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# Opportunities for Student Physical Activity in Elementary Schools: A Cross-Sectional Survey of Frequency and Correlates

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The objectives of this study were to describe opportunities for student physical activity (PA) in elementary schools and to identify factors in the school environment associated with higher PA opportunity. Self-report questionnaires were completed by school principals and physical education teachers in 277 schools (88% response) in metropolitan Montreal. Correlates of opportunity were identified using ordinal logistic regression. There was substantial variation in PA opportunities between schools. Higher opportunity was associated with role modeling of PA by school principals, their interest in increasing PA through links to the municipality, adequate financial and human resources, access to school sports facilities, adequate space for storing student sports equipment, and suburban location. There is both the need and the potential for intervention to increase PA opportunities in elementary schools. Addressing barriers related to resources and access to sports facilities may help reduce disparities between schools in opportunities for students to engage in PA.

**Keywords:** *physical activity; environment; schools; children; public health; cross-sectional studies*

Age-related declines in physical activity (PA) that occur throughout adolescence and early adulthood (Caspersen, Pereira, & Curran, 2000; Sallis, Prochaska, & Taylor, 2000) are cause for concern because physical inactivity in youth is associated with increased

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coronary heart disease risk factors including obesity or adiposity (Janz et al., 2002; Johnson-Down, O'Loughlin, Koski, & Gray-Donald, 1997; Moussa, Skaik, Selwanes, Yaghy, & Bin-Othman, 1994; Muecke, Simons-Morton, Huang, & Parcel, 1992; Raitakari et al., 1994), insulin sensitivity (Raitakari et al., 1994; Schmitz et al., 2002; Jenner, Vandongen, & Beilin, 1992), elevated blood pressure (Ramirez-Lopez et al., 2001; Simons-Morton et al., 1997), and poor lipid profile (Raitakari et al., 1994; Stewart et al., 1995). These declines are evident even during elementary school years (Barnett, O'Loughlin, & Paradis, 2002; Bradley, McMurray, Harrell, & Deng, 2000), suggesting that patterns of PA behavior are established prior to the sixth grade (Kelder, Perry, Klepp, & Lytle, 1994; Sullivan, 2002; Telama, Leskinen, & Yang, 1996).

School-based PA accounts for 20% to 40% of children's total activity (Craig, Cameron, Russell, & Beaulieu, 2001; Ross, Dotson, Gilbert, & Klesges, 1985; Stewart et al., 1995). Recent published guidelines call on schools to play a greater role in promoting PA (National Center for Chronic Disease Prevention and Health Promotion, 1997), because out of school, PA among elementary school-age children is decreasing (Health Canada, 1999). Increases in PA in elementary school are associated with increases in out-of-school recreational PA (Kelder et al., 1994; O'Loughlin, Paradis, Kishchuk, Barnett, & Renaud, 1999), and positive experiences during elementary school physical education (PE) class can lead to favorable behaviors and attitudes later in life. These include more moderate alcohol consumption and balanced weight concerns in adolescent girls (Gillander Gadin & Hammarstrom, 2002), nonsmoking in men (Trudeau, Laurencelle, Tremblay, Rajic, & Shephard, 1999), and increased PA levels in adolescents (Gillander Gadin & Hammarstrom, 2002) and adults (Telama, Yang, Laakso, & Viikari, 1997; Trudeau et al., 1999). In addition, schools are an ideal setting in which to encourage daily PA, because virtually all children attend, and because the infrastructure and equipment necessary for students to be physically active is usually available (Wechsler & Devereaux, 2001). However, little is known about opportunities available for students to be physically active at school. The first objective of this investigation was therefore to describe the kinds of opportunities available for elementary school students to be active at school.

Investigations of the determinants of PA to date have been based largely on intrapersonal models of health behavior (Sallis & Owen, 1997), such as the Health Belief Model, the Theory of Reasoned Action, and the Transtheoretical Model (Rimer, 1997), or in interpersonal frameworks such as Social Cognitive Theory (Baranowski, Perry, & Parcel, 1997). Although studies developed within the context of these frameworks explain 40% to 60% of the variance in behavioral intentions and 20% to 40% of the variance in health behaviors (Godin & Kok, 1996), several researchers have suggested broadening investigations to include factors beyond the individual (Buchner & Miles, 2002; Orleans, 2000; Powell, 2002; Richter, Harris, & Paine-Andrews, 2000; Sallis, Kraft, & Linton, 2002; Smedley & Syme, 2001). Emerging theories of PA behavior take influences from settings or neighborhoods into account, in addition to those related to the individual and his or her immediate environment (King, Stokols, Talen, Brassington, & Killingsworth, 2002). In particular, the "social ecological" model posits that individual

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behavior patterns are influenced not only by ability and experiences but by the social and physical environment, which are often shaped by social policies (Sallis & Owen, 1997). Similarly, the “behavior settings” model posits that within defined physical locations, environmental factors can either facilitate or constrain specific behaviors (Owen, Leslie, Salmon, & Fotheringham, 2000). Applied to the school setting, behavior setting theory suggests that in schools where greater environmental support for PA exists, students will be more physically active.

