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journal homepage: www.elsevier.com/puhe

Original Research

Distance from home to the nearest park and the use of the parks for physical activity: the mediator role of road safety perception in adolescents

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ARTICLE INFO

Article history:
Received 28 July 2018
Received in revised form
5 November 2018
Accepted 30 November 2018
Available online 18 January 2019

Keywords:
Neighborhood safety
Environment
Public space
Public health
Physical activity
Students

ABSTRACT

Objective: The objective of the study is to examine whether adolescents' road safety perception (RSP) acts as a mediator on the association between the distance from home to the nearest park and the use of the parks for physical activity (PA).

Study design: This is a cross-sectional study.

Methods: The evaluation was through a random sample of 1130 adolescents (534 male), corresponding to 47.3%, 14–20 years old, from Porto Alegre, Brazil. RSP was assessed through some questions of the Neighborhood Environment Walkability Scale for Youth. Park use, socioeconomic status, age, and sex were measured using a questionnaire. Distance from home to the nearest park was evaluated through geographic information system. Data analysis was performed using Pearson correlation, and linear regression models were fitted as per the Baron and Kenny procedures for mediation analyses. All analyses were adjusted for sex and socioeconomic status.

Results: Road safety perception is independently associated with less distance from home to the nearest park ($P = 0.04$) and use of the parks for PA ($P = 0.02$). Road safety perception is a mediator and explains 16% of the association between park use and distance from home to the park (indirect Effect = −40.9966; 95% confidence interval [CI]: 119.3733–2.2455).

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https://doi.org/10.1016/j.puhe.2018.11.021

Conclusion: Our findings indicated that RSP is a mediator on the association between the distance from home to the nearest park and the use of the parks for PA. Future studies should take this into consideration frequency and intensity of PA and other environmental characteristics, such as crime, aesthetics, and neighborhood facilities.

Introduction

Physical inactivity has been related to the rising prevalence of different cardiometabolic risk factors in adolescents, such as type 2 diabetes, hypertension, and obesity.[1] Nevertheless, data from many countries, including Brazil, indicate that 80% of adolescents do not meet the physical activity (PA) recommended levels for health.[2] Recent data from Southern Brazil showed similar prevalence; 76.8% of adolescents were considered insufficiently active (<300 min/week).[3] PA is a complex behavior that involves interpersonal, intrapersonal, community, social, and cultural factors. Thus, considering the relevance of environment characteristics, ecological models have helped to elucidate PA behavior among youth.[4]

Studies have shown that the presence of trails, specific types of sports fields, neighborhood design, recreation facilities, transportation systems, street lighting, paved streets, and cycle paths/lanes seem to be some of the characteristics associated with PA among youth.[5–7] In addition, distance between squares/parks and adolescents' home increases the probability of engaging in PA.[3,8] Thus, understanding the characteristics of the places that may facilitate PA should be a priority for health promotion.[4]

Therefore, road safety perception (RSP) seems to be a relevant issue, although evidence regarding this topic and its relationship with PA is inconclusive.[9–11] Mitáš et al.[10] and Lenhart et al.[11] showed that adolescents Who perceived the neighborhood environment as safe were more likely to meet PA recommendations. On the other hand, a recent systematic review indicated that safety and aesthetics are secondary factors in the relationship with PA.[9]

The majority of studies have explored the association between RSP with different PA domains. Taking this aspect into consideration, we intend to understand how much does RSP explain the relationship between two environment variables. Indeed, Bracy et al.[12] showed that the associations of PA with crime, traffic, and pedestrian safety may be more complex than through direct associations. Therefore, the aim of the present study was to examine whether adolescents' RSP acts as a mediator on the association between the distance from home to the nearest park and the use of the parks for PA.

Methods

Study design and setting

This is a cross-sectional study, carried out in the city of Porto Alegre, capital of the state of Rio Grande do Sul (Southern Brazil).

Participants

The population was composed of approximately 34,645 high school students from 71 public schools.[13] They were allocated in the following regions: 8,057 northern, 6,423 southern, 4,268 eastern, and 15,897 central regions.

The sample selection was realized by multiple phases procedure.[14] Initially, the schools were selected, based on each region, and then, in the schools, the high school classes were selected randomly. A number was assigned for each school, and all numbers were placed in a box, mixed, and randomly reelected one by one. Data were collected in one class from each year: first, second, and third.

