for age and sex (Kuczmarski et al., 2000) (see Table 1).

The school was participating in an ongoing, large community-based East Lubbock Promise Neighborhood (ELPN) project. In brief, the ELPN is a part of Promise Neighborhood initiatives supported by a US Department of Education aiming to revitalize the historically disadvantaged neighborhoods by providing comprehensive educational and social supports to the entire community. The ELPN has been initiated since 2012 in collaborations with leading local public and private organizations/agencies, with four program goals in the areas of Health, Early learning, Education, and Community. Specifically, the ELPN has developed the Community Learning with Academic Solutions School (CLASS) model, which is a comprehensive and hierarchical approach building the continuum of solutions of the community by ensuring high-quality educational supports to all students from kindergarten to high school (5 to 18 years old) and reforming the social and educational climates in neighborhood. Example elements of CLASS model include the implementations of intensive project- and service learning-based curriculum/instructions, extensive AS programs, and one-to-one Academic Case Management systems. The more comprehensive details of ELPN project can be found elsewhere (US Department of Education, 2012). This study was conducted within the ELPN environments and ethical approval associated with afterschool PA program as well as data collection protocols was approved by the Institutional Review Board of Texas Tech University (#503995). Informed consents from parents as well as verbal assent from the children were obtained.

ELPN afterschool PA program

A range of afterschool programs, which included the programs focusing on academics (e.g., catch-up academies, home-work assistance), visual and performing arts (e.g., digital photography, music, instruments, play productions), and PA, have been established in the school in order to address the specific goals of ELPN project. Particularly, the evidence-based PA program has been established as part of strategic plans of ELPN for improving health and academic achievement while reducing morbidity rates in school-aged children. PA programs have been structured with age-appropriate and task-centered mastery activities that involve gross motor skills (such as running, kicking, throwing), with the primary goals of fostering enjoyment of PA and increasing MVPA. The programs have been delivered by two trained undergraduate and/or graduate level coaches based on the concept of creating a mastery motivational climate, which have been proven to be effective for increasing PA for minority children by fostering enjoyment of and commitment to PA (Griffin et al., 2013).

Table 1. Demographic characteristics of the participants (n = 75). Data are number (%).

		Total	Boys	Girls
Grade (n, %)	3rd	21 (28.0%)	10 (34.5%)	11 (23.9%)
	4th	28 (37.3%)	10 (34.5%)	18 (39.1%)
	5th	26 (34.7%)	9 (31.0%)	17 (37.0%)
Ethnicity (n, %)	Non-Hispanic Black	41 (54.7%)	17 (58.6%)	24 (52.2%)
	Hispanic	22 (29.3%)	10 (34.5%)	12 (26.1%)
	Other ethnicities [a]	12 (16.0%)	2 (6.9%)	10 (21.7%)
BMI[b] (n, %)	<85th	33 (44.0%)	13 (44.8%)	20 (43.5%)
	≥85th	42 (56.0%)	16 (55.2%)	26 (56.5%)
Total monitoring days	Mean (SD)	5.3 (3.9)	5.2 (4.3)	5.3 (3.3)

BMI = body mass index. [a] including those with mixed ethnicities. [b] BMI for age and sex percentile

All afterschool programs have been offered across two sessions (40 minutes each) starting at 3:30 pm, and lasted until 4:50 pm each day. The children were pre-scheduled to participate in PA programs in one of two sessions in a rotational basis. However, in some circumstances, the child was reported by school teacher to be excluded from PA programs due to the academic catch-up tasks.

Objectively measured physical activity

For this study, the PA data were collected during the middle of spring 2016 for about six (non-consecutive) weeks. During the measurement periods, the children were instructed to visit a designated school staff member's classroom between 7:30 am – 7:50 am for as many days as they could to receive a watch-style PA monitoring device (Polar Active; Polar Electro Inc, Kempele, Finland). They were instructed to wear the device on their non-dominant wrist until they returned the device after completion of afterschool programs at around 4:50 pm. The Polar Active is a water-proof, uniaxial accelerometer that measures vertical acceleration of movements in 30-second epoch length, and has been used for measuring PA among children (Grasten et al., 2012; Schaefer and Marta Van Loan, 2014). The device is designed to provide visual feedback on MVPA minutes, with a small progress bar, on its face. A recent study demonstrated that the Polar Active's user feedback feature did not alter MVPA minutes in overweight and obese children (Dauenhauer and Castelli, 2014). To further prevent possible motivational effects, the device was locked from accessing additional features of the device before the distribution, with no explanation of the meanings of data shown on its face (Schaefer et al., 2015). The validity of device has been previously reported showing a high correlation (r = 0.9) with oxygen consumption measurement in this population (Virtanen and Kinnunen, 2010).

