Is the environment near school associated with active commuting to school among preschoolers?

O ambiente no entorno da escola está associado ao deslocamento ativo para escola em pré-escolares?

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Abstract – Available studies show that environmental factors may influence how parents choose to commute their children from home to school. Thus, the aim of this study was to analyze the association between the characteristics of the physical and social environment near school and active commuting to school among preschool children. A school-based cross-sectional study with a sample of children aged 3 to 5 years (n=914) was undertaken. Participants were selected by a single-stage cluster sampling process. To obtain data on commuting to school and demographic and socioeconomic variables, a previously validated questionnaire was used while an audit tool was used to assess the environment near school. Binary logistic regression was used to analyze the association and results were presented as Odds Ratio values. Results showed that 28.3% (95%CI 25.5-31.3) of the children were active commuters from home to school. A positive association was found between public transportation (p=0.002) and social environment (p=0.004) domains and active commuting. However, this association was found only among children from families that did not have a car. The likelihood of a child being an active commuter was higher among those who are enrolled in schools with better environmental surroundings (OR=1.88; 95%CI 1.31-2.70). It was concluded that there was a positive association between some of the environmental factors near school and active commuting to school among children from families that did not have a car.

Key words: Bicycling; Environment; Motor activity; Preschool; Walking.

Resumo – *Estudos indicam que as características do ambiente podem afetar a escolha dos pais em relação ao modo como a criança se desloca para a escola. Portanto, o objetivo deste estudo foi analisar a associação entre as características do ambiente físico e social no entorno das escolas de educação infantil e o deslocamento fisicamente ativo no trajeto de casa para escola em crianças pré-escolares. Foi realizado um estudo transversal aninhado a uma coorte de base escolar com crianças de 3 a 5 anos (n=914), selecionadas mediante amostragem por conglomerados em estágio único. Para obter dados demográficos, socioeconômicos e sobre o deslocamento foi aplicado um questionário respondido pelos pais e para avaliação do ambiente foi empregado o Inventário para Avaliação do Ambiente Comunitário. Análise de associação foi efetuada por meio de regressão logística binária e os resultados apresentados na forma de valores de odds ratio (OR). Os resultados indicaram que a proporção de crianças que realizavam deslocamento fisicamente ativo no trajeto para escola foi de 28,3% (IC95% 25,5-31,3). Verificou-se associação positiva dos domínios do transporte público (p=0,002) e ambiente social (p=0,004) com o deslocamento fisicamente ativo, porém, somente entre crianças de famílias que não possuem carro. A chance de uma criança ser fisicamente ativa no deslocamento para escola aumentava proporcionalmente à elevação no escore global da qualidade do ambiente no entorno da escola (OR=1,88; IC95% 1,31-2,70). Concluiu-se que quando as características ambientais no entorno da escola eram melhores havia maior chance das crianças de famílias que não possuem carro se deslocarem de forma ativa para a escola.

Palavras-chave: Ambiente; Atividade motora; Caminhada; Ciclismo; Pré-escolar.*

INTRODUCTION

Physical activity at preschool age is important due to its effects on weight control[1,2], on bone health[3], on the development of motor skills[4], and on aspects related to mental health and social adjustment[5]. Despite the potential benefits associated with this health behavior, studies show a high prevalence of low levels of physical activity in this population and draw attention to the need to develop interventions[6,7].

Commuting actively and reducing transportation by car and strollers are some of the recommendations for physical activity for preschool children established by the American Academy of Pediatrics[8]. Besides being a strategy to increase physical activity levels among children[9], these recommendations are important because there is evidence that physically active commuting in childhood influences overall physical activity levels in adolescence[10]. Regarding this physical activity domain, studies have shown a sharp decrease in the prevalence of active commuting to school over the last decades[11]. In Australia, the number of children aged 5 to 9 years who walked to school dropped from 57% in 1971 to 25% in 2003[12]. In the United States, there was also a reduction in the number of children (5 to 11 years) who used to walk or cycle to school, from 49% in 1969 to 15% in 2001[13].

Knowing the factors associated with physical activity in commuting is important because it may provide support for the planning of interventions. In this sense, available studies show that the characteristics of the building environment (school location, presence of sidewalks, traffic safety, number of roads to cross, among others) may influence how parents choose to commute their children from home to school[14-16]. In this same sense, results from other investigations also suggest that the improvement in road infrastructure may contribute to promote active commuting in several population groups[17,18].