In adults, numerous cross-sectional studies support the hypothesis that environmental variables are associated with PA (Booth, Okely, Chey, & Bauman, 2001; Brownson, Baker, Housemann, Brennan, & Bacak, 2001; Craig, Brownson, Cragg, & Dunn, 2002; Giles-Corti & Donovan, 2002; Humpel, Owen, & Leslie, 2002; Linenger, Chesson, & Nice, 1991; Merom, Bauman, Vita, & Close, 2003; Sallis, Bauman, & Pratt, 1998; Sallis et al., 2002). Activity levels in preschoolers are associated with time spent outdoors (Baranowski, Thompson, DuRant, Baranowski, & Puhl, 1993; Klesges, Eck, Hanson, Haddock, & Klesges, 1990; Sallis et al., 1993), and with number of play spaces close to home (Sallis et al., 1993). School-based opportunities for PA have been described to some extent in middle (Powers, Conway, McKenzie, Sallis, & Marshall, 2002), secondary (Allison & Adlaf, 2000), and elementary schools (Allison & Adlaf, 2000), and positive associations have been reported between PA levels of Grade 6 students and variables describing both the school physical (Smith, Bibeau, Altschuld, & Heit, 1988) and social (Gillander Gadin & Hammarstrom, 2002) environment. However, factors that influence the availability of PA opportunities for students in elementary schools have not been examined.

The second objective of this study was to identify factors associated with schools offering more PA opportunities. We hypothesized that schools with more support for PA (i.e., including greater access to, and availability of, sports facilities and equipment, as well as support from the school staff, schoolboard, parents, and community) would provide more opportunities for students to engage in PA. To identify school characteristics that favor PA opportunities, we examined associations between a range of environmental factors and PA opportunities available to students, and we identified independent correlates of higher opportunity.

## METHOD

Data were collected in a cross-sectional mail survey in May and June 2000. The target population comprised school principals and PE teachers in all 323 public elementary schools in Montreal. Seven schools that served special needs children were excluded. Two self-administered questionnaires (one for principals and one for PE teachers) were pretested in March 2000 in seven schools to verify item comprehension, face validity, clarity, acceptability, ease of completion, and feasibility. The final versions of the questionnaires comprised 56 and 46 questions to PE teachers and principals, respectively, and took approximately 25 minutes to complete. School principals were sent an explanatory letter, two questionnaires in the language of instruction used in the school (French or English), and a stamped addressed return envelope. The principal was asked to complete one questionnaire and to give the other questionnaire to the PE teacher. Three weeks later, nonrespondents were contacted by telephone to encourage completion of the questionnaires.

### Study Variables

PA opportunities were defined as occasions before, during, and after school, when students have the opportunity to participate in organized sports or free play activity at school. Indicators of organized sports opportunities included frequency and duration of the PE class, percentage of time devoted to motor activity during the PE class, number of hours per week and student participation in extracurricular PA, number of hours of PA offered per week in the day care program, and number of special PA events per year such as the Terry Fox Run and Jump Rope for Heart. Indicators of extracurricular PA included sports clubs, intramural (i.e., competitive and noncompetitive sports activities involving students within their school), and interscholastic (i.e., team or individual competition between schools) PA offered outside the formal PE class (National Center for Chronic Disease Prevention and Health Promotion, 1997). Indicators of free play opportunities included duration of recess and the lunch period.

#### *Dependent Variable*

To categorize schools as having high, medium, or low PA opportunity, a score was created in three steps. First, variables were selected to be included in the score based on the following criteria: The variable represented an opportunity that (a) is largely dependent on school-specific initiatives (in contrast to opportunities dictated by schoolboard policy such as duration of recess or frequency of PE class), (b) is accessible to all students, and (c) varies substantially between schools. Variables retained to be included in the score included number of special PA events, hours of extracurricular PA offered per week, and percentage of time devoted to motor activity during PE class. The number-of-special-events variable was normally distributed, but the hours-of-extracurricular-PA variable was not (23% of schools did not offer any extracurricular PA). The time-in-motor-activity variable, which had ordered, categorical responses, was also not normally distributed (30% of PE teachers selected the highest response category). Second, responses to each variable were categorized by quartile, which were then summed across the three variables, yielding scores ranging from 3 to 12. Higher scores indicated greater opportunity for school-based PA. For 39 schools in which data were missing for one of the three variables, the two-variable score was adjusted to obtain scores with equivalent domains by multiplying by 1.5. Finally, scores were categorized by tertile to designate low-, medium-, and high-opportunity schools.