PA data were downloaded using a Polar Flowlink (Polar Electro Inc, Kempele, Finland) software. PA data were extracted for the days where the children participated in afterschool PA program. The data were provided in the form of metabolic equivalent (MET) values in 30-second epoch length that were calculated by a manufacturer's proprietary algorithm based on children's age, sex, height, and weight. The estimated MET values were used to determine the PA levels: sedentary (<1.5 METs), light- (1.5 – 2.9 METs), moderate- (3.0 – 5.9 METs), and vigorous- (≥6 METs) intensity PA (Freedson, Pober, & Janz, 2005; Ridley, Ainsworth, & Olds, 2008). The total time spent in each intensity level was extracted across the three time blocks for each monitoring day: 1) during school hours (450 mins/day); 2) during PE (45 mins/day); and 3) during afterschool PA programs (40 mins/day). We also calculated the frequency of continuous bouts (without interruptions) of MVPA ≥5-min, ≥10-min, and ≥15-min observed during the three time blocks for each monitoring day to examine the accumulation patterns of MVPA. The highest and median frequency of continuous bouts of MVPA among the monitoring days were also extracted for each child. In addition, the number of monitoring days meeting PA recommendations was obtained, which included 1) ≥30 minutes of MVPA during school hours;(Institute of Medicine, 2005) and 2) ≥50 percent of MVPA during PE time (US Department of Health Human Services, 2010) and afterschool PA programs (Weaver et al., 2015; Wiecha et al., 2011).

Statistical analysis

The descriptive statistics for the following demographic variables were calculated: grade (3^{rd} to 5^{th}), ethnicity (non-Hispanic black, Hispanic, and others ethnicities), BMI status ($<85^{th}$ and $\geq 85^{th}$ percentiles) determined by the BMI percentile for age and sex (Kuczmarski et al., 2000), and average number of monitoring days for each individual. The average time spent in different PA levels and the average number of continuous bouts of MVPA ≥5-min, ≥10-min, and ≥15-min observed during three time blocks were estimated using a general linear mixed model with random intercept accounting for multiple observations within each individual. We also estimated averages of highest and median number of continuous bouts of MVPA during three time blocks. The differences in the percentage of time spent in PA levels and the number of continuous bout of MVPA between PE and afterschool PA programs were examined. In addition, the average percentage of monitoring days achieving different PA recommendations was estimated using the general linear mixed model. Finally, the time spent in MVPA during three time blocks were compared by demographic characteristics (sex, grade, ethnicity, and BMI status) using the general linear mixed model followed-up with Tukey's post hoc test. SAS v9.4 (SAS Institute, Cary, NC) was used for all data management and analyses, and a familywise alpha level of .05 was used for statistical significance.

Results

Table 2 presents the minutes and percentage of time spent in different PA levels during school, PE, and afterschool PA programs. On average, children spent 45.4% (SE = 1.3), 45.3% (SE = 1.3), and 9.3% (SE = 0.4) of school hours in sedentary, light-intensity PA, and MVPA, respectively. The percentage of MVPA accumulated during PE was 31.3% (SE = 1.3), which was significantly lower than the percentage of MVPA observed during afterschool PA programs (54.2%; SE = 1.2).

The accumulation patterns of MVPA as well as the percentage of monitoring days meeting PA recommendations are presented in Table 3. On average, 20.8% (SE = 0.02) of monitoring days had PE with ≥50 percent of time spent in MVPA, which is significantly lower than for afterschool PA programs (59.6%; SE = 0.03). Meanwhile, the percentage of monitoring days meeting ≥30 minutes of MVPA during school hours was 69.5% (SE = 0.03). The average number of continuous bouts of MVPA ≥5-, ≥10-, and ≥15-min were 0.9, 0.2, and 0.03 for during school hours, 0.5, 0.1, and 0.02 for during PE, and 1.0, 0.2, and 0.1 for during afterschool PA programs, respectively. When comparing to PE, children had significantly greater number of MVPA bouts during afterschool PA programs (Ps <0.001).

