

# Physical Activity in a Multiethnic Population of Third Graders in Four States

## ABSTRACT

**Objectives.** This research assessed the amount of daily physical activity in a multiethnic sample of US third-grade students.

**Methods.** Physical activity interviews were conducted with 2410 third graders from 96 schools in four states. Blood pressure, cholesterol, body mass index, timed run for distance, physical-activity self-efficacy, and perceived support for physical activity were also assessed.

**Results.** Students reported a daily average of 89.9 minutes of moderate to vigorous physical activity, 34.7 minutes of vigorous activity, and 120.4 minutes of sedentary behavior; however, 36.6% obtained less than 60 minutes of moderate to vigorous physical activity daily, and 12.8% reported less than 30 minutes. Boys reported more physical and sedentary activity than girls; White children reported more activity than Black or Hispanic children; California children reported the most activity and Louisiana children the least. Geographic location, male gender, lower cholesterol, higher perceived efficacy in physical activity, and higher social support were associated with more physical activity.

**Conclusions.** Average reported activity met the Year 2000 objectives; however, many students reported less than recommended amounts of activity. These findings support the need for health promotion programs that increase the number of physically active children. (*Am J Public Health*. 1997;87:45-50)

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## Introduction

Physical activity during childhood is important to health and development.<sup>1</sup> Measurable benefits of regular childhood physical activity include improved strength, weight control, body composition, and cardiorespiratory fitness.<sup>2</sup> Physical activity during youth may be particularly important to the extent that lifetime activity habits develop and persist into adulthood.<sup>3</sup> While activity is a national priority,<sup>4,5</sup> the current status of children's physical activity is not well documented.<sup>6</sup>

The purpose of this research was to assess through systematic interviews the amount and distribution of daily physical activity in a multiethnic sample of third grade children in 96 schools located in four states. A secondary goal was to examine the potential relationships between physical activity and gender, ethnicity, geographic location, psychosocial factors, and cardiovascular disease risk factors (obesity, cholesterol, and blood pressure). This research was part of a larger study of school-based cardiovascular health promotion program entitled the Child and Adolescent Trial for Cardiovascular Health (CATCH).<sup>7</sup>

## Background

There is great public and scientific interest in the status of physical activity and fitness among preadolescent children. One perspective holds that modern urban children, freed from the demands of farm chores and other physical labor, spend most of their leisure time in sedentary activities such as watching television and playing video games.<sup>8</sup> It may also be that children use their free time to engage in a variety of leisure activities, including

some sedentary and some physical activities. Indeed, the few available surveys of preadolescent physical activity suggest that children are quite active, at least compared with adult standards.<sup>9,10</sup> Other research indicates that children spend an average of 24 hours per week watching TV, a sedentary behavior that is associated with obesity.<sup>8</sup> On measures of aerobic power, however, preadolescent children are among the most fit of any age group.<sup>11</sup> Furthermore, for most measures of fitness, there is little evidence that American children are becoming less fit over time or that they are any less fit than children in other developed nations in Europe.<sup>6</sup>

The lack of valid measures for assessing the physical activity of preadolescent children has impeded research in this area. Researchers have employed a variety of methods to measure children's physical activity.<sup>12</sup> Objective measures of physical activity, such as direct observation,<sup>13</sup> Caltrac accelerometers, and heart rate monitors,<sup>14</sup> are useful in assessing the activity of a limited number of subjects

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for specified time periods. Self-reports in the form of diaries, self-administered recalls, or interviews, however, are the only feasible method of assessing activity on large numbers of children.<sup>15</sup>

Assessing preadolescents' physical activity is especially challenging owing to the developmental limits on children's cognitive abilities to recall events and estimate time.<sup>15</sup> Since children's cognitive capacities are age dependent, accurate recall of physical activity is likely to be much better for children 10 and older than for younger children.<sup>15,16</sup> Nevertheless, with proper instruction and format, children as young as 8 should be able to recall their physical activity fairly accurately. For example, Baranowski and colleagues<sup>17</sup> found that the accuracy of preadolescent children's recall was better on a questionnaire with a time-segmented format than on one with a more open format. Relatedly, dietary recalls are routinely conducted with preadolescent children by trained interviewers using a structured format.<sup>18</sup>