#### *Independent Variables*

Potential correlates of PA opportunity were selected on the basis of the Centers for Disease Control and Prevention's (National Center for Chronic Disease Prevention and Health Promotion, 1997) and Wechsler and Devereaux's (2001) descriptions of environmental factors that may affect PA at school. Consistent with Moos's (1979) Ecological Model of Health, these were categorized into social-climate indicators and indicators pertaining to the physical, organizational, or sociocultural environments. Table 1 summarizes each indicator.

As described in Table 1, potential correlates were either single-item or composite indicators. Several composite indicators were created on the basis of respondents' perceptions of the importance of 23 potential barriers to increasing PA at school. Responses to

Table 1. Potential Environmental Correlates of Physical Activity (PA) Opportunity in Elementary Schools<sup>a</sup>

School policies	Social Climate	Physical Environment	Organizational Environment	Socio-cultural Environment
1. PA limited by cost and resources (5 items) <sup>b</sup> ( $\alpha = .7$ )	Support in the municipality 11. Perceived interest in the municipality in student PA	1. PA limited by lack of sports equipment at school (3 items) <sup>b</sup> ( $\alpha = .8$ )	1. Duration (hours) of school day	1. Socioeconomic status
2. PA limited by school council/board/government policy (3 items) <sup>b</sup> ( $\alpha = .6$ )	12. Resources shared between the school and municipality (3 items) <sup>c</sup>	2. PA limited by lack of sports facilities at school (4 items) <sup>b</sup> ( $\alpha = .7$ )	2. Total number of students in the school	2. Location (urban/suburban)
3. Time spent on health issues in PE class	School staff support 13. Principal's level of interest in increasing student PA	3. Availability of space for storing specific student equipment (2 items) <sup>c</sup>	3. Proportion of students bussed to school	3. Language of instruction
4. Frequency of student exemptions from physical education (PE) class	14. Principal's level of interest in links with municipality		4. Proportion of students that remain at school during the lunch period	
5. Participation in PA during day care	15. PE teacher involvement in school PA		5. Proportion of students registered in the school day care	
6. PA limited by academic load	Role modeling of PA 16. Principal activity level		6. PA limited by transport and scheduling (3 items) <sup>b</sup> ( $\alpha = .7$ )	
7. Parents' level of interest in increasing PA at school	17. PE teacher activity level			
8. School council's level of interest in increasing PA at school				
9. Parent involvement in school activities				
10. PA limited by lack of family interest in school activities (4 items) <sup>b</sup> ( $\alpha = .8$ )				

a. Potential correlates are single-item unless otherwise indicated.

b. Identified in principal components analysis;  $\alpha$  = Cronbach's alpha.

c. Cumulative score.

these 23 items were coded 1 (*not at all*), 2 (*a bit*) or 3 (*quite or very important*). Parsimonious clusters of interrelated items were identified using principal component analysis with orthogonal varimax rotation. The number of factors selected was based on the scree test and a minimum eigenvalue of 1.0. A factor loading of at least .40 was selected as the criterion for determining which items contributed to a given factor. Factor-based scores were created for each indicator, based on the average of the responses of the factor's corresponding items. Scores were prorated for missing responses and dichotomized for analyses purposes (2.5 or more vs. less than 2.5). Questionnaire items can be obtained by contacting the corresponding author.

*School Social Climate.* We investigated 17 items pertaining to the social climate in the school, categorized into five groupings including school policies related to PA, family support, support in the municipality, school staff support, and PA role modeling by school principals (Wechsler & Devereaux, 2001) (Table 1).

School policies related to PA were measured in six indicators, including a five-item indicator of cost and human resources barriers, a three-item indicator of policies and priorities barriers, a measure of time spent on health-related theory during PE class, frequency of student exemptions from PE class, rules regarding participation in PA during day care, and the importance of academic load as a barrier to increasing PA at school. Family support was measured in four items including perceived level of interest of parents for increasing PA at school, perceived level of interest of school council (which is composed mostly of parents) for increasing PA at school, frequency of parental involvement in school activities, and a four-item indicator of family barriers to school involvement. Support in the municipality for PA was measured in two indicators: (a) perceived level of interest in the municipality for increasing PA at school and (b) agreements with the municipality concerning sharing of sports facilities and recreational staff.

