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## Support for Physical Education as a Core Subject in Urban Elementary Schools

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### Abstract

**Introduction**—Physical inactivity and childhood obesity are prevalent in American children, with increased vulnerability in minority, low-resource populations. The aim of this study was to quantify the impact of physical education (PE) on in-school physical activity quantity and intensity in urban minority children attending public elementary schools.

**Methods**—This observational study included elementary children (N=212; mean age, 9.9 years; 81.7% black) in Grades 2–5 attending urban public schools with high eligibility for the National School Lunch Program. In-school physical activity was quantified during 4 school weeks across 4 months (January–April 2012) using Omron HJ-151 accelerometer–pedometers. Fitness was assessed with the 20-meter Progressive Aerobic Cardiovascular Endurance Run. Data were analyzed in 2013 using generalized estimating equations to determine the influence of PE and sex on total in-school steps and moderate to vigorous physical activity (MVPA) steps.

**Results**—Based on 3,379 observation days (mean, 15.9 school days/student), students achieved higher in-school physical activity on days with PE (4,979 steps) than on days without PE (3,683 steps,  $p < 0.0001$ ). Likewise, MVPA steps were greater on days with PE than on days without PE ( $p < 0.0001$ ). Boys were more active than girls, but both accumulated more steps on days with PE. Low aerobic fitness was observed in 29.0% of students and overweight/obesity in 31.1%.

**Conclusions**—PE significantly increases total in-school and MVPA steps in urban minority elementary children. PE as a core subject can provide opportunities for urban, minority public school children in low-resource areas to achieve age-appropriate physical activity and fitness goals.

### Introduction

Mounting evidence links childhood physical activity (PA) to musculoskeletal, cardiovascular, and mental health benefits, including lower adiposity and blood pressure

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(BP) and higher cardiorespiratory fitness, self-concept, and academic performance.<sup>1</sup> The *Physical Activity Guidelines for Americans*<sup>2</sup> and *President's Challenge Program*<sup>3</sup> recommend that children aged 6 years engage in 60 minutes of moderate to vigorous PA (MVPA) or 12,000 steps daily.<sup>2-4</sup> Unfortunately, 58% of children and 92% of adolescents in America fail to meet these guidelines.<sup>5</sup> PA barriers in urban settings include neighborhood safety concerns, financial constraints, or lack of access to safe playgrounds and organized activities.<sup>6</sup> Problematically, 16.9% of American children and adolescents are obese, and racial/ethnic minorities are at greater risk than non-Hispanic whites.<sup>7,8</sup>

National initiatives,<sup>9</sup> including *Healthy People 2020*,<sup>10</sup> Surgeon General's *Vision for a Healthy and Fit Nation*,<sup>11</sup> and IOM's *Educating the Student Body*,<sup>12</sup> highlight school environments as ideal settings to provide multicomponent PA opportunities.

Recommendations include enhancing physical education (PE) frequency and quality. Currently, daily PE is required in only 3.8% of public and private elementary schools.<sup>10</sup>

Pedometers are valid, reliable, objective monitors of ambulatory PA in children,<sup>13</sup> yet the literature contains little data on in-school PA of urban minority children in low-resource neighborhoods. The aim of this study was to quantify the impact of PE on in-school PA quantity and intensity in urban minority children attending public elementary schools.

## Methods

### Study Population

Students in Grades 2–5 attending two public elementary schools in St. Louis, MO were invited to participate. Study inclusion required written consent of a parent/guardian and child verbal assent. This observational study was approved by the Washington University in St. Louis IRB and the Saint Louis Public Schools Research Review Committee.

### Measures

In-school PA was quantified for 1 school week/month across 4 months (January–April 2012) using Omron HJ-151 uni-axial accelerometer-pedometers (Omron Healthcare, Lake Forest, IL) worn on the child's waistband from the beginning to the end of each school day. These pedometers have been validated in children.<sup>14</sup> Daily in-school steps and MVPA steps were saved in the instrument's 7-day memory. At least 4 days of monitoring were required for inclusion in the analysis.<sup>15</sup> PE classes were held twice per week in 50-minute sessions.

Cardiorespiratory fitness was assessed twice using the 20-meter Progressive Aerobic Cardiovascular Endurance Run (PACER; The Cooper Institute, Dallas, TX)<sup>16</sup> in each school's gymnasium. The highest number of completed laps was used to calculate maximal oxygen consumption ( $VO_{2max}$ ) with an age-, sex-, and BMI-specific formula.<sup>17</sup> Low fitness was defined as lack of achievement of the Healthy Fitness Zone® based on sex- and age-specific  $VO_{2max}$  standards for children aged 10 years.<sup>16</sup> Additional health metrics included sex- and age-specific percentiles for BMI,<sup>7</sup> waist circumference,<sup>8</sup> and resting BP.<sup>18</sup>

## Statistical Analysis

Analyses were conducted in 2013 using SAS, version 9.3. Generalized estimating equations with an exchangeable correlation matrix were used to compare total in-school steps and MVPA steps between PE and non-PE days and to explore sex differences. Pearson  $r$  correlation coefficients were used to explore associations between in-school steps and fitness. Significance was established using a two-tailed  $\alpha=0.05$ .