## Methods

### Sample

Appropriate institutional and written parental consent to participate in the data collection were obtained. Data were collected from third graders in 96 participating schools, 24 each from California, Louisiana, Minnesota, and Texas, from September 1991 through January 1992 as part of the CATCH baseline assessment. The physiological risk factor assessment included cholesterol (obtained by finger stick), blood pressure, body mass index, and skinfolds, administered according to standardized protocols by trained research assistants.<sup>19</sup> Other assessments included the 9-minute timed run for distance,<sup>20</sup> physical activity interview, dietary recall, and a health behavior questionnaire. The health behavior questionnaire was administered in class to all third graders. The questionnaire included the following measures related to physical activity: (1) a scale measuring physical activity self-efficacy (95 items,  $\alpha = 0.67$ ), (2) a scale measuring perceived support (7 items,  $\alpha = 0.60$ ) from parents, peers, and teachers, and (3) a scale measuring reinforcement (11 items,  $\alpha = 0.68$ ) from parents, peers, and teachers.<sup>21</sup>

To minimize the response burden on students, subjects were selected to complete the physical activity interview and a diet interview in the following manner. In

schools with 70 or fewer third graders, a random sample of 30 children was first selected to complete the diet recall, and the remaining students were selected to complete the physical activity interview. In schools with more than 70 third graders, a random sample of up to 30 students was first assigned to dietary recall interviews, and a separate sample of up to 40 of the remaining students was selected for the physical activity interview. A randomly ordered list of names was available at each school to assign remaining or "leftover" students to either measure as needed to meet the required sample.

### Measurement and Procedures

A minimum of three interviewers at each study site completed an extensive training program that lasted approximately 12 hours and included both instruction and supervised practice. Interviewers completed a minimum of two practice interviews, which were audio-recorded and rescored by the trainer. To obtain and maintain certification, the interviewer needed to achieve the following levels of correspondence with the trainer: an average of 90% or greater agreement on categorizing each physical activity reported, an intraclass coefficient of 0.90 on the duration of each reported activity, and 80% agreement on measures of probing technique and completeness of information obtained.

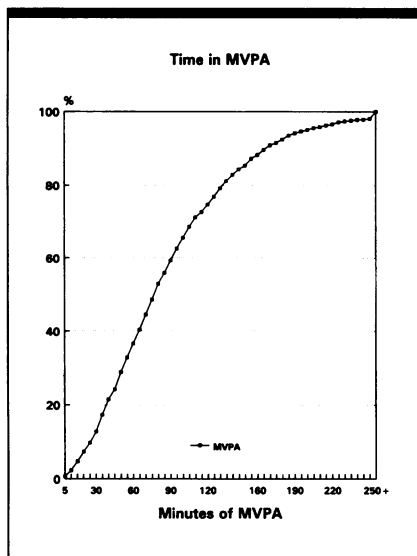
The morning preceding the interview, children were trained during class to estimate time and complete a memory aid, the Physical Activity Record form. Students received instruction and then practiced recording the type and duration of their activities for that day on the Physical Activity Record. Research assistants provided examples, answered questions, and worked with individual students. The following morning, students were interviewed one on one in a quiet space at school. If the student had his or her completed Physical Activity Record, it was used to help the interviewer and the student complete the Children's Physical Activity Interview.

The Children's Physical Activity Interview was segmented by time of day (e.g., before school, at school before lunch, at school after lunch, after school until supper, after supper until bedtime). The interviewer started with the earliest time segment (i.e., before school) the previous day, and used nondirective probes (e.g., "Were you inside or outside?" "What did you do then?") to guide

children in recalling their activities in chronological order, accounting for as much time as possible, and estimating the duration of their participation in each activity. Time spent in class and sleeping were excluded. According to energy expenditure estimates, each activity or activity category was categorized as sedentary (e.g., homework, reading, watching TV, playing video games), low intensity (e.g., playing a musical instrument, cooking, standing), moderate intensity (e.g., softball, kickball), or high intensity (e.g., basketball, dancing, jogging).