School staff support was measured in three indicators: level of interest of principal in increasing PA at school, level of interest of principal in increasing links with the municipality to increase PA at school, and frequency of PE teacher organizing PA at school (outside of PE). In addition, level of PA of the school principal and the PE teacher were measured.

*Other Environmental Correlates.* Potential correlates of opportunity related to the physical environment included a three-item barriers indicator describing the availability and quality of school sports equipment; a four-item indicator of the availability of school sports facilities; and a score based on the amount of space schools provided for students' sports equipment including in-line skates, bicycles, and helmets.

School-related organizational factors included duration of school day, number of students in the school, proportion of students bussed to school, proportion of students eating lunch at school, and proportion of students registered in the school day care. In addition, a three-item indicator of organizational barriers was identified in principal component analyses.

To describe the school sociocultural environment, each school was assigned a deprivation score, based on a composite index of socioeconomic variables related to students (Montreal Island School Council, 2000). Higher deprivation scores indicated a more disadvantaged status. Schools were coded as being located within urban or suburban areas and categorized according to language of instruction (English or French).

*Respondent Characteristics.* Respondents reported their age, sex, and university degree(s) obtained. Three indicators were created to measure principals' and PE teachers' beliefs about the benefits of PA to students (Cronbach's  $\alpha = .86$ ), the benefits of PA in general ( $\alpha = .90$ ), and the importance of selected lifestyle factors to maintain good health ( $\alpha = .80$ ).

### Data Analysis

With the exception of questions pertaining directly to the PE class and to respondent characteristics, data were drawn from the school principal questionnaire. As the senior school administrator, the principal is responsible for, and likely more knowledgeable about, all aspects of the curriculum and school schedule and is usually in charge of liaisons with parents, schoolboards, and the community (Smith et al., 1988). The PE teacher response was used when the principal response was missing (except for respondent characteristics and PA role modelling). In a recent study based on reports by principals, vice principals, or PE teachers, no significant differences were observed between respondents for eight of nine indicators describing school-based PA (Allison & Adlaf, 2000).

Questions on school characteristics included in both the school principal and the PE teacher questionnaires were used to study interrater reliability. Intraclass correlation coefficients (ICCs) between school principal and PE teacher responses ranged from .93 to .98 for duration of PE class in Grades 1 to 6, ICCs for hours of extracurricular PA per week ranged from .44 to .53, ICCs for number of students participating in extracurricular PA ranged from .66 to .77, and the ICC for number of special PA events per year was .61.

To identify environmental correlates of PA opportunity, unadjusted odds ratios (ORs) and 95% confidence intervals (CIs) were computed for each potential correlate. Variables significant at  $p < .10$  were then entered into an ordinal logistic regression analysis. Ordinal logistic regression models are an extension to the binary regression models, in that several categories of mutually exclusive outcomes are possible. Ordinal regression results in a more sensitive and efficient analysis than would be obtained by (arbitrarily) dichotomizing the opportunity score (Scott, Goldberg, & Mayo, 1997). This method takes advantage of the ordered nature of the outcome variable, without imposing a quantitative structure to the outcome categories. For this analysis, outcome categories included low, medium, and high levels of PA opportunity in schools. All variables not retained were subsequently entered one by one into the model to test for confounding. The assumption of proportionality of odds was tested and not rejected (score  $\chi^2 = 1.61$  with 7 degrees of freedom,  $p = .98$ ), indicating that the proportional odds model fit the data adequately.

In secondary analyses, we investigated the possibility that opportunity might vary according to both the principal's and the PE teacher's age, sex, university degree, and beliefs about the importance of PA. Personal characteristics associated with opportunity may result in reporting bias; variables significant in univariate analyses were added to the final multivariate model to examine their effect on the environmental correlates. Because nonresponses were not replaced for personal characteristics, the sample size for this analysis was reduced.

## RESULTS

A total of 277 of 316 eligible schools participated (87.8%); there was no response from 22 schools to repeated mail or telephone contacts, and 17 schools refused (3 schools refused because there was no PE teacher or no PE class). In 229 schools, both the school principal and PE teacher completed a questionnaire; only the principal or PE teacher responded in 32 and 48 schools, respectively.

The mean number of students per school was 396 ( $SD = 146.5$ ), and the mean duration of the school day was 6 hours 32 minutes ( $SD = 38$  minutes). Two thirds of students (67.2%) ate lunch at school, 35.6% were bussed to and from school, and 43.7% were enrolled in the school day care. There was substantial variation in the proportion of students bussed to school and eating lunch at school, which likely reflects differences between schools in the geographic area they serve.

