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Characteristics of School Campuses and Physical Activity Among Youth

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Abstract

Background—Previous research suggests that school characteristics may influence physical activity. However, few studies have examined associations between school building and campus characteristics and objective measures of physical activity among middle school students.

Methods—Students from ten middle schools ($n=248$, 42% female, mean age 13.7 years) wore TriTrac-R3D accelerometers in 1997 recording measures of minute-by-minute physical movements during the school day that were then averaged over 15-minute intervals ($n=16,619$) and log-transformed. School characteristics, including school campus area, play area, and building area (per student) were assessed retrospectively in 2004–2005 using land-use parcel data, site visits, orthophotos, architectural plans, and site maps. In 2006, linear mixed models using SAS PROC MIXED were fit to examine associations between school environmental variables and physical activity, controlling for potentially confounding variables.

Results—Area per enrolled student ranged from 8.8 to 143.7 m² for school campuses, from 12.1 to 24.7 m² for buildings, and from 0.4 to 58.9 m² for play areas. Play area comprised from 3% to 62% of total campus area across schools. In separate regression models, school campus area per student ($\beta=0.2244$, $p<0.0001$); building area per student ($\beta=2.1302$, $p<0.02$); and play area per student ($\beta=0.347$, $p<0.0001$) were each directly associated with log-TriTrac-R3D vector magnitude. Given the range of area density measures in this sample of schools, this translates into an approximate 20% to 30% increase in average vector magnitude, or walking 2 extra miles over the course of a week.

Conclusions—Larger school campuses, school buildings, and play areas (per enrolled student) are associated with higher levels of physical activity in middle school students.

Background

Small amounts of accumulated physical activity may add up to significantly larger energy expenditure over time. Given the growing rates of overweight in young people, increasing energy expenditure is an important health priority. Significant recent attention has been given to identifying strategies that might promote more lifestyle physical activity among children

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and youth, including active commuting to school and increasing opportunities for play and physical activity.³ However, the quantification of incidental and intermittent physical activity associated with these strategies can be difficult to capture without rigorous measurement.

Studies using objective measures of physical activity such as accelerometry, or a combination of objective and self-report methods, can improve our ability to accurately measure and monitor activity levels among youth. Using physical activity monitoring devices such as accelerometers allows researchers to study activity patterns occurring within ecologic contexts^{4,5} of specific time and place. When measured objectively, the physical activity levels of children and adolescents vary with respect to time of day,^{6,7} day of the week,^{7,8} and specific context.^{9–11}

For youth, much routine physical activity occurs within contexts including spaces such as homes, schools, and neighborhoods. Krizek et al.¹² provide a general schematic for investigations of the environment and physical activity among youth. Their approach advocates for a focus on both how **and** where youth spend their time. This study focuses on schools, a singularly universal destination for most youth.

Most American children attend school and as a result spend considerable time in school buildings and on school campuses. In 2003, fewer than 3% of students in the United States were home schooled (www.ed.gov/about/offices/list/oii/nonpublic/statistics.html). While there is evidence that the physical characteristics of schools can influence learning,¹³ Zimring et al.¹⁴ propose that the characteristics of buildings and sites can affect physical activity levels as well. These effects occur at several spatial scales (i.e., site, building, and building element). For example, the selection and design of the location of the school, the physical characteristics of the school building (e.g., size of the building), and the design of the elements within a given building (e.g., location of stairs, exercise areas) might each play a role.¹⁴ These hypotheses are supported by previous research suggesting school characteristics may influence physical activity.^{11,15,16}