The validity of a preliminary version of the Children's Physical Activity Interview was assessed against monitored heart rates during a pilot study.<sup>22</sup> Twenty-seven third-grade and 21 fifth-grade students wore heart-rate monitors for an average of 12.5 hours and were interviewed the following morning. The Pearson product-moment correlations between activity minutes as reported by the students on a physical activity interview and monitored minutes of high intensity activity, defined as 180% of resting heart rates, were  $r = 0.57$  for third graders and  $r = 0.72$  for fifth graders. While administering this preliminary version of the CPAI, interviewers probed for activities and total duration of time. Much of the inaccuracy, especially among the younger children, was judged to be from overreporting the duration of participation in moderate and vigorous physical activities.

On the basis of the pilot study, the physical activity interview form was modified for use in CATCH and was renamed the Children's Physical Activity Interview. In the preliminary version and the Children's Physical Activity Interview, the minutes each child reported in an activity or activity category were recorded and labeled as total minutes. To more accurately account for actual time in activity, two unique variables were added to the Children's Physical Activity Interview: minutes of moderate to vigorous physical activity and vigorous minutes. To obtain minutes of moderate to vigorous physical activity, interviewers assessed the time during which students were truly engaged in the activity. For example, if the child reported playing soccer for a total of 30 minutes, 30 minutes was recorded as total minutes. If, upon further questioning, the child indicated that he or she actually played soccer 15 of the 30 minutes, then 15 was recorded for soccer for minutes of moderate to vigorous physical activity. The interviewer then assessed the time the child engaged in



**FIGURE 1—Cumulative percentage distribution of participation in moderate to vigorous physical activity (MVPA) among third graders (n = 2385) in Texas, Minnesota, Louisiana, and California: The Child and Adolescent Trial for Cardiovascular Health.**

activity vigorously (i.e., “Of the 15 minutes you were actually playing soccer, how many minutes did your heart and breathing speed up?”). This amount was recorded as vigorous minutes.

Minutes of moderate to vigorous physical activity and vigorous minutes were summed across all reported activities, providing the number of minutes in daily moderate to vigorous physical activity and vigorous activity, respectively.

The Children’s Physical Activity Interview also assessed time spent in specific categories of sedentary behavior (sedentary minutes), including video games, television, listening to music, talking, studying, and reading.

**Analysis**

For each of the three dependent variables—minutes of moderate to vigorous physical activity, vigorous minutes, and sedentary minutes—one-way ANCOVAs were performed to assess the extent of association with each of three independent variables: gender (*df* = 1), ethnicity (*df* = 3), and CATCH site (*df* = 3). A mixed-model ANCOVA was then performed for each dependent variable with gender, ethnicity, and site as fixed effects,

**TABLE 1—Daily Minutes of Moderate to Vigorous Physical Activity among White, Black, and Hispanic Boys and Girls in California, Louisiana, Minnesota, and Texas**

Group	No. <sup>a</sup>	Minutes			F <sup>b</sup>	P <sup>b</sup>
		Mean	SD	SE		
Total	2410	89.9	60.0			
Gender					35.22	.0001
Boys <sup>c</sup>	1207	97.1	62.6	1.7		
Girls <sup>d</sup>	1186	82.6	56.4	1.7		
Race/ethnicity					5.96	.0005
White <sup>c</sup>	1683	93.1	60.6	1.4		
Black <sup>d</sup>	316	79.7	61.9	3.4		
Hispanic <sup>d</sup>	301	83.1	54.8	3.4		
Other <sup>c,d</sup>	88	88.4	53.9	6.4		
Study site					33.43	.0001
California <sup>c</sup>	633	103.8	66.9	2.3		
Louisiana <sup>d</sup>	623	73.2	53.2	2.4		
Minnesota <sup>e</sup>	644	97.2	55.5	2.3		
Texas <sup>f</sup>	510	83.4	58.7	2.6		
Location					733.82	.0001
Away from school <sup>c</sup>	2278	63.3	53.2	0.8		
At school <sup>d</sup>	2271	31.2	19.0	0.8		

<sup>a</sup>Totals may be less than 2410 owing to missing values.  
<sup>b</sup>From Proc Mixed multiway ANCOVA.  
<sup>c-f</sup>Groups with different superscript letters were significantly different (*P* < .01) in pairwise comparisons.