The mean age of school principals and PE teachers was 50.1 ( $SD = 6.1$ ) and 42.1 ( $SD = 9.0$ ) years, respectively. Two thirds of PE teachers and 45% of principals were male. Although all respondents held a university degree, 13% of principals and 96% of PE teachers held a degree specialized in PE.

### Description of PA Opportunities

There was marked variation between schools in PA opportunities (Table 2). Time in PE class ranged from 30 to 120 minutes per week; the proportion of time spent in motor activity during the class ranged from 20% to 90%. PE was available more than once a week in most schools. However, it was available less frequently in the higher grades. Among schools that reported having any extracurricular PA, 21% made them available during lunchtime only, 51% after school only, and 28% on both occasions. Approximately half of schools reported one recess period per day; half reported two recess periods per day. The median length of the lunch period was 105 minutes (range 56-140 minutes).

### Profile of High-Opportunity Schools

As described in the Method section, schools were categorized by PA opportunities available, defined by special PA events, hours per week of extracurricular PA, and time devoted to motor activity during PE. The medians for high-, medium-, and low-opportunity schools, respectively, were 3.7, 2.8, and 2.0 special events per year; 1.5, 1.0, and 0.0 hours per week of extracurricular PA; and 87.5%, 67.5%, and 62.5% of time devoted to motor activity in PE. In addition, in high-opportunity schools, 33% of children participated in at least one extracurricular PA each week, compared with 9% and 18% in low- and medium-opportunity schools, respectively; among schools with day care services, high-opportunity schools offered 5.3 hours per week of PA in the context of day care, compared with 2.3 hours and 3.4 hours in low- and medium-opportunity schools, respectively.

### Opportunity for Organized PA

Summing across PE, extracurricular PA, and PA during day care, the median time for organized PA opportunity was 60 minutes daily (range 17-192 minutes). Taking reported student participation in extracurricular PA and day care enrollment into account (because

Table 2. School-Based Opportunities for Student Physical Activity (PA) in Elementary Schools—Montreal, Canada, 2000

PA Opportunity	<i>Mdn</i>	<i>M</i>	<i>SD</i>	Range
Duration of physical education class (minutes per week)	60.0	67.3	16.1	30-120
Time in motor activity (% of physical education class)	67.5	71.1	14.5	20-87.5
Extracurricular PA <sup>a</sup> (hours per week)	1.0	1.45	1.22	0.17-10.0
Participation in extracurricular PA <sup>a</sup> (%)	22.9	29.6	22.7	3.6-100
No. special PA events per year <sup>b</sup>	2.8	2.8	1.3	0.17-7.0
PA during day care <sup>c</sup> (hours per week)	3.0	3.97	2.83	0.5-15
Duration of recess (minutes per day)	20	22.4	8.0	10-50
Lunch break (minutes per day)	80	77.5	13.9	26-125

NOTE: Mean, standard deviation, and median are computed for schools where PA opportunity is offered. Where grade-specific data were provided, estimates were averaged across all grades.

Questionnaire items:

*PE class:* For each grade, indicate the number of physical education periods per week and the duration of each period.

*Motor activity:* Which percentage best reflects the amount of time students engage in motor activity during their physical education period in Grades 1 and 2, Grades 3 and 4, Grades 5 and 6? (<25%, 26%-45%, 46%-60%, 61%-75%, >75%).

*Extracurricular PA:* Approximately how many hours of extracurricular physical activities are organized each week for students during lunch hour and after school for students in . . . Grades 1 and 2, Grades 3 and 4, Grades 5 and 6? Approximately how many students participate in extracurricular physical activities each week for students in . . . Grades 1 and 2, Grades 3 and 4, Grades 5 and 6?

*Special events:* (For each grade) in a usual school year, does your school organize any of the following physical activities for students: overnight winter field trips, overnight spring/fall field trips, track-and-field days, outings to promote physical activity, sports tournaments, physical activities or events to reward students, fund-raising activities (Jump-Rope for Heart, Terry Fox Run, etc.), others?

*Recess:* How long is recess in the morning and afternoon for students in . . . Grades 1 and 2, Grades 3 and 4, Grades 5 and 6?

*Lunch:* What time does your school break for lunch? From \_\_\_\_ to \_\_\_\_ .

*Day care:* Approximately how many hours per week does the day care allocate to physical activities for students in . . . Grades 1 and 2, Grades 3 and 4, Grades 5 and 6?

a. Offered in 78% of schools.

b. Offered in 98% of schools.

c. Offered in 95% of schools. Percentage in day care: *Mdn* = 39.7%, *M* (*SD*) = 43.7 (22.4), range = 9%-100%.

not all students participate in extracurricular PA or are enrolled in day care), the median time for organized PA opportunity was 31 minutes daily (range 13-145 minutes).