The students from the classes selected were invited to participate in the study, and the inclusion criteria were: (a) belonging to the first, second, or third year of high school; (b) handing in the consent document signed by a parent or guardian; and (c) signing the assent document manifesting the will to participate.

To calculate the sample size, the following criteria were considered: (1) estimated population of 34,645 students (N); (2) proportion of 50% (p); (3) complementary percentage of 100−p (q); (4) degree of confidence of 2 standard deviations (SDs); and (5) acceptable sampling error of 3% (e). After the adoption of these criteria and according to the formula presented in the following section, it was estimated that 1077 students should be evaluated. However, to avoid probable difficulties with the sample loss, an increase of 5% was assumed, totaling 1130 adolescents. This formula was used to have a sample that represents the study population. This calculation was performed using the formula to have a representative sample of the population. The power of the test was tested through the software G*power, version 3.1.9.2; for the statistical analysis used in the study, the value of the power of the test was 1.0.

$$n = S^2 \cdot p \cdot q \cdot N / e^2 (N - 1) + (S^2 \cdot p \cdot q)$$

Sample selection considered the proportion of adolescents enrolled in the schools by region. Thus, the sample was composed of 263 adolescents from four schools in the north region (23.26%); 518 adolescents from seven schools in the central region (45.88%); 140 adolescents from two schools in the east region (12.32%); and 209 adolescents from two schools in the south region (18.54%).

Data collection

Data collection was performed during an eight-month period in 2017. First, the researcher went to the selected schools and explained the aims of the study, and if the managers agreed to participate, they were asked to sign an acceptance term. Then,

data collection was scheduled. Questionnaires were filled out during a regular class, corresponding to approximately 45 min.

Study materials

To evaluate adolescents environment perception, the Neighborhood Environment Walkability Scale for Youth (NEWS-Y), validated in Brazil was used.[15] NEWS-Y evaluate perceived environmental factors that may influence adolescents PA.[16] This questionnaire is composed of eight sections; however, to meet the aim of the present study, only the section related to RSP was used which included the following questions: (1) 'There is so much traffic along nearby streets that it makes it difficult or unpleasant to walk (alone or with someone) in your neighborhood?'; (2) 'Is the speed of traffic in most of the nearby streets generally low (40 km/h or less)?'; (3) 'Most drivers go faster than the posted speed limits in your neighborhood?'; (4) 'Are the streets of your neighborhood well lit at night?'; (5) 'Walkers and bikers on the streets in your neighborhood can be easily seen by people in their home?'; (6) 'There are crosswalks and signals to help walkers cross busy streets in your neighborhood?'; (7) 'When walking in your neighborhood, there are a lot of exhaust fumes?'; and (8) 'Do you feel safe crossing the streets in your neighborhood?'. The answer options were as follows: 'strongly disagree', 'partially disagree', 'partially agree', and 'strongly agree'. For descriptive analyses, these answers were dichotomized into agree and disagree. The questions 1, 3, and 7 were standardized to allow the same sense of the answers, to leave all the questions in the negative toward positive. Then, all questions were transformed to standardized values (Z-score); then, the sum of Z-scores was performed to create the RSP score.

The question "Do you use any park to PA practice?' was used to assess the use of the park by adolescents. The possible answers were 'yes' or 'no'.

The adolescents' address was reported in the questionnaire. Adolescents' addresses were represented in the Geographic Information System (GIS) environment through the ArcMap 10.3.1 software. With the shapefile of the streets and parks provided by the Municipal Department of Urbanism (SMUrb) of Porto Alegre—RS, Brazil, the distances between houses and parks of the city were defined through the tool "Network Analyst/Closest Facility". With this procedure, it was possible to calculate the smallest distance, in meters, between the student's home and the nearest parks.

Socioeconomic status was assessed through the number of owned items at the adolescents' residence and the level of schooling of the parent or guardian by the criteria established by the Brazilian Association of Research Companies.[17] For the analyses, the classes were grouped as: high (A1+A2), medium (B1+B2), and low (C1+C2+D+E). Sex and age were assessed in the same questionnaire.

Statistical analysis

Descriptive data were calculated as absolute and relative values for age, socioeconomic status, park use, and RSP. Means and standard deviations were calculated for distance from home to the park and RSP z-score. The internal consistency from questions about RSP variables was verified using Cronbach Alpha, indicating 0.51 as an acceptable reliability. Differences between gender was determined using Chi-squared test for dichotomized variables and independent t-test for continuous variables. The Pearson correlation was used to determine relation between all variables.