## Results

Of 222 enrolled children, 218 were assessed and 212 students (51% male) comprised the final sample. Mean age was 9.9 years (SD=1.2, range=7.7–12.3). Racial/ethnic distribution was 81.7% black, 14.9% white, 3.4% other, and 5.7% Hispanic. Eligibility for the National School Lunch Program (NSLP), an index of family poverty, was 87.6% and 97.5% at the two schools.

As shown in Table 1, the prevalence of combined overweight and obesity was 31.1%, similarly distributed in boys and girls. Equal proportions of students (18.4%) were classified as obese by BMI and abdominally obese by waist circumference. Elevated BP was observed in 4.2% of students. In an age-eligible subsample ( $n=100$ ), low fitness was observed in 29.0%.

A total of 3,379 PA assessments were acquired (mean days/student, 15.9; SD=3.4; range=4–20; mean steps/day, 4,216 steps/day; SD=2,067). Figure 1 highlights that total in-school steps were greater by 1,296 steps/day on PE days than non-PE days. On PE days, students achieved 41.5% of the recommended 12,000 steps in school, compared with 30.7% on non-PE days. MVPA was 235 steps/day greater on PE days than non-PE days.

Boys were more active than girls, achieving more total in-school steps (4,386 [SD=2,182] vs 4,053 [SD=1,937] steps/day,  $p=0.02$ ) and more MVPA steps (529 [SD=772] vs 407 [513] MVPA steps/day,  $p=0.004$ ). On days with PE, boys and girls similarly increased total steps (+1,413 and +1,184, respectively,  $p=0.15$ ), but boys increased MVPA steps to a greater extent than girls (+308 vs +178 MVPA steps,  $p=0.003$ ). No significant correlations were observed between fitness and daily in-school steps or MVPA steps (both  $p>0.10$ )

## Discussion

Our key finding was that PE enabled urban minority elementary school children to achieve 35.2% more in-school steps and 63.5% more MVPA steps relative to days without PE. This is substantive, considering that in-school PA was low in these children compared with expected in-school steps defined by Tudor-Locke et al.<sup>19</sup> (6,700–7,600 steps/day for boys; 4,900–6,100 for girls). To our knowledge, this is the first study quantifying the influence of PE on in-school PA in urban, predominantly black, elementary-age children from low-resource neighborhoods. Many children exhibited low fitness and the proportion classified as overweight or obese in our sample (31.1%) was similar to the National Health and Nutrition Examination Survey sample of youth assessed in 2011–2012 (31.8%).<sup>7</sup>

Our observation that PA was 1,296 steps greater on days with a 50-minute PE class supports previous studies of Hispanic children in the Bronx, NY with 89–99% NSLP eligibility (+724 steps/day on PE days)<sup>20</sup> and Hispanic and African American children in the south with approximately 75% NSLP eligibility (1,296 steps/60-min PE class).<sup>21</sup> Similarly, PE was shown to be the single greatest contributor (23%–25%) to in-school steps in American Indian children<sup>22</sup> and Hispanic and non-Hispanic girls in the Southwest.<sup>23</sup> Importantly, both boys and girls experienced benefits of PE, which supports previous research.<sup>24</sup> When economic and environmental barriers to PA exist, the “whole-of-school approach” that includes PE as a core subject<sup>12</sup> is critical for providing PA opportunities for all children.

Experts recommend that 33%–50% of PE time be spent in MVPA,<sup>25</sup> with around 60–63 steps/minute during a 30-minute PE class.<sup>26</sup> The estimated step rate in our students during 50-minute PE classes was approximately 25.9 steps/minute. The Omron pedometer’s 4-second filter excludes steps taken in activity bouts lasting <4 seconds, which may have contributed to lower step counts than school studies that used the Yamax Digi-Walker pedometer. PE quality may be enhanced by providing age- and sex-appropriate activities led by specialist instructors (particularly for minority girls who often accrue less MVPA than boys), increasing PE frequency, and limiting class sizes.

### Limitations

Limitations include exclusively measuring in-school PA without segmenting the school day. Therefore, we were unable to assess achievement of national PA guidelines in our sample.

### Conclusions

Our findings support frequent PE for elementary-age children, particularly in urban public school districts serving minority children in low-resource environments. Consistent with national priorities to combat childhood obesity, creating healthy school environments includes requiring quality PE daily. Modifications to state policies and resource allocation to public schools are critical. Future research should evaluate the health, behavioral, and academic benefits of PE policy changes in urban public schools.