### Correlates of Opportunity

Among the six school policy indicators in the social-climate category, only the indicator of cost and human resources barriers was associated with opportunity univariately (Table 3). High level of interest in increasing PA at school among parents and in the school council was associated with opportunity. Neither municipal support nor indicators of sharing of resources barriers were associated with opportunity, but high interest among

Table 3. Unadjusted Odds Ratios (OR) and 95% Confidence Intervals (CI) for Potential Correlates of Opportunity—Montreal, Canada, 2000

Potential Correlate	OR	95% CI
Social climate		
School policies		
Fewer cost and human resources barriers <sup>a</sup>	1.73	1.06-2.82
Mandatory physical activity (PA) in day care	1.58	0.90-2.77
More theory during physical education (PE) class <sup>b</sup>	1.39	0.83-2.35
Students rarely exempted from PE class	1.23	0.71-2.11
Fewer policies and priorities barriers <sup>a</sup>	1.02	0.63-1.65
Lighter academic load	0.90	0.69-1.18
Family support		
High interest by parents in increasing PA	2.26	1.35-3.77
High interest by school council in increasing PA	2.04	1.17-3.58
Frequent parent involvement in school activities	1.67	0.99-2.84
Fewer lack of family interest barriers <sup>a</sup>	1.39	0.74-2.62
Support in the municipality		
Local municipality interested in increasing PA	1.51	0.89-2.58
More sharing of resources <sup>c</sup>	0.89	0.73-1.07
School staff support		
High interest by principal in links to municipality	1.69	1.05-2.71
PE teacher organizes PA outside PE class	1.56	0.94-2.57
High interest by principal in increasing PA at school	1.02	0.66-1.57
PA role modeling by school staff		
Principal active at least once/week	2.46	1.47-4.12
PE teacher active at least once/week	1.17	0.51-2.71
Physical environment		
Provision of more storage amenities <sup>c</sup>	2.00	1.34-2.99
Fewer facilities barriers <sup>a</sup>	2.02	1.21-3.38
Fewer school equipment barriers <sup>a</sup>	2.12	1.00-4.50
Organizational characteristics		
More students <sup>d</sup>	1.09	0.92-1.29
More students bussed <sup>d</sup>	1.09	0.91-1.30
More students eating lunch at school <sup>d</sup>	1.00	0.84-1.18
Longer lunch period <sup>d</sup>	0.83	0.70-0.98
More students enrolled in day care <sup>d</sup>	0.82	0.69-0.98
Longer school day <sup>d</sup>	0.77	0.65-0.91
Fewer organizational barriers <sup>a</sup>	0.67	0.39-1.13
Sociocultural characteristics		
English school board (reference: French)	2.06	1.26-3.37
Suburban (reference: urban)	1.74	1.12-2.70
Lower socioeconomic status <sup>d</sup>	1.15	0.98-1.34

NOTE: OR = odds ratio; CI = confidence interval.

a. Low (more favorable) versus high barrier score.

b. 15 minutes/month or more (reference: less than 15 minutes).

c. Score = 0, 1, 2. Higher scores indicate more amenities/resources.

d. Quintiles.

Table 4. Adjusted Odds Ratios (OR) and 95% Confidence Intervals (CI) for Independent Correlates of Physical Activity (PA) Opportunity in Elementary Schools—Montreal, Canada, 2000 ( $N = 277$  schools)

Correlate	OR	95% CI
Social climate		
Principal PA level <sup>a</sup>		
Less than once/week	(Reference)	
At least once/week	2.40	1.23-3.46
Principal's level of interest in links to municipality		
Low	(Reference)	
High	1.95	1.18-3.21
Barriers related to cost and human resources		
Many	(Reference)	
Few	1.80	1.08-3.00
Physical environment		
More space for storing students' sports equipment <sup>b</sup>	2.06	1.23-3.46
Barriers related to availability of facilities		
Many	(Reference)	
Few	1.96	1.52-3.35
Sociocultural indicators		
School location		
Urban	(Reference)	
Suburban	1.60	1.01-2.53

NOTE: OR = odds ratio; CI = confidence interval.

a. OR for PA level missing = 2.75 (95% CI = 1.41-5.37)

b. Score = 0, 1, 2. Higher scores indicate more amenities for storing equipment.

school principals in establishing links with the municipality to increase PA at school was a significant correlate. Role modeling of PA was a significant correlate of opportunity for school principals only.