Researchers have been paying particular attention to the study on how the physical and social environment may influence or be associated with active commuting to school[19-21]. Salmon et al.[22] conducted a study aimed to examine the association between individual, social and environmental barriers and active commuting to school in children aged 4 to 13 years. The results found showed an inverse association between the barriers mentioned by parents and child's active commuting. The social barriers reported were the fact that there was no other child to walk to school with their child, there were no adults to walk with, and parents' concerns with the risks their children may face when walking to school. The environmental barriers identified were distance from home to school and the lack of a direct route to school.

In view of the foregoing, it is observed that efforts have been made to find evidence on how the physical and social environment has influenced children's active commuting to school. However, the studies already performed included simultaneously children and adolescents in the samples. This is the first study conducted in Brazil addressing this issue in the

preschool population, a fact that indicates the existence of an important knowledge gap, especially considering the continental size of the country and the existing inter-regional differences.

The socioecological model[23] proposes a conceptual framework through which it is possible to analyze factors potentially correlated with physical activity in childhood. It is a model which establishes that the factors associated with physical activity are multidimensional and act based on connections between individual, social, physical and environmental domains. Using the theoretical basis of the socioecological model, the aim of this study was to analyze the association between the characteristics of the physical and social environment near schools and active commuting from home to school among preschool children.

METHODOLOGY

Study design

School-based cross-sectional study which is part of the project Observational Longitudinal Study on Health and Welfare of Preschool Children (Estudo Longitudinal de Observação da Saúde e Bem-estar da Criança em Idade Pré-escolar, ELOS-Pré), conducted in Recife, Brazil. The investigation protocol of this study was approved by the Human Research Ethics Committee of Universidade de Pernambuco (CAAE: 0096.0.097.000-10). The parents/guardians of all participating children signed a free and informed consent form.

Population and sample

The target population of the study was limited to preschool children (3 to 5 years), enrolled in public and private preschools located in the area of influence of the Regional Education Management Department from Northern Recife and Southern Recife. Based on data provided by the Department of Education of Recife, in 2009 the number of children enrolled in these schools was estimated to be nearly 49 thousand preschoolers, distributed in 782 schools.

Sample size calculation considered the following parameters: (a) an estimated target population of 49 thousand children; (b) the estimated prevalence of the variables of interest in the study population was set at 50%, due to the multiplicity of variables focused in the project ELOS-Pré; (c) a 95% confidence interval; (d) a maximum tolerable error of 4 percentage points; and, (e) a sample design effect preset at 1.5. Sample size was initially estimated as 890 participants, which was increased by 20% in order to compensate for possible losses and refusals, resulting in a sample of 1,068 children.

The sample was selected by a single-stage cluster sampling process, taking the school as the sampling unit. All schools with preschool classes were considered eligible for inclusion in the study. Aiming to guarantee greater representativeness, the stratification criterion was established as the

proportion of preschools according to type (public or private), size and location in the six political-administrative regions (PAR) of the city of Recife. Schools with less than 50 children enrolled in preschool were categorized as small-sized schools; those with 50 to 199 children, as medium-sized schools; and those with 200 or more children, as large-sized schools.

Participating schools were chosen by draw using a numbered list with the name of all schools eligible for participation in the study. Epi-Info 6 software was used to generate random numbers for the draw. The final sampling unit was represented by the school class, but the sampling element (unit of analysis) contained in the sampling unit (school) was the child. All children enrolled in the schools were considered eligible and were invited to participate in the study. The present study excluded those who were absent from school during the period of data collection or those who had missing data on the study variables.

Data were collected between August and November, 2010 by a previously trained team comprising undergraduate and graduate (MSc and PhD) students, following a previously standardized protocol for operational procedures in order to guide data collection. All field work was directly supervised by the researchers involved in the development of the project.

Measurements

For data collection on active commuting and demographic and socioeconomic factors, children's parents or legal guardians answered a questionnaire by face-to-face interview. The instrument was previously tested in a pilot study consisting of repeated applications of the instrument to a group of 65 parents and children, with a seven-day interval between applications. The results from the pilot study showed good indicators of reproducibility both for demographic and socioeconomic characteristics (Spearman's correlation coefficients [rho] above 0.80) and for modes of commuting to school (rho= 0.84).