A few recent studies have examined the relationships between the school environments and objective measures of physical activity during the school day. In an observational study of 24 public middle schools, Sallis et al.¹¹ characterized 137 areas for physical activity and made observations of the levels of physical activity of students using these areas. When a school environment was supportive (i.e., had both physical improvements such as basketball courts or playground markings and adult supervision), the proportion of students actively engaged in physical activity was higher than when school environments were deficient in both facilities and supervision. In schools with no environmental support, the proportion of active students was near zero. In general, higher proportions of youth were active in courts or fields compared with indoor activity areas. A subsequent randomized controlled trial focused on increasing physical activity using environmental interventions such as increasing supervision, availability of equipment and organized activities, and active time in physical education (PE) class. Using these strategies, intervention schools saw increases in moderate and vigorous physical activity both in and out of PE settings. However, PE curriculum interventions contributed more than the out-of-class strategies in increasing rates of physical activity overall.¹⁶

While PE classes can be the source of substantial physical activity,¹⁶ the time offered for PE can vary greatly among schools and by age or grade.¹⁷ Excluding PE classes and recess periods, much of the physical activity occurring during the school day is instrumental, occurring as students go from class to class or to lunch. Therefore, the role of the school site, characteristics of the building, and potentially the space allotted for play and active recreation may be important factors in physical activity levels of middle school youth.

A few additional studies have examined whether certain built or structural characteristics influence physical activity among elementary students,¹⁸ older adults,¹⁹ and preschoolers,²⁰

finding that more facilities and equipment and opportunities (e.g., classes) translated into increased activity levels.

Study Objectives

This study describes the development of objective measures of school campuses, school buildings and school play areas using geographic information system (GIS) data, site visits, archival records, and aerial photographs (ortho-photos); discusses the development of statistical models defining accelerometer measures of school day physical activity; and presents findings regarding associations between objectively measured school characteristics and accelerometer estimates of physical activity in middle school youth. These data are then used to test the study hypothesis that increased space per enrolled student leads to more physical activity.

Methods

Data for this study were derived from a randomized controlled trial of a school-based intervention among 7th- and 8th-grade students in ten middle schools.²¹ A stratified random sample of 256 students participated in a substudy that collected objectively monitored physical activity data in 1997.

Student-Level Data

Student questionnaire data were collected in 1997 to assess individual nutrition and physical activity-related behaviors and other student characteristics (i.e., gender, age, race/ethnicity, and average days per week of PE participation). Body mass index (BMI) was calculated from measurements collected in 1997 by trained project staff.²¹ The data used in this analysis are from 248 study participants with both accelerometer data and complete corresponding survey and BMI data for study covariates from 1997.

School Characteristics

This study characterizes ten middle schools in four communities in the Boston metropolitan area. According to the 2000 U.S. Census, the total population in these four communities ranged from 66,910 to 101,355, with population densities per square mile from 2664 to 18,868 (1028 to 7285 people/km²), including both urban and rural areas. The average median household income of the ZIP code areas in which the schools were located (\$48,485) was below the average for Massachusetts (\$50,502) and ranged from \$31,751 to \$70,613. The proportion of households living in poverty in these areas ranged from 2% to 16% and the proportion of the population in these areas earning more than \$200,000 ranged from 1% to 8%.

Objective physical characteristics including school campus area, campus play area, building area, and area densities per student were assessed retrospectively in 2004–2005 using local parcel data, site visits, ortho-photos, architectural plans, and site maps. Building footprints and parcel boundaries were available from local government offices for eight schools. ArcGIS, version 9 (Environmental Systems Research Institute, Redlands CA, 2004), was used to screen-digitize school campus parcel boundaries and building footprints for the remaining two schools based on 2001 ortho-photos. Ortho-photos—1:5000 ortho-images from 2001 and 1995—were downloaded from the Office of Geographic and Environmental Information, Commonwealth of Massachusetts Executive Office of Environmental Affairs. Black-and-white ortho-photos from 1995 defined campus areas where school buildings had been altered between 1997 and 2001 (two schools) and were used to verify 2001 imagery.