All three physical environment indicators were associated with PA opportunity, including provision of space for storing student equipment, availability of sports facilities at school, and availability of school sports equipment. Among organizational characteristics, duration of the school day, duration of the lunch period, and proportion of students registered in day care were negatively associated with PA opportunity. Both school board language and geographic location were significantly correlated with opportunity univariately.

In multivariate analyses, higher opportunity for students to engage in PA was significantly correlated with the school principal's level of PA (i.e., role modeling) and interest in establishing links with the community (Table 4). Higher opportunity was also associated with provision of space for storing student equipment and with the absence of barriers related either to human resources or to the availability of school sports facilities. Suburban location was significantly associated with opportunity, and both language and the deprivation score approached statistical significance. Once other factors were taken into account, no organizational characteristics were retained as independent correlates of PA opportunity.

## Secondary Analyses

### *Influence of Personal Characteristics*

In univariate analyses, female sex and stronger beliefs in the importance of a healthy lifestyle were significantly associated with higher opportunity in both principals and PE teachers. Younger age and stronger belief in benefits of PA were associated with higher opportunity in school principals only; university degree in PE was associated in PE teachers only. Beliefs about benefits of PA to students were unrelated to PA opportunity. In multivariate analyses, only principal's sex was significant; the odds ratios for the environmental correlates were unchanged (data not shown).

### *Estimated Active Time*

We estimated active time, that is, the amount of time that children were actively engaged in PA at school, by using estimates from the published literature. Although there are opportunities for PA in schools, children may not be actively expending energy during all the time available. Several reports quantify active time during PE class and recess. One such study suggests that children are active during 30% to 40% of PE class time (McKenzie et al., 1995), although estimates below 10% have been reported (Barnett, van Beurden, Zask, Brooks, & Dietrich, 2002; Simons-Morton, Taylor, Snider, & Huang, 1993). Children are active during approximately half of recess time (Kraft, 1989), although again, much lower estimates have been reported both among kindergarten (McKenzie et al., 1997) and middle school students (McKenzie, Marshall, Sallis, & Conway, 2000). To date, no estimates of activity levels during organized school sports outside PE among elementary students have been reported. However, middle school students observed during organized (non-PE) PA engaged in moderate to vigorous PA for approximately 60% of the scheduled activity time (McKenzie et al., 2000). Combining the most favorable estimates of active time with our findings, the median time that elementary school students actively *engage* in school-based PA through extracurricular PA, PE, PA during daycare, and recess is 29 minutes per day (range 14-100 minutes).

## DISCUSSION

In light of decreasing PA levels in youth (Health Canada, 1999) and rising pediatric obesity (Troiano & Flegal, 1998; Troiano, Flegal, Kuczmarski, Campbell, & Johnson, 1995), schools share in the responsibility to provide children with a variety of opportunities to engage in PA during the school day. Most research on children's PA behavior to date has focused on individual determinants of activity levels, and little is known about environmental determinants. Ours is the first study to document PA opportunities available to children in elementary schools and to identify factors associated with increased availability.

### **Opportunities and Children's Levels of PA**

Compared with earlier estimates in the United States (Powers et al., 2002; Simons-Morton et al., 1993; Myers, Strikmiller, Webber, & Berenson, 1996; Ross & Pate, 1987) and Canada (O'Loughlin et al., 1999), school-based opportunities were more limited in

our study. We observed fewer minutes weekly (Allison & Adlaf, 2000) and less frequent PE (Allison & Adlaf, 2000; Simons-Morton et al., 1993), shorter and less frequent recess (Kraft, 1989; Myers et al., 1996), and fewer hours (Allison & Adlaf, 2000; Powers et al., 2002) and lower participation in extracurricular PA (O'Loughlin et al., 1999). This finding is of considerable concern, given recent evidence that reduced PA in school settings is not offset by children participating to a greater extent in PA in settings outside school (Dale, Corbin, & Dale, 2000; Myers et al., 1996). We estimated, on the basis of reports in the literature, that the median time that children could be actively engaged in PA at school was 29 minutes per day. If schools do not increase or optimize opportunities for PA at school, most children will need to engage in substantial amounts of PA outside school to meet current recommendations for youth advocating 60 minutes of activity daily (Health Canada, 2002).