Linear regression models were fitted to examine whether the association between park use and distance from home to the park was mediated by RSP, using the PROCESS macro for the Statistical package for Social Sciences (SPSS) version 24.0 (IBM Corp, Armonk, NY). The goal of this model was to investigate the total (c) and direct effects (a,b,c'), reflected by the unstandardized regression coefficient and significance between the independent and dependent variables in each model. The model also explored the indirect effect obtained from the product of coefficients (a×b), which indicates the change in the distance from home to the park for every unit change in the park use that is mediated by the proposed mediator (i.e., RSP). The PROCESS macro used bootstrapping methods recommended by Preacher and Haye[18] for testing mediation hypotheses, using a resampling procedure of 10.000 bootstrap samples. Indirect effect was estimated through point estimates and confidence intervals (CIs) (95%). When the CI did not contain zero, the point estimate was considered significant.

The following criteria were used to establish mediation: (1) the independent variable (park use) is significantly related to the mediator (RSP); (2) the independent variable (park use) is significantly related to the dependent variable (park distance); (3) the mediator (RSP) is significantly related to the dependent variable (park distance); and (4) the association between the independent and dependent variable is attenuated when the mediator is included in the regression model. The analyses were adjusted for gender and socioeconomic status.

Results

Descriptive characteristics of the sample are presented in Table 1. The study sample comprised 1130 adolescents, aged 14–20 years, from 16 public schools. Most adolescents were

Table 1 – Characteristics of the study sample by gender [n (%)].

Characteristics	All	Male	Female
Age in years			
14	07 (0.6)	3 (0.6)	4 (0.7)
15	201 (17.8)	90 (16.9)	111 (18.6)
16	369 (32.7)	171 (32.0)	198 (33.2)
17	384 (34.0)	174 (32.6)	210 (35.2)
18	136 (12.0)	79 (14.8)	57 (9.6)
19	22 (1.9)	11 (2.1)	11 (1.8)
20	11 (1.0)	6 (1.1)	5 (0.8)
Socioeconomic status			
High	202 (18.1)	104 (19.8)	98 (16.7)
Medium	625 (56.2)	308 (58.6)	317 (54.0)
Low	286 (25.7)	114 (21.7)	172 (29.3)
Park use*			
Yes	419 (37.2)	244 (45.9)	175 (29.4)
No	708 (62.8)	288 (54.1)	420 (70.6)

*difference park use and gender. Chi-squared test (X^2) = 32.55 $P < 0.001$.