ArcGIS was used to calculate the total area of all campus polygons (i.e., total campus area) as well as additional specific subcategories for each school (i.e., building footprint and play areas),

thereby creating a school site map (Figure 1). Buildings were characterized and subdivided according to floors using architectural plans. School building area was calculated from the number of building floors and the building footprint area. (Examples and detailed methodology can be found at

http://biosun1.harvard.edu/research/divisions/env_stat/GISinLMA/localfeatureswebsite/localfeaturesintro.htm.) Researchers consulted with school staff during site visits to obtain reported school building area, and to review architectural drawings and site maps to verify site and building characteristics and document changes that occurred since 1997. School enrollment data for 1997 were obtained from the Massachusetts Department of Education. The school campus characteristics were rescaled (i.e., divided by 100) before inclusion in the regression models.

Physical Activity Data

The study protocol assigned students to wear the TriTrac-R3D accelerometer for either one or two 4-day sessions conducted by school between February and May of 1997. Data were not collected simultaneously in schools. The students wore the accelerometers on their hip in a “walkman”-style pouch. The TriTrac-R3D collects measures of movement in three planes and provides a summary vector measure of movement-vector magnitude—for each minute the monitor is worn. Minute-by-minute TriTrac-R3D vector magnitude counts from 248 students were reviewed. Periods with little or no movement recorded for ≥ 30 consecutive minutes (i.e., vector magnitude < 10) were considered missing. The vector magnitude data were averaged over consecutive 15-minute intervals for further analysis when ≤ 5 minutes were missing. The date, day of the week, and time of day were used to calculate physical activity measures specific to days and times that corresponded to the school hours for each school. In order to examine the study hypotheses related to school settings, this data set was further limited to only those intervals occurring during school hours ($n=16,578$).

Data Analysis

In 2006, linear mixed models were fit to the data to examine associations between school environmental variables and objective physical activity levels during the school day. The models were fit using PROC MIXED in SAS, version 9.1 (SAS Institute, Inc., Cary NC, 2005). The outcome variable, TriTrac R3D vector magnitude (a measure of movement) was averaged within each 15-minute interval ($n=16,619$) throughout the school day and (natural) log transformed. The model included fixed effects for time of day (in 15-minute intervals), day of week, gender, and race/ethnicity. Student age in years, days/week of PE, and student BMI were also included as continuous or ordinal covariates. In addition, we included a single random effect for each child in order to account for correlation among activity level observations for that child. Also, we modeled the correlation of 15-minute activity level measurements within the same day and child using a spatial power covariance matrix, with the correlation between activity level measurement at time t_i and t_j represented by $\rho|t_i t_j|$ for some estimated correlation coefficient ρ .

Results

Of the total 248 students, 42% were female, 56% were white, 11% black, 14% Hispanic, and 11% Asian, and 8% other race/ethnicity. The students had a mean age of 13.7 years and an average BMI of 22.0. The majority of students attended PE classes on ≥ 2 days per week (69%), and the distribution of students across schools was not equal (Table 1).

Table 2 details the distribution of school campus areas ranging from 3263 to 129,936 m² f (median=15,989 m²). Campus area/student ranged from 8.8 to 143.7 m². School building area ranged from 5727 to 20,312 m² (median=9470 m²), and building area/student from 12.1 to

24.7 m². Correlation between objectively measured and school-reported school building areas was $r = 0.94$ ($n=9$, $p<0.0001$). Total play area ranged from 352 to 48,532 m² (median=4941 m²) and play area per student from 0.4 to 58.9 m². Play area comprised from 2.7% to 62.3% of total campus area across schools. Student enrollment ranged from 255 to 914.

In separate regression models adjusting for student age, gender, race/ethnicity, BMI, PE days/week, day of the week, and time of day, the variables school campus area per student (Model 2: $\beta=0.2244$, $p<0.0001$), play area per student (Model 3: $\beta=0.347$, $p<0.0001$), and building area per student (Model 4: $\beta=2.1302$, $p<0.02$) were each directly associated with log-TriTrac-R3D vector magnitude (Table 3). Compared with Monday, on average, the students recorded lower average log-vector magnitude levels on the remaining school days. Female students were less active than male students during the school day, although no statistically significant effects of age on activity levels were observed. In each regression model, a positive association was observed between the number of days of PE class and the average vector magnitude, although this association only reached statistical significance in one of the three final models after controlling for campus variables.