Demographic and socioeconomic variables

Child's age, family income, mother's education level, and ownership of a motor vehicle were reported by parents, while school shift (morning/afternoon) and type of school (public/private) were directly written down on the data collection chart by the interviewer. Age was expressed in years (3, 4 or 5 years), while family income was expressed considering the approximate number of minimum wages earned by the head of the family and then grouped into two categories: <2 minimum wages and ≥2 minimum wages. The value of the minimum wage was 510 Brazilian reais in the period of data collection. Mother's education level was determined by the following question: "How many years did you attend school?". Answer categories were: incomplete elementary education, complete elementary education, incomplete high school education, complete high school education, incomplete higher education, and complete higher education. The data obtained were subsequently grouped into two categories expressing the number of years of study (≤8 years / >8 years), with the first category including those

who reported incomplete or complete elementary education. We considered that the child's family had a motor vehicle when parents reported that they had at least one car. These co-variables were used to characterize the sample to the reader and to adjust association analyses.

Active commuting

The measure of active commuting from home to school was determined based on the answers for two questions. The first one, "How does your child usually commute from home to school and return home?", had the following answer choices: (a) on foot; (b) by car or bus; (c) by motorcycle; (d) by bicycle (on the backside); (e) by bicycle (riding); and (f) other. The second one, "How long does it normally take to commute from home to school?" allowed for the answer to be expressed in minutes. Active commuting was considered if children walked or cycled to school and if it took them more than 10 minutes to commute to school, while the other cases were considered inactive commuting.

Evaluation of the environment near schools

The independent variables were numerical scores expressing the quality of the physical and social environment near schools, which were measured using the "Inventory for Evaluation of the Community Environment Related to Physical Activity" ("*Inventário para Avaliação do Ambiente Comunitário Relacionado à Atividade Física*", ICAF), a translation and adaptation of the Active Neighborhood Checklist[24]. The process of adaptation and validation was conducted by the Research Group on Physical Activity and Quality of Life from Pontifícia Universidade Católica do Paraná. The instrument is applied to evaluate environmental characteristics that could be associated with higher levels of physical activity. Since it is an instrument that has not been published yet, this section provides its detailed description.

The process of adaptation and validation of the instrument included the translation and adaptation of the 175 items that comprise the checklist, followed by the application of a "clarity" test. Finally, after correcting items with comprehension issues, the instrument was applied again. The final version of the instrument comprised seven domains covering 175 items. Reproducibility was tested in three regions of the city of Curitiba, Brazil, with different patterns of land use (commercial, residential, mixed). A total of 18 segments of streets (six in each region) were independently assessed by eight previously trained researchers. The mean percentage of inter-rater agreement was 96.6% for the public transportation domain, 97.8% for characteristics of the streets, 92.6% for esthetics, 84.6% for places for walking and cycling, and 95.6% for social environment. The average time of application was nearly 10 minutes.

The present study omitted the domains related to use of land (83 items) and reports, signs and messages (5 items). This methodological choice was adopted because such domains, although potentially associated with physical activity in other age groups, do not make sense in a study with

preschool children, due to their lack of reading skills, among other reasons. Our analysis included only those domains that could be conceptually associated with physically active commuting at preschool age, namely: public transportation (14 items), characteristics of the streets (18 items), esthetics (15 items), places to walk and cycle (27 items), and social environment (13 items). All segments of streets adjacent to schools were assessed, including segments located in front of, behind and next to the school.

For the construction of a score expressing the quality of the environment near schools, we chose to standardize (Z strategy) the scores obtained for each of these domains and then calculate a mean score in order to express an overall measure of the attributes. Analyses were performed using the standardized numerical scores (numerical variables) for each of the domains, as well as the mean score, both of them considered as independent variables in the analyses.

Statistical analysis

Descriptive analysis was performed using frequency distribution for categorical variables and, given the lack of normal distribution, numerical variables were expressed as median and interquartile range. Eta coefficient was used to explore, in bivariate analyses, the correlation between scores expressing the quality of the environment near schools and active commuting from home to school (dichotomic variable). A chi-square test was used to test the association of demographic and socioeconomic variables with active commuting, in order to identify the need to include these factors in the adjusted multivariate analysis.

Afterwards, multivariate analysis by binary logistic regression was performed in order to analyze if the factors expressing the quality of the environment near schools were associated with active commuting. Active commuting to school was defined as dependent variable, while the characteristics of the environment near preschools were treated as independent variables. Demographic and socioeconomic variables (co-variables) were used to adjust the analyses.