The results of comparing the percentage of MVPA minutes by different demographic characteristics are presented in Table 4. Across all time blocks, boys had significantly greater MVPA than girls (Ps <0.05), whereas no statistical differences were found by BMI status. During school hours and PE, there were significant differences in percentage of time spent in MVPA by grade and ethnicity, whereas no differences were observed during afterschool PA programs.

Table 2. The Levels of Physical Activity During School, PE, and Afterschool PA Program. Values are presented as mean and standard error estimated from the general linear mixed model accounting for repeated observations within each individual.

	During school hours (450 mins/day)		During PE (45 mins/day)		During afterschool PA program (40 mins/day)	
	Minutes (SE) †	% (SE) ‡	Minutes (SE) †	% (SE) ‡	Minutes (SE) †	% (SE) ‡
MVPA	41.6 (1.8)	9.3 (0.41)	14.1 (0.6)	31.3 (1.3)	21.7 (0.5)	54.2 (1.2) #
LPA	203.9 (5.8)	45.3 (1.3)	18.8 (0.4)	41.8 (1.0)	13.6 (0.4)	34.0 (1.0) #
Sedentary	204.5 (6.6)	45.4 (1.5)	12.1 (0.7)	26.9 (1.4)	4.7 (0.3)	11.8 (0.6) #

PA = physical activity; PE = physical education; LPA = light intensity physical activity; MVPA = moderate and vigorous intensity physical activity. †average time spent in each intensity category; ‡average percentage of time spent in each intensity category; #significantly different from PE hours (p <.001).

Table 3. Compliance of MVPA Recommendations and Accumulation Patterns of MVPA During School, PE, and Afterschool PA Program.

	During school hours (450 mins/day)	During PE (45 mins/day)	During Afterschool PA program (40 mins/day)
% of monitoring days meeting the recommendations			
≥50% of MVPA	-	20.8 (0.02)	59.6 (0.03)
≥30-min of MVPA	69.5 (0.03)	-	-
Accumulation patterns of MVPA			
≥5-min bouts			
Average mean (SE) *	0.9 (0.1)	0.49 (0.04)	1.0 (0.1) #
Highest mean (SD) †	1.9 (1.4)	1.21 (0.95)	1.92 (0.9) #
Highest median‡	2	1	2
≥10-min bouts			
Average mean (SE) *	0.2 (0.03)	0.10 (0.02)	0.2 (0.03)§
Highest mean (SD) †	0.6 (0.7)	0.35 (0.53)	0.7 (0.6)§
Highest median‡	0	0	1
≥15-min bouts			
Average mean (SE) *	0.03 (0.01)	0.02 (0.01)	0.1 (0.02) #
Highest mean (SD) †	0.2 (0.4)	0.1 (0.3)	0.3 (0.5) #
Highest median ‡	0	0	0

PA = physical activity; PE = physical education; MVPA = moderate and vigorous intensity physical activity; *average number of continuous bouts of MVPA across all monitoring days within each individual; †average of highest number of continuous bouts of MVPA for each individual; ‡ median of highest number of continuous bouts of MVPA observed within each time block; § significantly different from PE hours (p < 0.001)

Table 4. Differences in Percentage of Time Spent in MVPA During School, PE, and Afterschool PA Program by Demographic Characteristics*.

		During school hours (450 mins/day)	During PE (45 mins/day)	During afterschool PA program (40 mins/day)
Sex	Boys	10.5 (0.7)	37.4 (1.5)	60.9 (1.8)
	Girls	8.0 (0.5)	25.8 (1.2)	51.6 (1.4)
	P-value †	.002	<.001	<.001
Grade	3rd	7.9 (0.8)	27.1 (2.2)	56.9 (2.1)
	4th	10.2 (0.6)	32.8 (1.7)	57.5 (1.6)
	5th	9.6 (0.7)	34.8 (2.2)	54.5 (2.1)
	P-value†	.061 (3rd vs 4th) #	.020 (3rd vs 5th) #	.455
Race/ethnicity	Black	10.2 (0.5)	35.16 (1.52)	53.0 (1.4)
	Hispanic	7.9 (0.7)	29.48 (1.80)	56.2 (1.7)
	Others	9.6 (1.1)	30.09 (3.09)	59.7 (2.9)
	P-value †	.031 (Black vs Hispanic) #	.045 (Black vs Hispanic) #	.092
BMI‡ (n, %)	<85th pct	9.1 (0.6)	31.7 (1.5)	57.2 (1.5)
	≥85th pct	9.4 (0.6)	31.5 (1.9)	55.4 (1.8)
	P-value †	.697	.927	.398

PA = physical activity; PE = physical education; MVPA = moderate and vigorous intensity physical activity; *values are the average % of time spent in MVPA estimated from the general linear mixed model adjusting for other variables; †*P*-values were estimated from the omnibus *F*-test in the general linear mixed model; ‡BMI for age and sex percentile; #Tukey's adjustment was used for pairwise comparisons.