Figure 2 plots the exponentiated time of day model estimates from the base regression model (Table 3, Model 1) of vector magnitude along an axis of time. These estimates show that movement was greatest at the beginning and the end of the school day (start and ending times of schools ranged from 7:45 to 2:05 to 8:15 to 2:45). Additionally, peaks in estimated average vector magnitude were observed for 15-minute intervals crossing between class periods and during the lunch period (approximately 11:15 to 1:00).

Conclusion

In this study, larger school campus, building, and play areas per enrolled student were associated with increased physical activity in middle school students. An approximate increase of 20% to 30% in average vector magnitude of physical activity was associated with the difference in total campus, school, and play areas per student seen in this sample of schools, independent of the other variables in the model. These increases translate into approximately 34 kcal/day, walking an extra 96 m/hour over an average school day, or walking 2 extra miles (3.2 km) weekly (see online appendix at www.ajpm-online.net). Given the substantial number of students attending schools, these subtle shifts in physical activity levels associated with the amount of space per student on school campuses, in school buildings, and in areas for play merit further consideration.

Isolating the exact feature(s) of the school campus associated with such shifts in physical activity will require more study. The variables of campus, playground, and building size per enrolled student were positively correlated in this sample of ten schools ($r=0.60$ to 0.89 ; $p<0.07$ to 0.001). These relationships make it difficult to disentangle the independent effects of each of these school characteristics on physical activity levels, and to determine whether the increases in physical activity levels observed in larger spaces were attributable to more instrumental activity (e.g., walking to and from classes or the cafeteria) or structured/unstructured recreational or programmed activities occurring in a larger space (e.g., gym or playground areas). For example, movement tended to peak at the beginning, middle, and end of the school day (Figure 2). The movement mid-day likely includes travel to and from the cafeteria as well as free time spent in play areas or other school spaces. The early and late peaks likely represent movement associated with moving through a school building to homeroom classrooms or to the pickup areas at the end of the day. The location and physical movements of individual students within a school campus were not collected simultaneously in this study. However, the observations and school administrator reports of student movement and school

day structure made during site visits to schools support the interpretation that both the built structure and the organization of time within a space may influence physical activity.

Nationally, communities are re-evaluating school site standards, and in doing so must address a host of complex and interrelated issues. The construction of a new school is influenced by many factors, including existing facilities and potential changes in school utilization.²² While larger schools (and school campuses) may be favored for their benefit for cost sharing in facility and equipment needs, small schools provide intimacy and the ability to promote individualized learning and involvement²³ and easy access to the surrounding neighborhoods.^{24,25} Communities must balance issues such as congestion and air quality and transportation budgets, providing sites to which students can walk, and encouraging community use of schools²⁵—all while recognizing the need to provide a quality educational environment within the context of existing state regulations that can influence how and where schools are built.

Guidelines and regulations regarding school sites vary by state. In this study's sample of Massachusetts schools, only one school was below the recommendation in the school architectural design literature²⁰ for schools with comparable enrollments (i.e., 14.5 m²/student). However, recently amended regulations in Massachusetts (603 Code of Massachusetts Regulations [CMR] 38.00, amended as of 2004) promote construction of smaller school buildings by limiting the Commonwealth's share in construction cost for schools planning more than 135 square feet per pupil (12.5 m²/student) (www.doe.mass.edu/lawsregs/603cmr38.html). This study's findings also suggest that campus size may be a factor promoting increased physical activity in students. Massachusetts is one of 22 states without specific campus-size recommendations (<http://cefpi.org/pdf/smartgrowthpub.pdf>). However, the state promotes placement of new schools in areas in close proximity to natural resources, businesses, and other cultural institutions (e.g., museums, libraries) in order to enhance the education programs (www.doe.mass.edu/lawsregs/603cmr38.html). While this policy could potentially improve a school's accessibility (thereby increasing the potential for active transport to school, parental involvement in student education, and use of facilities by community members), other states, by contrast, have differing requirements. California recommends campuses of 7 to 13 acres (28,328 to 80,937 m²) for schools with enrollments comparable to this study sample. This is considerably larger than the median campus size (15,989 m²) observed in this study. California's guidelines reflect the prominent roles of PE and housing sufficient facilities for community recreation (www.cde.ca.gov/ls/fa/documents/schoolsiteanalysis2000.pdf), as well as recent legislative efforts favoring class size reduction and gender equity; all of these efforts have increased requirements for number and types of play fields, classrooms, and parking for the additional staff.