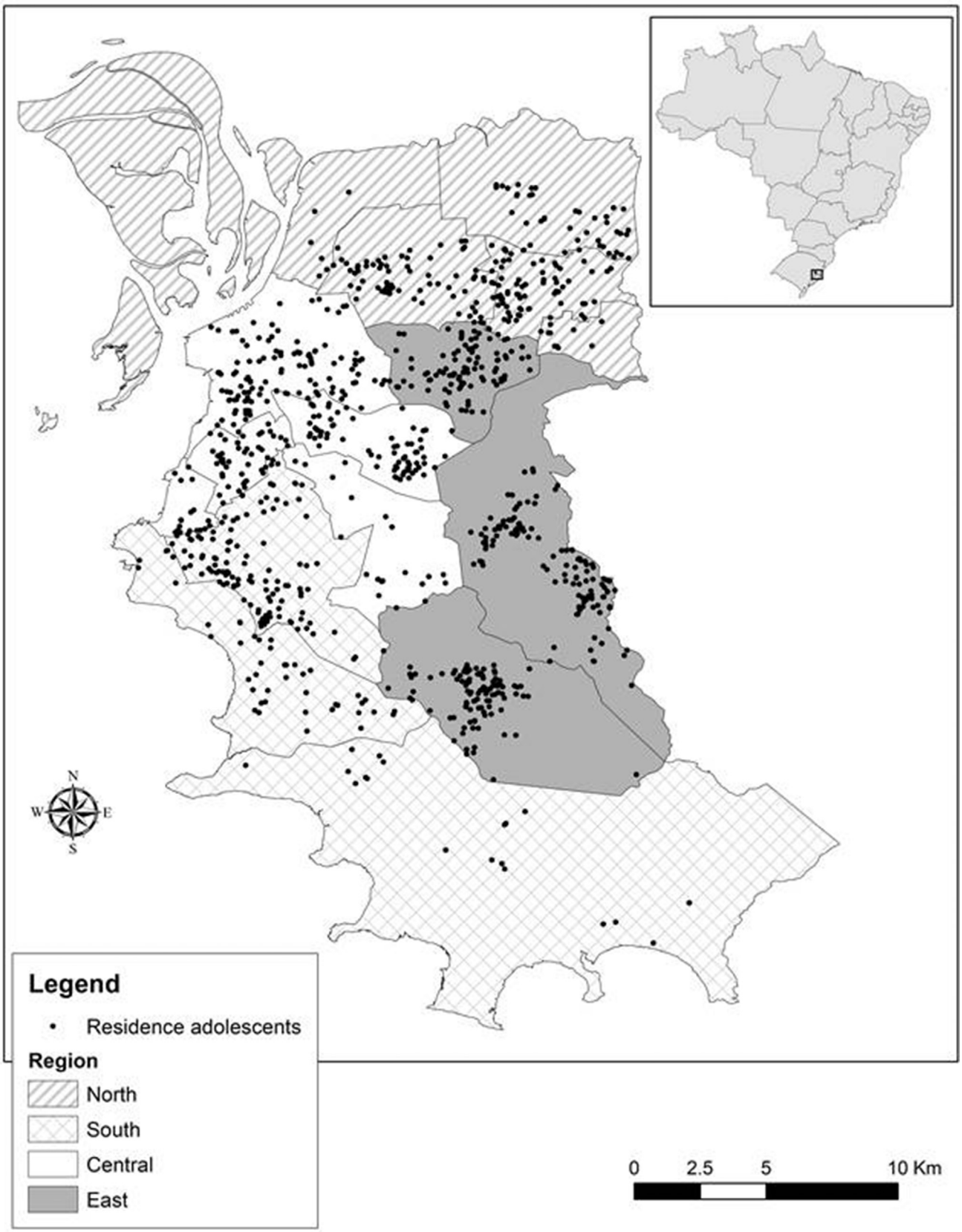

Fig. 1 – Georeferenced of participants of the sample (n = 1110).

Table 2 – Road safety perception of adolescents [n (%)][a].

Road safety perception	All	Male	Female	P
1. There is so much traffic along nearby streets that it makes it difficult or unpleasant to walk (alone or with someone) in your neighborhood?				0.03*
Disagree	645 (57.1)	322 (60.3)	323 (54.2)	
Agree	485 (42.9)	212 (39.7)	273 (45.8)	
2. Is the speed of traffic in most of the nearby streets generally low (40 km/h or less)?				0.005*
Disagree	472 (41.8)	200 (37.5)	272 (45.6)	
Agree	658 (58.2)	334 (62.5)	324 (54.4)	
3. Most drivers go faster than the posted speed limits in your neighborhood?				0.01*
Disagree	540 (47.8)	276 (51.7)	264 (44.3)	
Agree	590 (52.2)	258 (48.3)	334 (55.7)	
4. Are the streets of your neighborhood well lit at night?				0.005*
Disagree	537 (47.5)	230 (43.1)	307 (51.5)	
Agree	593 (52.5)	304 (56.9)	289 (48.5)	
5. Walkers and bikers on the streets in your neighborhood can be easily seen by people in their home?				<0.001*
Disagree	434 (38.4)	176 (33.0)	258 (43.3)	
Agree	696 (61.6)	358 (67.0)	338 (56.7)	
6. There are crosswalks and signals to help walkers cross busy streets in your neighborhood?				0.85
Disagree	534 (47.3)	251 (47.0)	283 (47.6)	
Agree	595 (52.7)	283 (53.0)	312 (52.4)	
7. When walking in your neighborhood, there are a lot of exhaust fume?				0.13
Disagree	679 (61.7)	342 (64.0)	335 (59.7)	
Agree	432 (38.3)	192 (36.0)	240 (40.3)	
8. Do you feel safe crossing the streets in your neighborhood?				<0.001*
Disagree	397 (35.1)	154 (28.8)	243 (40.8)	
Agree	733 (64.9)	380 (71.2)	353 (59.2)	
Road safety perception (z-score all variables) [mean (SD)]	−0.0007 (0.47)	0.0937 (0.44)	−0.0854 (0.48)	<0.001**

SD = standard deviation; *P-value <0.05 according to Chi-squared test; **P-value according to independent t-test.
[a] Unless stated otherwise.

classified in medium socioeconomic status. Regarding park use, significant statistical difference ($x^2 = 32.55$; $P < 0.001$) was found between boys and girls, being that the use is more frequently among boys (45.9%).