**TABLE 2—Daily Minutes of Vigorous Physical Activity among White, Black, and Hispanic Boys and Girls in California, Louisiana, Minnesota, and Texas**

Group	No. <sup>a</sup>	Minutes			F <sup>b</sup>	P <sup>b</sup>
		Mean	SD	SE		
Total	2410	34.7	34.3			
Gender					13.58	.0002
Boys <sup>c</sup>	1206	37.2	36.2	1.0		
Girls <sup>d</sup>	1180	32.1	32.0	1.0		
Race/ethnicity					4.72	.0028
White <sup>c</sup>	1678	36.1	35.7	0.8		
Black <sup>d</sup>	314	28.3	32.6	1.9		
Hispanic <sup>c</sup>	301	34.0	29.1	2.0		
Other <sup>c</sup>	89	33.2	26.1	3.6		
Study site					52.86	.0001
California <sup>c</sup>	633	47.2	39.2	1.3		
Louisiana <sup>d</sup>	623	23.5	29.2	1.4		
Minnesota <sup>e</sup>	644	34.0	31.4	1.3		
Texas <sup>e</sup>	510	33.1	31.8	1.6		
Location					222.19	.0001
Away from school <sup>c</sup>	2267	23.2	28.6	0.5		
School <sup>d</sup>	2250	13.4	12.4	0.5		

<sup>a</sup>Totals may be less than 2410 owing to missing values.  
<sup>b</sup>From Proc Mixed multiway ANCOVA.  
<sup>c-e</sup>Groups with different superscript letters were significantly different (*P* < .05) in pairwise comparisons.

adjusted for the following covariates: cholesterol; body mass index; systolic and diastolic blood pressure; physical activity

support from parents, teachers, and peers; and physical-activity self-efficacy.<sup>23,24</sup> Performance on the 9-minute run was not

**TABLE 3—Daily Minutes of Sedentary Behavior among White, Black, and Hispanic Boys and Girls in California, Louisiana, Minnesota, and Texas**

Group	No. <sup>a</sup>	Minutes			F <sup>b</sup>	P <sup>b</sup>
		Mean	SD	SE		
Total	2410	120.4	80.3			
Gender					25.39	.0001
Boys <sup>c</sup>	1203	128.6	82.1	2.3		
Girls <sup>d</sup>	1185	112.1	77.6	2.3		
Race/ethnicity					0.83	.4797
White	1679	120.9	77.2	2.0		
Black	316	122.5	98.0	4.5		
Hispanic	299	113.8	77.8	4.6		
Other	89	124.1	77.9	8.5		
Study site					11.19	.0001
California <sup>c</sup>	633	114.4	80.2	3.2		
Louisiana <sup>d</sup>	623	136.4	92.9	3.2		
Minnesota <sup>c</sup>	644	114.1	66.1	3.2		
Texas <sup>c</sup>	510	116.2	77.6	3.2		

<sup>a</sup>Totals may be less than 2410 owing to missing values.

<sup>b</sup>From Proc Mixed multiway ANCOVA.

<sup>c,d</sup>Groups with different superscript letters were significantly different ( $P < .001$ ) in pairwise comparisons.

**TABLE 4—Factors Associated with Moderate to Vigorous, Vigorous, and Sedentary Activity in Mixed Model ANCOVAs**

Factor	F Score		
	Moderate to Vigorous Activity	Vigorous Activity	Sedentary Activity
Gender (male, female)	22.75***	8.42**	21.85***
Race/ethnicity (White, Hispanic, Black)	1.15	1.31	0.50
Site (California, Minnesota, Texas, Louisiana)	10.72***	25.21***	5.56**
Physical activity support (11 to -11) x = 5.59 SD = 4.30	8.17**	9.69**	0.91
Physical activity self-efficacy (5 to -5) x = 2.39 SD = 2.33	11.22***	8.95**	0.01
Cholesterol <sup>a</sup> x = 170.18 SD = 27.07	6.22**	4.75*	3.67
Systolic blood pressure x = 106.06 SD = 9.06	1.30	0.56	0.50
Diastolic blood pressure x = 53.87 SD = 6.76	1.97	1.29	0.50
Body mass index x = 17.53 SD = 2.93	0.17	0.38	1.33

<sup>a</sup>Negative association.