Discussion

The present study aimed to describe the objectively measured PA in minority children of low SES during regular school days. The findings showed that children engaged in MVPA for an average of 41.6 minutes during school hours, and of those, more than one-third of school-hour MVPA (34%; 14.1 minutes) were accumulated during PE. The importance of PE in promoting daily PA for school-aged children has been largely emphasized (Chen et al., 2014; Pate et al., 2006a), and our findings also support that PE class is one of the effective time periods in which to substantially increase MVPA during school hours (Chen et al., 2014; Meyer et al., 2013). Further, although very rare, more than half of continuous bouts (at least 5 consecutive minutes) of MVPA observed during school hours was contributed during PE which also highlights the role of PE promoting health-enhancing PA in the school. However, we also observed that the average percentage of time spent in MVPA during PE was 31.3% which fell short of the current recommendation (≥50 percent of MVPA), and only 20.8% of monitoring days met this recommendation during PE time. The current results are aligned with most previous studies demonstrating insufficient amount of MVPA during PE (approximately<40%) (Chen et al., 2014; Meyer et al., 2013). We did not collect the detailed data about PE settings (e.g., learning topics/outcomes, delivery methods), and thus it is difficult to identify factors influencing MVPA within PE. However, one possible explanation is that because PE, as a conventional part of school curriculum, typically has a wide range of learning objectives across different domains (e.g., educational, social, cognitive) that are not necessarily directed toward increasing MVPA (Chen et al., 2014; Pate et al., 2006a). Thus, it may be practically difficult to achieve the percentage of MVPA recommendation during PE with a standard curriculum, and further efforts, such as developing 'health-related PE' curriculum that emphasizes promoting in-class MVPA (Pate et al., 2006a), would be needed.

In addition, although the average time spent in MVPA during school hours was above the recommendation, children only had 69.5% of monitoring days with ≥30 minutes of school-hour MVPA. This gap clearly leaves room for improvement in the school to provide additional opportunities increasing PA during school hours. Such opportunities may include classroom breaks and recess time that has been shown to be effective for increasing PA in children (Pate et al., 2006a; Wadsworth et al., 2012). In our study, the school did not offer the scheduled recess time during school hours, and the detailed data on academic breaks during class time were not collected. Yet these opportunities are largely subjected to policies and competing priorities of the school (Story et al., 2009), our findings clearly demonstrated that further effort is needed to address the gaps in achieving the recommended levels of PA during school hours.

The participants in our study are racial and ethnic minority children living in poverty-concentrated neighborhoods. These children have been traditionally disadvantaged in receiving extra PA opportunities outside of school hours due to many of well-known PA barriers related to their surrounding environments (e.g., unsafe neighborhoods, limited access to recreational PA facilities) (Ding et al., 2011), which may subsequently affect the health of this population. As part of community revitalization initiatives under the ELPN project, the school-based afterschool PA program has successfully been established in the school with the goal of increasing MVPA. The current study demonstrated that, on average, children participated in MVPA for more than half of afterschool PA programs (54.2%). The average number of continuous MVPA bouts observed during afterschool PA programs was consistently greater than the total observed during entire school hours including PE. Although slightly less than 60% of monitoring days met the ≥50 percent of MVPA recommendations, afterschool PA program provided an average of 22 minutes of MVPA outside of school hours which accounts for a relatively large portion of daily recommended MVPA minutes (≈1/3 of 60 minutes of MVPA). Our findings are generally in support of previous studies emphasizing the significant role of school-based afterschool PA programs in promoting MVPA during outside of school hours for minority children (Beets et al., 2012; Kumanyika and Grier, 2006; Madsen et al., 2009).