However, the factors associated with increased physical activity observed in this study were not only designed features of schools. Features of school programming also influence physical activity levels, consistent with other studies in the literature.^{11,16} Increased participation in PE was directly associated with physical activity in all models (but reached statistical significance only in Model 3) (Table 3). Although this study is not well suited to fully explore the effect of changes in frequency of PE participation on physical activity due to the inability to match days of physical activity monitoring with those days that students participated in PE classes, these results support the conclusion that multiple aspects of the school environment can influence physical activity levels. The students in this sample reported higher rates of participation in PE in 1997 than Massachusetts high school students overall (96% vs 73%, respectively). However, rates of PE participation in Massachusetts are declining. By 2003, just 58% of Massachusetts high school students reported that they were enrolled in PE during an average week (<http://apps.nccd.cdc.gov/yrbss>).

Limitations

This study used objective data to calculate both school campus areas and youth physical activity in order to investigate study hypotheses. However, since the strategies used for the initial data collection were not devised to address this study's hypotheses, there are limitations that could be addressed in future studies. Future research could address the potential influence of seasonality and seasonal school programming on student activity levels by collecting data in multiple schools simultaneously, and for other characteristics of students and schools that were not available for this study (e.g., socioeconomic indicators). Furthermore, in this analysis, we averaged activity over 15-minute intervals. Newer analytic methods⁸ could provide better statistical power to analyze the relatively rare outcomes of moderate and vigorous physical activity among youth as well as address issues of missing data. This analysis did not directly address issues of missing data. However, a previous analysis suggests no pattern in missing data with respect to activity intensity,²⁶ and data missing at random in this study's outcome variable will not bias the regression estimates.

While objectively measured campus and school characteristics were verified by school personnel during site visits, some inconsistency between how spaces were defined for study purposes and the use of these spaces during the time of physical activity data collection in 1997 may be present. Additionally, given the time lapse since data were collected, it was not possible to account for practices of schools that may promote or restrict movement (e.g., block scheduling, quality of PE program) and organizational or school characteristics (e.g., provision of equipment, supervision, and quality of play spaces) that have been associated with physical activity levels in previous research.^{11,24}

In assessing the school campus and building characteristics, fairly crude measures were employed, and the measures of physical activity over the day cannot be attributed to certain spaces within a given school building or campus. Frequently, design guidelines break down school building area into separate calculations (e.g., gross area, net area, field house, lab space, classroom centers, administrative areas) (see, for instance, www.edfacilities.org), and studies of play spaces often account for physical site improvements (e.g., courts, fields) and supervision by school staff.^{11,15,18} However, the methods of characterizing schools used in this study are easily replicable using data that are primarily publicly available, and therefore could be considered in future studies of schools and youth physical activity. These methods may also be expanded to the study of surrounding neighborhoods and physical activity levels outside of the school campus environment, thus looking at the broader roles that school and school sites play in influencing physical activity levels among youth.

In this study, larger school campuses, school buildings, and play areas per enrolled student were associated with increased physical activity during the school day in middle school students. Further study may better inform researchers of the potential mechanisms through which these associations operate.

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Appendix

Appendix

The following example describes the procedure that was used to interpret the model coefficient estimates and produce related estimates of activity energy expenditure for practical interpretation.