### Correlates of Opportunity

We studied potential correlates of increased school opportunity to identify possible directions for interventions to increase school-based PA. In fact, very little is known about how the physical or social environment in elementary schools affects student PA. In middle schools, access to activity areas, availability of sports equipment, and provision of supervision have all been associated with student participation in extracurricular PA (McKenzie et al., 2000). Organizational characteristics have also been reported to affect access to specific PA opportunities at school (Chambers, 1991). For example, increased school size (i.e., enrollment) (Allison & Adlaf, 2000) is associated with the number of intramural sports offered. Similarly, number of students bussed to school is positively associated with student participation in organized sports (McKenzie et al., 2000). One study, however, reported no association between extracurricular programs offered and school size, duration of lunch break, or number of students bussed to school (Powers et al., 2002). In our study, longer lunch periods, longer school days, and higher day care enrollment were associated univariately with fewer opportunities. However, none of these organizational factors were significant multivariately, after controlling for physical and social environment variables. This finding is encouraging in that it supports the feasibility of offering high levels of PA opportunity, regardless of the school's organizational structure.

The presence of day care services can both facilitate and restrict PA opportunity. On one hand, school sports facilities used for day care services were the most important barrier to offering more extracurricular PA in our study. On the other hand, some schools successfully incorporated many hours weekly of opportunity for PA in the context of the day care program. Strategies for simultaneously meeting the PA needs of children and providing the day care services required by families (such as combining extracurricular PA programming with day care activities) are clearly feasible; these need to be better delineated in order to help all schools creatively and successfully offer both high PA opportunity and day care services.

Level of PA opportunity in our study was related to the school principal's level of PA, but not that of the PE teacher. Although school staff can influence the school environment by role modeling health behaviors (Smith et al., 1988), opportunities for PA may relate more to priority setting and decision making by school principals. Future studies should examine the role of school principals in implementing policies pertaining to PE and PA and how personal preferences and lifestyle influence this process.

In the next few paragraphs, the implications of our findings for children, schools, policy makers, and public health researchers are addressed.

### **Public Health Implications**

While interventions to increase PA opportunity for students will need to take each school's organizational characteristics into account, our results suggest that high levels of opportunity for student PA can be achieved by schools with a variety of organizational profiles. However, because there are no guidelines or published standards on PA opportunities that schools should provide, we ranked each school's performance in providing PA opportunities relative to the performance of all other schools in the sample. Simons-Morton, Taylor, Snider, Huang, & Fulton (1994) used a similar approach to identify characteristics of "best schools" with respect to PE programs. In the absence of an external standard, levels of opportunity for PA attained by high-opportunity schools represent feasible targets that most schools should be able to attain. Schools could create a checklist of the PA opportunities they currently provide, assess their performance based on the standards we report herein, and use disparities noted to argue for increased resources from their school boards. In addition, policy makers could consider implementing minimum standards for PA opportunity in elementary schools to ensure that the distribution of resources between schools is both adequate and equitable.

Future research should focus on further developing and validating measures of the social, physical, and organizational school PA environment. Although self-report measures are useful, observational tools may prove even more valuable in characterizing school environments and providing standardized information for sound decision making. Emerging principles of ecometrics, that is, the measurement of ecological settings, may provide an innovative approach for the accomplishment of this task (Diez-Roux, 2000; Raudenbush & Sampson, 1999). Finally, public health researchers should conduct multi-level analyses comprising both school-level and student-level determinants to assess the relative contributions of each of these levels of influence to overall PA behavior.

### **Limitations**

Although the cross-sectional design limits causal interpretation, this study provides valuable insight into reasons for variation between schools in PA opportunity. Collection of longitudinal data on school environments will improve understanding of the directionality of these associations, on how environments change across time, and how these relate to PA opportunity and behavior.

Because this is a developing area of investigation, we created new indicators for both school opportunity and potential correlates. Nevertheless, although replication and extension are warranted, several factors suggest that our findings are robust and meaningful. First, there was substantial and significant variation between schools for all indicators of opportunity, but virtually no variation within school boards in opportunities dictated by school board policy (i.e., number and length of recess periods, minutes of PE weekly); second, with the exception of the respondents' own level of PA, the correlates of opportunity were not related to the type of respondent (i.e., school principal or PE teacher). Third, in a confirmatory analysis, correlates of high-opportunity schools using low- or medium-opportunity schools as the reference were identical to the correlates of medium- or high-opportunity schools using low-opportunity schools as the reference, but increased in

strength. Finally, factor-based correlates comprised three or more conceptually similar items identified in principal components analyses.

## CONCLUSION

We observed marked variation between schools in opportunities available to children to engage in PA, which suggests both the need and the potential for intervention to increase opportunities in elementary schools. These findings can help public health practitioners assess PA opportunities in schools and develop interventions to increase PA opportunities at school, notably by involving the school principal, identifying low-cost resources, and combining services such as day care and extracurricular activities, that compete for limited space. Helping schools to increase PA opportunities will result in a more active youth population and should be a public health priority.

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