The magnitude of the association between the variables was expressed as Odds Ratios (OR) and their respective confidence intervals (95%CI). Logistic regression was chosen because we found low values of intraclass correlation (ICC= 0.02 to 0.29) for the scores of the independent variables, suggesting that there is a small clustering effect (environmental evaluation of the school) on the proposed association analyses.

The presence of interactions was tested by bivariate regression analysis, in which the predictor variables were defined as the product between each domain of the physical environment and the co-variables considered in this study (child's age, family income, mother's education level, ownership of a motor vehicle, school shift, and type of school), using active commuting to school as the outcome. Criterion for identifying interactions was established as a p-value<0.05. An interaction was found between owning a vehicle and the scores expressing the quality of school surroundings, which

is why the analyses were stratified by ownership of a vehicle. Thus, four different association analyses were performed, namely: (1) domain scores X active commuting, considering data from children from families that did NOT have a car; (2) mean score X active commuting, also considering data from children from families that did NOT have a car; (3) domain scores X active commuting, considering data from children from families that had a car; and (4) mean score X active commuting, considering children from families that had a car. Variance Inflation Factor (VIF) values were higher than 1 and lower than 3, suggesting a lack of collinearity between domain scores, which is why they were included simultaneously in the analyses. However, the overall score showed collinearity with domain scores; therefore, it was not included with the other independent variables, requiring separate analyses (analyses 2 and 4). All independent variables were included simultaneously and excluded step-by-step using the conditional backward stepwise method, considering the following parameters for stepwise probability: 0.05 for entry and 0.10 for removal of variables.

RESULTS

Data from 1,155 children were available for the study. However, 241 were excluded due to missing data on demographic and socioeconomic variables (n=113) or due to lack of data regarding mode or duration of commuting from home to school (n=128). Therefore, 914 pre-school children enrolled in 28 schools from Recife were included in the present study (50.1% boys). With this number of participants (n=914), it was found, using *a posteriori* calculations, that it would be possible to detect as significant Odds Ratio (OR) values equal to or higher than 1.4, considering a 95% confidence interval, a statistical power of 80% and outcome prevalence of 30% among non-exposed subjects and 37.5% among exposed subjects.

Table 1 shows the characteristics of the children included in the study. Mean age was 4.3 years (SD=0.8). No statistical significant differences were observed between boys and girls regarding any of the independent variables, except for school shift.

A total of 28.3% (95%CI 25.5-31.3) of the children were active commuters from home to school, a percentage that was higher among children from less educated mothers (p<0.001) and from families that did not have a car (p<0.001), as shown in Figure 1. There was also a linear trend of increase in the proportion of active commuters as age increased (p=0.002). Sex (p=0.44) and school shift (p=0.49) were not found to be associated with active commuting to school.

Eta correlation analyses allowed to identify that the scores for three domains (esthetics, places to walk and cycle, and social environment), as well as the overall score expressing the quality of the environment near schools, were significantly correlated with active commuting to school (Table 2). Table 2 also shows a descriptive analysis of scores expressing the quality of the environment near schools.

Table 1. Demographic and socioeconomic characteristics and school-related factors in preschool children from Recife (n=914)

| Variable	Categories	Boys		Girls		All	
		%	n	%	n	%	n
Age (years)	3	18.8	86	15.6	71	17.2	157
	4	33.0	151	30.9	141	31.9	292
	5	48.2	221	53.5	244	50.9	465
Family income (minimum wages)	<2	73.1	335	71.7	327	72.4	662
	≥2	26.9	123	28.3	129	27.6	252
Mother's education level (years of study)	≤8	41.7	191	43.4	198	42.6	389
	>8	58.3	267	56.6	258	57.4	525
Ownership of a vehicle (car)	No	77.9	357	79.2	361	78.6	718
	Yes	22.1	101	20.8	95	21.4	196
School shift*	Morning	52.2	239	45.6	208	48.9	447
	Afternoon	47.8	219	54.4	248	51.1	467
Type of school	Public	41.3	189	44.3	202	42.8	391
	Private	58.7	269	55.7	254	57.2	523