Example: Campus Size Per Student

The statistical model used in this study estimated an effect size of 0.2244 of the independent campus area per student variable on the outcome variable, average log vector magnitude for a given 15 minute interval. In our sample of schools, the campus area per student ranged from 8.8–143.7 m²/student. For analysis, this independent variable was rescaled (by dividing by 100) providing a range between the smallest and largest campus areas per student of 1.349 (0.088–1.437). Multiplying this range of change in x (1.349) by the model effect size (0.2244) gives an adjusted model estimate of 0.3027, or approximately a 30% increase in average vector magnitude for a given 15 minute interval.

$$\beta \text{ (School campus area per student)} = 0.2244$$

$$\text{So, } X_{10} - X_1 = 1.437 - 0.088 = 1.349$$

Then $1.349 * (B) = .3027$ or approximately 30% increase in vector magnitude

Translation into Energy Expenditure Estimates

Additional statistical model estimates, as well as other estimates using categorical specification of variables produced estimates of an effect size within a range of 20–30% increase in average vector magnitude for a given 15-minute interval. Therefore, using conservative estimates one can calculate the expected extra calories burned per day, and translate this energy expended into a hypothetical distance walked per week for an average student.

A 20% average increase in average vector magnitude would translate into an approximate increase of 45 in the average vector magnitude per minute seen in the sample of observations (i.e., $20\% * 225 \text{ vector magnitude/minute}$). The mean vector magnitude in this study sample was 225.85. There are approximately 360 minutes in the average school day (8:30–2:30, or 6.0 hours). In prior work with the TriTrac-R3D data (Gortmaker, 2002), the author derived an equation to estimate activity calories (ACTCAL) from vector magnitude (i.e., $\text{ACTCAL} = \text{vector mag} * \text{weight (kg)} * 0.000037$). Using this equation and the model estimates and assumptions above, the excess caloric expenditure that is associated with the range in school campus size observed in our sample of schools can be calculated using the following (sex-specific) equations:

For Male Students

$$\text{ACTCAL/minute} = 45 \text{ (the vector magnitude)} * 57.9 \text{ Kg (an average weight for male students in 1997)} * 0.000037 = 0.0931 \text{ kcals/minute}$$

For Female Students

$ACTCAL/minute = 45 \text{ (the vector magnitude)} * 55.9\text{Kg (an average weight for female students in 1997)} * 0.000037 = 0.0964 \text{ kcals/minute}$

Using an average of 0.09475 kcals/minute (an approximation calculated assuming equal weighting for male and female students) multiplied by the number of minutes per school day and the average number of days per week the students are in school (5) suggests a total excess energy expenditure per week of 171 kcals/wk.

$(0.09475 \text{ kcals/min} * 360 \text{ mins/day} = 34.1 \text{ calories per day} * 5 \text{ days/week})$

According to the Compendium of Physical Activities (<http://prevention.sph.sc.edu/tools/compendium.htm> accessed online, July 2005), one MET is defined as 1 kcal/kg/hour and is roughly equivalent to the energy cost of sitting quietly. A MET also is defined as oxygen uptake in ml/kg/min with one MET equal to the oxygen cost of sitting quietly, equivalent to 3.5 ml/kg/min. Several estimates of energy costs associated with the types of activities common on school campuses are as follows:

- walking at 2.5 mph on a firm surface –3.0 METs
- walking to from house to bus etc –2.5 METs
- walking at 3.0 MPH –3.3 METs
- walking 2.0 MPH –2.5 METs

Using these figures and an average weight for a sample student (57 Kg average weight for sample) we calculated 2.4 miles and 2.5 miles to be the distances that could be walked using 171 Kcals using two separate estimates of energy cost (2.5 METs and 3 METs). This estimate was then rounded down to 2.0 miles for report in this paper.

Figure 1.
Examples of school campus site maps.

Figure 2.
Estimated vector magnitudes over the school day.