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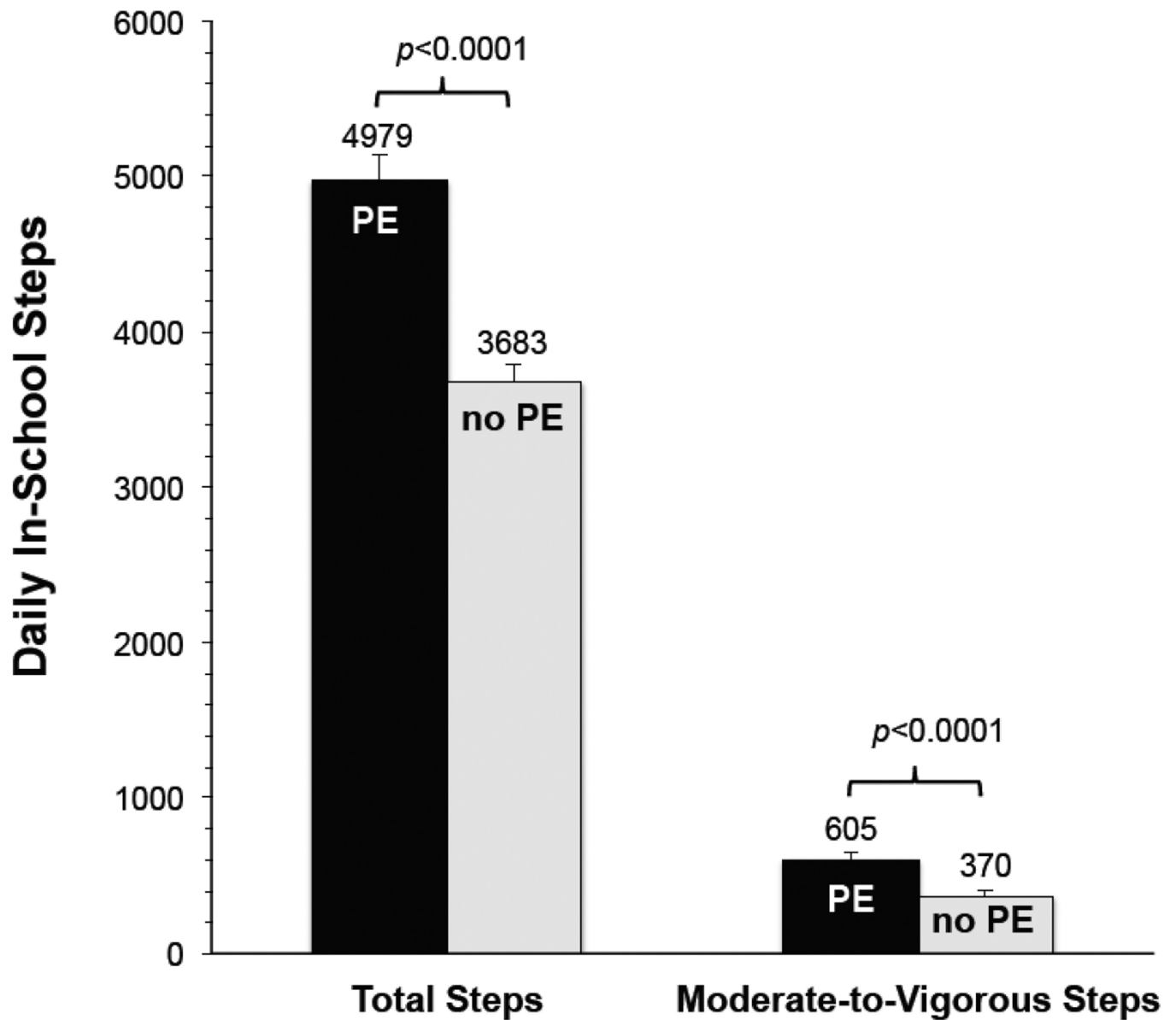
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**Figure 1.**

Daily in-school total steps and moderate-to-vigorous intensity steps on days with physical education (PE) and days without PE among 212 urban public elementary school children in 2012.

*Note:* Bars reflect mean and SE steps for 3,379 PA monitoring days across 4 months.

Generalized estimating equations with an exchangeable correlation matrix were used to determine the influence of PE on total steps and moderate-to-vigorous steps.



Table 1

## Risk Factor Prevalence Among Urban Public Elementary School Children

	All	Boys	Girls	Grade				
				2	3	4	5	
N	212	108	104	44	57	50	61	
% <b>Overweight:</b> BMI 85th and <95th percentile	12.7	13.0	12.5	11.4	14.0	16.0	9.8	
% <b>Obese:</b> BMI 95th percentile	18.4	18.5	18.3	18.2	15.8	20.0	19.7	
% <b>Abdominally obese:</b> WC 90th percentile	18.4	16.7	20.2	20.5	14.0	24.0	16.4	
% <b>Elevated BP:</b> SBP or DBP 90th percentile or BP 120/80 mm Hg	4.2	3.7	4.8	6.8	3.5	2.0	4.9	
% <b>Low fitness:</b> VO <sub>2max</sub> <Healthy Fitness Zone®	29.0	28.3	28.8					

Note: Data are reported as percentages per stratum. Low fitness was determined using the 20-meter Progressive Aerobic Cardiovascular Endurance Run (PACER) in a subsample of 100 students (46 boys, 54 girls) aged 10 years. Use of the Healthy Fitness Zone® standards was permitted by The Cooper Institute, Dallas, TX.

WC, waist circumference; BP, Blood pressure; SBP, systolic blood pressure; DBP, diastolic blood pressure.