* p<0.05
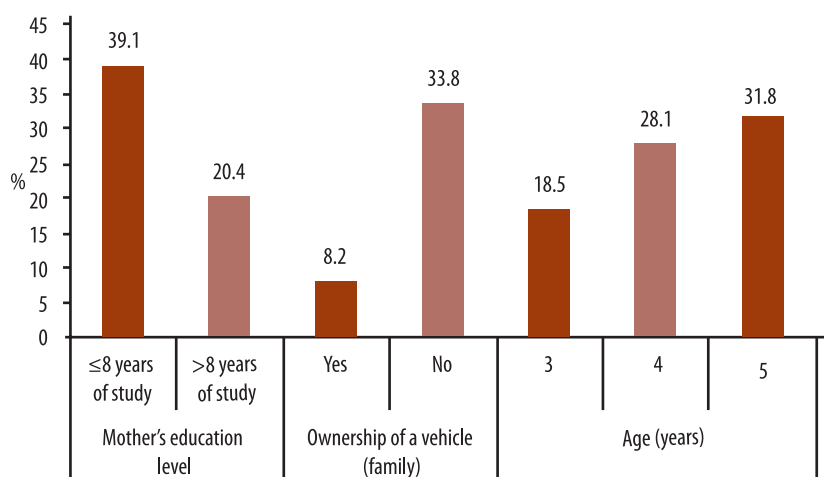
Figure 1. Proportion of preschoolers who were active commuters from home to school, according to mother's education level, child's age, and ownership of a vehicle.

Table 2. Descriptive statistics (median and interquartile range [IR]) of standardized scores for the domains of the environment near schools, according to active or inactive commuting to school

Variable	Active commuting		Inactive commuting		Eta CC (p-value*)
	MED (IR)	Mean (SD)	MED (IR)	Mean (SD)	
Public transportation	0.25 (-0.91; 1.02)	0.13 (1.10)	-0.52 (-0.91; 0.64)	0.01 (0.91)	0.05 (0.13)
Characteristics of the streets	-0.20 (-0.76; 0.92)	0.15 (1.11)	-0.20 (-0.76; 0.92)	0.69 (1.06)	0.02 (0.50)
Esthetics	0.17 (-1.25; 1.12)	-0.02 (1.14)	0.17 (-0.78; 1.59)	0.38 (1.03)	0.15 (<0.01)
Places to walk or cycle	-0.45 (-0.45; 1.21)	0.03 (1.08)	-0.21 (-0.45; 0.97)	0.49 (1.13)	0.18 (<0.01)
Social environment	0.45 (-0.21; 1.11)	0.23 (0.85)	0.45 (-0.87; 0.45)	-0.13 (1.15)	0.17 (<0.01)
Overall score for quality of school surroundings	0.12 (-0.11; 0.50)	0.08 (0.43)	0.02 (-0.22; 0.27)	0.16 (0.42)	0.09 (0.01)

MED=Median; IR=interquartile range; Eta CC=Eta correlation coefficient; * p-value associated with Eta correlation coefficient.

Multivariate analysis adjusted for potential confounding factors showed that there was an association between environmental factors near school and active commuting from home to school, but only among children from families that did not have cars (Table 3, analysis 1). Additionally, it was found that the overall score for quality of school surroundings was also significantly associated with active communing (Table 3, analysis 2).

Table 3. Regression coefficient (β) and OR values (95%CI) for analysis of factors of the environment near preschools associated with active commuting from home to school among preschoolers, stratified by ownership of a motor vehicle.

Ownership of a vehicle	Analysis	Variable (domains)	Outcome: active commuting to school					
			Crude values			Adjusted values*		
			β	OR (95%CI)	Valor P	β	OR (95%CI)	p-value
No	1	Public transportation	0.25	1.28 (1.11-1.48)	0.001	0.23	1.26 (1.09-1.46)	0.002
		Characteristic of the streets	0.12	1.12 (0.98-1.29)	0.090		Excluded	
		Esthetics	-0.10	0.91 (0.79-1.04)	0.164		Excluded	
		Places to walk and cycle	0.08	1.08 (0.94-1.24)	0.261		Excluded	
		Social environment	0.40	1.49 (1.21-1.84)	<0.001	0.32	1.38 (1.11-1.72)	0.004
	2	Overall score (mean for all domains)	0.69	1.99 (1.39-2.84)	<0.001	0.63	1.88 (1.31-2.70)	0.001
Yes	3	Public transportation	0.09	1.10 (0.61-1.99)	0.754		Excluded	
		Characteristic of the streets	-0.16	0.85 (0.50-1.44)	0.542	-0.55	0.58 (0.31-1.08)	0.085
		Esthetics	-0.33	0.72 (0.42-1.22)	0.221	-0.74	0.48 (0.21-1.08)	0.077
		Places to walk and cycle	-0.22	0.80 (0.49-1.31)	0.373		Excluded	
		Social environment	-0.04	0.96 (0.61-1.51)	0.857	-0.44	0.64 (0.34-1.22)	0.174
	4	Overall score (mean for all domains)	-1.09	0.34 (0.08-1.44)	0.143	-1.09	0.34 (0.08-1.40)	0.336