For distance from home to the park analyses, 1110 adolescents' addresses were geocoded (Fig. 1). Sample losses were caused by insufficient address information and incompatibilities in the street network. Results indicated that mean values of distance from home to the park was 4921.25 m for boys and 5267.25 m for girls; there was no statistical difference ($t = 0.008$; $P = 0.46$) between both.

Descriptive characteristics of RSP are presented in Table 2. There was no statistical difference between boys and girls only in questions 6 and 7. Regarding mean z-score RSP, there was difference between genders ($t = 2.53$; $P < 0.001$).

Table 3 presents the Pearson correlation between environment characteristics (RSP, distance from home to the park and the use of the parks for PA practice) and age, socioeconomic status, and gender. All environment characteristics variables showed correlation between each other.

Fig. 2 shows the model used to test the mediation role of RSP in the relationship between park use and distance from home to the park. In the first regression equation, the relationship between better RSP and use of the parks for PA was positive ($P = 0.02$). Results of the second equation showed that the use of the parks was negatively associated with distance from home to the park ($P = 0.008$). In the third equation, the relationship between RSP and distance from home to the park was negative ($P = 0.04$). Finally, in the fourth equation, when RSP and use of the parks were included simultaneously in the model, better RSP was negatively associated with distance from home to the park ($P = 0.005$). Furthermore, the relationship between use of the parks and distance from home to the park was attenuated when RSP was included in the model,

Table 3 – Pearson correlation between environment characteristics and age, and socioeconomic status and gender.

Characteristics	Road safety	Park use	Park distance	Gender	Socioeconomic status
Age	−0.04	−0.02	0.01	−0.05	−0.09**
Socioeconomic status	0.06*	0.08*	−0.12**	−0.04	–
Gender	−0.18**	−0.17**	0.04	–	–
Park distance	−0.08*	−0.09*	–	–	–
Park use	0.10**	–	–	–	–
Road safety	–	–	–	–	–

For road safety standardized value (Z-scores) were considered. *$P < 0.05$. **$P < 0.001$.

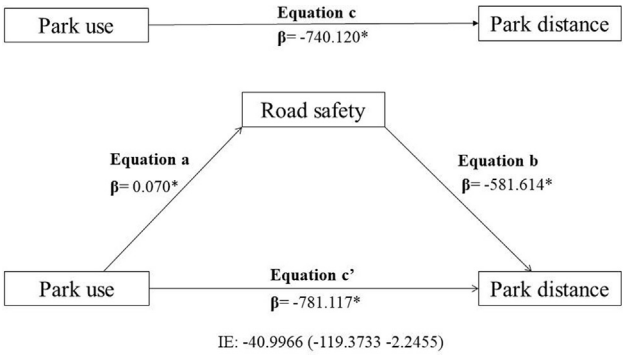

Fig. 2 – Road safety perception mediation model of the relationship between park use and park distance. n = 998, *P<0.05 adjusted for gender and socioeconomic status.

indicating that RSP is a mediator of this relationship (indirect effect = −40.9966; CI: −119.3733–2.2455) and explains 16% of this association.

Discussion

The aim of the present study was to examine whether adolescents' RSP acts as a mediator on the association between the distance from home to the nearest park and the use of the parks for PA. Our findings showed that RSP is associated with both the smallest distance to the park and the use of the parks. Besides, the mediation analysis showed that RSP explain 16% of the relationship between the distance from adolescent's home to the nearest park and their use of parks for PA.

Adolescents living at a shorter distance to parks were the ones more frequently reporting the use of the park for PA. Thus, the closer the park is, the more likely the adolescents are to use that space. In the same line, researches from the United States and the Netherlands found that perception of proximity to a park was associated with the use of that space for sports and leisure PA.[8,19] Likewise, in Brazilian youngsters, perception of parks and squares proximity enhances PA practice.[3,20] Furthermore, Silva et al.[7] showed that living near the beach enhances 3.3 times the chance of adolescents engaging in leisure PA. In agreement with these findings, a study developed in eight countries, including Brazil, demonstrated that both direct measure and proximity perception of a park was associated with PA practice. As well as, having multiple parks nearby was the strongest positive correlate of PA.[21]

The use of the park is another important aspect in this context. Our findings showed that the use of public spaces, such as parks and squares, for PA was more reported among boys (45.9%). These results could be related to the fact that boys are more active than girls, and perhaps, they use open spaces for PA practice more frequently. Van Hecke et al.[22] found similar results, reporting that boys and younger adolescents were more likely to use public open spaces than girls. According to these authors, urban planners should consider creating and refurbishing public open spaces, adding attractive feature for encouraging its visit by youth of all ages.