Table 1
Student and school campus characteristics

Student characteristics	<i>n</i>	%
Gender		
Male	144	58.1
Female	104	41.9
Race/ethnicity		
White	139	56.0
African American	28	11.3
Hispanic	34	13.7
Asian	28	11.3
Other	19	7.7
School		
1	5	2.0
2	15	6.1
3	9	3.6
4	15	6.1
5	4	1.6
6	10	4.0
7	25	10.1
8	34	13.7
9	67	27.0
10	64	25.8
Physical education (days/week)		
0	10	4.0
1	67	27.0
2	150	60.5
≥3	21	8.5
	Mean	SD
Age (years)	13.7	0.7
Body mass index	22.0	4.3

Table 2

School characteristics (n = 10)

Variable	Mean	SD	Median	Minimum	Maximum
Campus area (m ²)	37,494	47,269	15,989	3,263	129,936
Building area (m ²)	10,803	5,370	9,470	5,727	20,312
Play area (m ²)	12,972	16,816	4,941	3,52	48,532
Campus area per student (m ² /student)	55.5	53.5	26.7	8.8	143.7
Building area per student (m ² /student)	18.0	4.0	17.7	12.1	24.7
Play area per student (m ² /student)	19.9	21.7	8.1	0.4	58.9

SD, standard deviation.

Table 3

Parameter estimates and standard errors from models predicting average log vector magnitude of physical activity of middle school students

Variable	Base Model 1 ^a		Model 2 ^a : campus area		Model 3 ^a : playground area		Model 4 ^a : building area	
	Estimate	SE	Estimate	SE	Estimate	SE	Estimate	SE
Intercept	5.4507 ^{***}	0.522	5.2267 ^{***}	0.5105	5.2595 ^{***}	0.524	5.0945 ^{***}	0.5411
BMI	0.003857	0.00696	0.00691	0.00681	0.00615	0.00697	0.00441	0.00692
Age	-0.07534	0.04431	-0.0728	0.04305	-0.0722	0.04396	-0.075	0.04403
Female	-0.2095 ^{**}	0.06407	-0.2367 ^{***}	0.06268	-0.222 ^{***}	0.06377	-0.2144 ^{***}	0.0637
Black	0.04318	0.1027	0.1189	0.1018	0.08648	0.1035	0.07217	0.1028
Hispanic	0.09212	0.09368	0.1248	0.0914	0.1208	0.09368	0.09526	0.09309
Asian	-0.07629	0.09879	-0.0433	0.09633	-0.069	0.09801	-0.0658	0.09825
Other	0.2224	0.1194	0.3004 [*]	0.1178	0.2778 [*]	0.1207	0.2772 [*]	0.121
Tuesday	-0.1594 ^{***}	0.04473	-0.1617 ^{***}	0.04471	-0.1604 ^{***}	0.04472	-0.1605 ^{***}	0.04472
Wednesday	-0.205 ^{***}	0.04609	-0.2055 ^{***}	0.04607	-0.2054 ^{***}	0.04608	-0.2056 ^{***}	0.04608
Thursday	-0.09487 [*]	0.03841	-0.0946 [*]	0.03834	-0.09704 [*]	0.0384	-0.1004 ^{**}	0.03847
Friday	-0.1823 ^{***}	0.04431	-0.1809 ^{***}	0.0442	-0.1852 ^{***}	0.0443	-0.1894 ^{***}	0.0444
PE (days/week)	0.135 ^{**}	0.0457	0.08234	0.04639	0.1257 ^{**}	0.04548	0.0904	0.04934
Campus area per student			0.2244 ^{***}	0.05832				
Playground area per student					0.347 [*]	0.1474		
School building area per student							2.1302 [*]	0.9235

^a Referent categories are male, white, Monday, and time of day, 12–12:15; regression estimates for the remaining 25 indicators for 15-minute time of day intervals are not shown; variables BMI, age, and PE are modeled as continuous or ordinal variables.

* >*p*<0.05,
 ** *p*<0.01,
 *** *p*<0.001.

BMI, body mass index; PE, physical education; SE, standard error.