*Adjusted for sex, age, mother's education level, and shift

DISCUSSION

The aim of this study was to analyze the association between characteristics of the environment near preschools and active commuting from home to school. The results revealed that the overall score derived from the analysis of the characteristics of the environment near schools was significantly associated with active commuting in this population subgroup. Additionally, it was also observed that active commuting to school is associated with two domains of the environment near schools: public transportation and social environment.

The characteristics of school surroundings may play an important role in the opportunities created for the use of active means of transportation, such as walking. For example, the presence of trees nearby can encourage parents and children to actively commute to school because they will find a shadow to protect themselves from the sun. These hypotheses have been tested in international studies[25-27], but as far as we know this is the first study conducted with Brazilian preschool children. Therefore, it is dif-

ficult to compare the results from the present study with those of similar investigations and, due to methodological differences, such comparisons should be interpreted with caution.

In line with the available evidence[28], in the present study a positive association was observed between the environment near schools and active commuting to school. It was found that the likelihood of a child being an active commuter to school is higher with the increase in public transportation and social environment scores. This result is particularly encouraging due to the current debate on the need to adopt sustainable means of urban transportation.

The present study did not find an association between active commuting and esthetics, places to walk and cycle, and characteristics of the streets. A descriptive analysis of each item from the "characteristics of the streets" domain showed there was no general speed limit nor an area with special speed limit. In the environment near schools there were no demarcated lanes, highway median strip for pedestrians, U-turn, resources to organize the traffic, nor pedestrian sign. Most environments did not have pedestrian crosswalks nor illuminated sidewalks and roads. All schools were located in one-way streets. The set of these characteristics revealed, in general, the low environmental quality of the surroundings of the investigated schools, which possibly may hinder children's active commuting. A survey conducted with inhabitants of Recife revealed that subjects who reported to live in areas where there were no facilities for physical activity nor sidewalks to walk were less likely to perform physical activity in their leisure time[22]. Conversely, the authors of this study revealed that the esthetics of the neighborhood was inversely associated with active commuting[29].

The analysis of the scores by domain showed that factors related to public transportation and social environment were significantly associated with active commuting. This suggests that interventions to promote physical activity that include environmental change may need to emphasize certain aspects of the physical and social environment rather than others that could have less impact on health conducts, such as active commuting.

Although this is a cross-sectional study, it is not plausible to assume reverse causality bias as a limitation of the present study. However, there are other important limitations that should be considered, such as the possibility of selection bias due to the exclusion of children (~20%) with missing data on the variables included in the analysis. However, the comparison between overall and domain scores for children who remained in the analysis compared to those who were excluded did not reveal significant differences between the two groups, except in relation for the score for the "public transportation" domain. Response bias is also a possibility, considering that the information on the outcome was reported by children's parents and factors of the environment near preschools were obtained based on researchers' observation. We attempted to mitigate this possible bias by using a previously tested instrument, with a rigorous standardization of procedures for data collection and with training for evaluators.

CONCLUSION

The present study revealed that the overall score derived from the analysis of the characteristics of the environment near schools was a factor statistically associated with active commuting, but only among children from families that did not have a car. It was also observed that children who study at schools with higher scores for availability/accessibility to public transportation and social environment were more prone to go to and return from school in a physically active way.

Physically active commuting has been considered a behavior susceptible to environmental influences and of wide population coverage. In this sense, it is suggested that interventions developed to increase active commuting to school should focus several factors (individual, social and environmental) and articulate with several sectors of society with the purpose of reducing and overcoming barriers to physical activity in this stage of life. However, further research is needed in order to analyze, for example, how the distance from home to school may confound the association between the environment near school and active commuting to school.

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