Our data showed that RSP is a mediator of the relationship between the distance from home to the nearest park and the use of the parks for PA, explaining 16% of this association. Considering that several environment factors influence PA, we highlight that RSP seems to be an important issue for Brazilian adolescents. In addition, to the best of our knowledge, there are no studies that verified the relation of RSP with variables related to environment, using mediation analysis. Given that multiple barriers to PA may exist, our research, accounting for RSP, can be useful to guide PA promotion actions among adolescents.

Evidence about safety characteristics and its relation with PA are inconclusive. As shown in a recent review, issues such as aesthetics and safety perception features seems to be less important for visiting open public spaces and PA practice.[9] In addition, Janssen and Rosu[23] demonstrated that the presence of roads with low traffic speed had no relation with self-reported PA, whereas, according to Aradi et al.[24], less traffic and more lighting were associated with higher levels of outdoor visitation.

Despite these findings, we emphasize that the main result of our study was expected, considering that, in Brazil, the crime rates are high and safety is a factor that worries populations in general. Indeed, Reis et al.[25] indicated that poor lighting was negatively associated with lower involvement in PA in Brazilian adolescents. The same findings were observed in other countries. Researches from Australia and the United Sates showed positive associations of some security characteristics, such as perceived crime safety, perceived traffic safety, and presence of lighting with PA in adolescents.[26,27] Moreover, Canadian boys and girls with the highest perceptions of safety were 1.31 and 1.45 times more likely to be physically active, respectively, than those with the lowest perceptions.[28]

Taking these aspects into consideration, our findings are useful for public health professionals. As practical implications, we highlight that public managers will have access to concrete data that strengthen the importance of these aspects, and they will be able to allocate resources to invest in these places. In addition, planning and/or transport officers public and health managers should develop strategies to promote most active cities, through parks and other structures such as walking or running trails and bicycle paths to encourage active commuting with RSP. The availability of pleasant environments, with more quality and safety, may encourage adolescents to attend them, contributing to PA levels and consequently improving health conditions.

Future studies should take some aspects into consideration and try to look for causal inferences. Understanding the impact of improvements in the infrastructure of the parks on its use, and RSP, seems to be a promising strategy to PA promotion. Another important issue is to know the reasons that lead adolescents to attend these places, such as personal, environmental, social factors, that is, to look for information from users of the parks and qualitatively explore the reasons that lead them to use the park. Another interesting way to understand these relationships would be to sample by domicile around some parks. Thus, it would be possible to take into consideration parks with more or less equipment available for PA, within neighborhoods with higher or lower socioeconomic

level. It would be also relevant to consider parks that have a private or public security system and compare with those that do not. Finally, to verify if the smallest distance from the house to the park influence the use of the park, other socio-demographic and environmental factors, such as street safety, access, and aesthetics, should be considered.

Strengths of this study include the use of an objective measure of the built environment, through GIS, to assess the distance from home to the nearest park. In addition, this study included a large sample of Brazilian adolescents. Moreover, to the best of our knowledge, this was one of the first research studies that used mediation analysis to understand the relationship of RSP with variables associated to the built environment among Brazilian adolescents. Despite the pertinence of these results, some limitations must be mentioned. The study's cross-sectional design does not allow to determine the cause and effect. The use of the park for PA was a subjective measure, not allowing to know the frequency and intensity of PA.

In conclusion, better RSP is independently associated with less distance from home to the nearest park and with the use of the parks for PA. In addition, RSP acts as a mediator, explaining 16% of the relationship between park use and the shorter distance to the park. In fact, RSP is an important factor for park use for PA when these places are near from adolescent's house.

Author statements

Ethical approval

The study was approved by the Ethics Committee of Research with Human Beings of the Federal University of Rio Grande do Sul, under number 1.338.597.

Funding

This work was supported by the National Counsel of Technological and Scientific Development (CNPQ), Coordination for the Improvement of Higher Education Personnel (CAPES) and Foundation for Science and Technology (FCT), Portugal: SFRH/BSAB/142983/2018 and UID/DTP/00617/2019.

Competing interests

None declared.

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