\* $P \leq .05$ ; \*\* $P \leq .01$ ; \*\*\* $P \leq .001$ .

included in the models after exploratory analysis showed no relationship between it and the Children's Physical Activity Interview outcome measures. School, nested within site, was included as a random effect to account for between-school variation within the states. Interactions among site, gender, and race were also investigated. All analyses were performed with the SAS Proc Mixed routine.<sup>23</sup> Pairwise comparisons for each ANCOVA were made by examining contrasts constructed from the fitted model by the estimate option in Proc Mixed. Standard residual checks were performed for all ANCOVA models, including normality and variance homogeneity. No transformations were required.

### Results

Of 3746 children randomly selected to participate in the physical activity assessment, 2717 (72.5%) provided consent. Data were collected on 2410 (88.7%) of those consenting: 633 of 748 (84.6%) from California, 623 of 703 (88.6%) from Louisiana, 644 of 701 (91.9%) from Minnesota, and 510 of 565 (90.3%) from Texas. Most nonparticipation was due to students' being absent from school or having schedule conflicts during data collection. Participating and nonparticipating students had similar ethnicity and gender, except that Hispanics (57.5% consented) were less likely to provide consent than others.

The interviews took an average of 18.2 minutes (SD = 13.0) to complete. At the end of each interview, the interviewer rated the overall quality of the child's participation in the interview on the basis of subjective observation. Average scores on scales of 1 (poor) to 5 (excellent) were 3.4 for attentiveness, 3.2 for activity recall, and 2.8 for time estimation.

Figure 1 shows the distribution of participation in moderate to vigorous physical activity, with 12.8% reporting 30 or fewer daily minutes and 36.6% reporting 60 or fewer minutes of moderate to vigorous physical activity.

As Table 1 shows, children reported an average of 89.9 minutes of moderate to vigorous physical activity daily. One-way analyses of variance indicated that gender, ethnicity, study site, and location were significantly associated with the amount of moderate to vigorous physical activity reported. Boys reported significantly more minutes of moderate to vigorous physical activity than girls ( $P = .0001$ ) and White students reported more activity than Black

or Hispanic students ( $P = 0.01$ ). Significant differences also occurred among each of the four sites, with California students reporting the most and Louisiana students the fewest minutes of moderate to vigorous physical activity. Also, students reported about twice as much time in moderate to vigorous physical activity away from school as at school ( $P = .0001$ ).

As Table 2 shows, of the 89.9 minutes of reported daily moderate to vigorous physical activity, an average of 34.7 (SD = 34.3) minutes were vigorous. Boys reported significantly more vigorous activity than girls ( $P = .0002$ ); Blacks reported less than Whites, Hispanics, or others ( $P = .05$ ); California students reported significantly more vigorous activity, while Louisiana students reported less than other study sites ( $P < .05$ ). Nearly twice as much vigorous activity was reported to occur away from school as at school.

As Table 3 shows, students reported an average of 120.4 (SD = 80.3) minutes of sedentary activity daily. Nearly half of the sedentary minutes were devoted to playing video games, watching TV, and sitting listening to music, and nearly half to studying, homework, reading, lying down, or doing artwork (data not shown). Boys reported significantly more sedentary activity than girls ( $P = .0001$ ). Louisiana students reported significantly more sedentary minutes than those from each of the other sites ( $P < .05$ ). Sedentary minutes did not vary significantly by ethnicity.

Table 4 shows the results of mixed model ANCOVAs conducted separately for each dependent variable: minutes of moderate to vigorous physical activity, vigorous activity, and sedentary activity. Gender and geographic site were found to be independently associated with each of the three dependent variables, but ethnicity was not when the other independent variables were taken into account. Boys reported significantly more activity and more sedentary minutes than girls. There were no significant two-way interactions.

The type of sedentary behavior varied significantly by gender, ethnicity, and site ( $P < .05$  in all cases). Boys spent more time than girls playing video games and watching TV. Students from California spent less time watching TV than students from the other three sites. Girls spent more time on homework than boys, White students spent more time on homework than Hispanic students, and students from Louisiana spent more time on homework than students in other sites.

Table 4 also shows that higher levels of social support and physical activity self-efficacy were positively associated with minutes of moderate to vigorous physical activity and vigorous minutes.