Meanwhile, as shown in Table 4, the observed sex disparities in MVPA during school, PE, and afterschool PA programs are consistent with a large body of data in the literature that showed higher levels of PA for boys when comparing to girls (Beets et al., 2012; Eisenmann et al., 2008; Trost et al., 2013). This finding suggests the need of careful planning of activity curriculum for PE and afterschool PA programs that can facilitate girl's engagement in MVPA. In addition, it is intriguing to note that percentage of MVPA minutes during both PE and afterschool PA programs were not significantly different by BMI levels, and our findings support the special ability of PE and afterschool PA to reach overweight or obese children (Beets et al., 2012; Meyer et al., 2013). However, we also found that percentage of time spent in MVPA during PE times were significantly different by grade and ethnicity while no differences were found in afterschool PA programs. This may indicate that afterschool PA programs designed to foster enjoyment and commitment to PA may have potential to offer equal opportunities to all participating children to increase MVPA, and further efforts would be needed to address the gaps in MVPA levels by grades and ethnicity during PE.

The present study has several limitations worth noting. First, this study was restricted to a single public elementary school in a high poverty area in the US, and thus, caution is need when generalizing the results to other schools with different characteristics. Second, the number of monitoring days varied by individuals (M = 5.3 days; Median = 4 days; Range: 1 to 18 days). We used the linear mixed model with a random intercept in order to account for the repeated measures within each individual, rather than averaging the data; however, the small number of monitoring days still limits the generalizability of the results. Third, the exact start and end times of PE and afterschool PA programs were not directly recorded,

and PA data were extracted based on the pre-scheduled time periods for PE and afterschool PA programs in each day. However, it is likely that PE or afterschool PA programs did not start or finish at exactly the given time, and thus, our PA estimates might be under- or overestimated by including non-PE or non-afterschool PA programs. Fourth, as stated above, the detailed settings of PE and afterschool programs on each day of monitoring periods were not recorded. Further study is required to identify factors influencing MVPA within PE and afterschool PA programs in different settings. Fifth, there is limited data available providing evidence of reliability and validity of wrist-worn Polar Active accelerometer for the estimation of MET values in children, particularly using 30-second epoch length. Although the preliminary laboratory experiment conducted by the manufacturer showed acceptable validity, further efforts should be needed to address this issue in the future. In addition, although the visual feedback available from the Polar Active accelerometer might not be effective to alter child's MVPA (Dauenhauer and Castelli, 2014), we were not able to fully rule out the possibility of motivational effects of visual feedback features on child's PA. Lastly, the thresholds of MET values we used to determine the intensity levels of PA were based on the widely accepted standards (Freedson et al., 2005; Pate et al., 2006b; Ridley et al., 2008). However, there has also been debate in regard to the selection of intensity thresholds of MET values for children (Ridley & Olds, 2008) suggesting to use age- or pubertal-adjusted MET thresholds (Harrell et al., 2005). As reported by Pate et al. (2006b) the readers should be cautious in interpreting our results that different MET intensity thresholds would impact on the estimates of MVPA minutes and compliance of MVPA recommendations.

Conclusion

The findings of present study provide unique insights into the levels and patterns of PA in minority children, and inform the importance of PE and school-based afterschool PA programs for the promotion of MVPA during school days. This study demonstrated that children spent more time in MVPA during afterschool PA programs when comparing to PE during regular school days; however, PE still contributed large amount of total MVPA within school hours. We also highlighted the need of promoting 'health-related PE' to reduce the gaps in achieving the recommendation (≥50 percent of MVPA) during PE, as the average percentage of time spent in MVPA during PE hours was <32% which is lower than 54.2% observed during afterschool PA programs. The sex-disparities in PA observed in the study should be addressed in the future research and practice, particularly for the promotion of MVPA during PE and other afterschool PA programs.

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Key points

- School-based afterschool programs offer extra opportunity to increase moderate- and vigorous-intensity physical activity (MVPA) in minority children, which accounts for approximately one-third of recommended levels of MVPA per day (≥60-min of MVPA).
- The average percentage of time spent in MVPA during physical education classes fell short of the current recommendation (≥50 percent of MVPA), requiring further efforts to develop and implement health-enhancing physical education curriculum.
- Overall, school-based afterschool programs are important venue for promoting physical activity on school days for ethnic minority children living in a high-poverty neighborhood.

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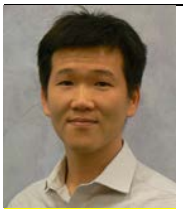

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