Lower cholesterol was associated with more minutes of moderate to vigorous physical activity and vigorous minutes although the magnitudes of the associations between cholesterol and each dependent variable were low, with Pearson product moment correlations of  $r \leq 0.1$ . Blood pressure and body mass index were not associated with the dependent variables.

The correlation between vigorous minutes and minutes of moderate to vigorous physical activity was  $r = 0.62$ . Sedentary minutes were not correlated with either vigorous minutes ( $r = 0.001$ ) or minutes of moderate to vigorous physical activity ( $r = -0.001$ ).

## Discussion

This is the first multisite study to assess preadolescent children's physical activity with the use of individual interview techniques rather than class-administered reports. A limitation of the study is that we sampled only 1 day per student, although an individual's physical activity is known to vary from day to day.

The 89.9 minutes of daily moderate to vigorous physical activity reported by the third-grade children in this study is consistent with previous national surveys<sup>9</sup> and the 34.7 minutes of vigorous activity is consistent with studies that have assessed physical activity by heart-rate monitors.<sup>25</sup> The mean values met or exceeded the minimum guidelines for physical activity proposed by various groups,<sup>4,5</sup> commonly 30 or 60 minutes of moderate to vigorous physical activity daily. However, the distribution of participation was uneven, 20% of the children reporting 120 minutes or more, 5.3% reporting no moderate to vigorous physical activity, 12.8% reporting 30 or fewer minutes, and 36.5% reporting 60 or fewer minutes. Hence, a substantial proportion of the population obtained less than recommended levels of activity, as was reported in one other study.<sup>26</sup> This finding underscores the importance of increasing participation in physical activity programs for youth.

There are no national guidelines regarding acceptable levels of sedentary behavior, but there is concern that youth may be too sedentary.<sup>4,8</sup> On average, the students in our study reported just over 2

hours of sedentary behavior, nearly evenly divided between generally constructive activities, such as studying, homework, and reading, and leisure activities, such as watching TV and playing video games.

Because the sample was large, we were able to assess factors associated with physical activity. Our findings are consistent with other research that has found that boys participate in more moderate and vigorous activity than girls,<sup>27</sup> although this has not been a consistent finding.<sup>26</sup> Whereas girls spent more time on homework than boys, overall, boys reported significantly more sedentary activity than girls, primarily watching TV and playing video games. Ethnicity was not associated with activity when other factors were included in the model. However, activity varied by geographic site, with California children obtaining the most, Texas and Louisiana children obtaining the least; this suggests the possible influence of climate, regional sociocultural factors, or differences in the availability of community resources.

The finding that the third graders obtained substantially more activity away from school than at school is consistent with recent research findings.<sup>28</sup> This may be attributed to children's having more time available for activity during non-school hours, the lack of daily physical education classes, low levels of physical activity during physical education classes,<sup>13,26,28</sup> and the limited amount of time students have for physical activity at school during recess and after lunch. It should be noted that the Children's Physical Activity Interview protocol did not assess incidental activity that may have occurred at school between classes.

Significant associations between higher childhood physical activity and lower total cholesterol have been reported in two other studies—one cross-sectional study that compared children with habitually high activity and children with habitually low activity levels<sup>29</sup> and one prospective study.<sup>30</sup> It should be noted that the magnitude of the relationship between lower total cholesterol and higher moderate to vigorous physical activity in the present study ( $r \leq 0.1$ ), although significant, was low. Because it was not feasible to obtain a measure of high density lipoprotein from the small sample of blood obtained by finger stick, we could not look for an association between high density lipoprotein and physical activity. Also, we found no association between blood pressure and activity,

although others have reported such an association.<sup>31</sup>

Also unlike others, we found no association between activity and cardiorespiratory fitness,<sup>32</sup> perhaps because a single 9-minute run, like other class-administered distance or timed runs, may not be a very sensitive individual measure of fitness in third graders.

Associations between physical activity and support from peers<sup>9,33</sup> and parents<sup>34,35</sup> have been reported in other research. Relatedly, our study confirms other research indicating that physical activity self-efficacy is associated with children's participation in physical activity.<sup>33,35,36</sup> These findings are consistent with the hypothesis that physical activity is mediated by perceived physical activity self-efficacy and social support.

These findings support the need for health promotion programs designed to increase the proportion of children who are regularly physically active. □

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