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ORIGINAL RESEARCH

Physical Activity and Its Relationship With Perceived Environment Among Adults Living in a Region of Low Socioeconomic Level

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***Background*:** The environment has a great influence on people's lifestyles and their capacity to choose healthy habits. The aim of this study was to investigate the association between perceived environment and physical activity among adults living in the city of São Paulo, Brazil. ***Methods*:** This was a cross-sectional population-based study conducted with 890 people age 18 years or over. Physical activity was measured through the International Physical Activity Questionnaire (IPAQ; long version) and perceived environment was evaluated using the Neighborhood Walkability Scale (NEWS) adapted. Poisson's regression was used for statistical analyses and prevalence ratios were calculated. The outcome variable was the attainment of at least 150 minutes per week of physical activities. The independent variables consisted of perceived environment variables and control variables (sex, age, schooling, time living in the home, and number of cars per household). ***Results*:** The perceived environment variables that explained physical activity were: receiving invitations from friends for activities (P = .012), low environmental pollution scores (p trend = 0.030) and high general safety scores (P-trend = 0.039). ***Conclusions*:** These results suggest that physical activity promotion in regions like this should be envisaged as a complex phenomenon and investments in public safety, prevention and combating of environmental pollution and social support networks are needed.

***Keywords*:** environment design, social class, Brazil

The environment has a great influence on people's lifestyles and their capacity to choose healthy habits. The ecological model proposed by Sallis et al[1] showed that modification of behavioral patterns in order to incorporate practice of physical activities is difficult and does not depend solely on individuals, but also on the environment within which they live. This model involves issues at 4 different levels. At the first level, there are individual/person characteristics such as demographic, biological, psychological, and family situation, which are at the center of the model. At the second level, there are the perceptions of safety, attractiveness, comfort, crime, facilities, and conveniences. At the third level, there are contextual variables such as the structure of the neighborhood, transport system and various services facilities that may influence physical behavior such as workplaces, schools, climate, topography, open public spaces, air quality, social networks, social capital, primary healthcare units and equipment, and installations for leisure and recreation. Finally, at the fourth level (the most macro level), there are local, state, and national public policies.

Clearly, all of this discussion stimulated researchers to begin studies on the relationships of various environmental variables with physical activity patterns. Two systematic reviews showed that a variety of environmental factors were associated with different types of physical activities among adults.[2,3] In addition, studies have shown that variations in the levels of physical activity practices exist, according to the socioeconomic level and environment in different regions.[4,5] However, all of these studies were conducted in high-income countries, particularly the United States and Australia. Starting from the assumption that the infrastructure for physical activity practice, general security, traffic safety, social support, and environmental pollution in middle-income countries like Brazil are different from those of high-income countries, and given that there are few studies conducted among adults living in regions of low socioeconomic level, the aim of the current study was to investigate the association between perceived environment and physical activity among adults living in a region of low socioeconomic level in the city of São Paulo, Brazil.

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Method

Design and Sample

This was a cross-sectional population-based study conducted in the Ermelino Matarazzo district, in the eastern zone of São Paulo, SP, Brazil (Figure 1). The municipality of São Paulo has more than 11 million inhabitants and is considered to be the fourth largest metropolis in the world. The eastern zone of São Paulo is the most heavily populated region of the municipality, with more than 4 million inhabitants (around 35% of the population of São Paulo). Moreover, this zone is the region of the city with the greatest social inequalities and a large proportion of the population live in distant peripheral areas like the Ermelino Matarazzo district. This district is at the eastern extremity of the city, at the boundary with the municipality of Guarulhos. According to 2009 data from the Data Analysis Foundation of the State of São Paulo (SEADE), Ermelino Matarazzo has an area of 8.95 km^2, divided into 143 census tracts, with a population of 113,615 inhabitants and a population density of 12,900 inhabitants per km^2. According to data from the Foundation for the State Data Analysis System (Fundação Sistema Estadual de Análise de Dados, SEADE), only 9.5% of the population living in Ermelino Matarazzo had an income greater than 10 minimum monthly salaries, compared with 21.1% for the whole of the municipality of São Paulo in 2007 (Brazilian minimum salary ≅ $270.00).

The sample for this study was derived from the research "Physical activity and its relationship with the environment among the adult population of the Ermelino Matarazzo district of the eastern zone of the municipality of São Paulo," which had the aim of investigating the relationships of leisure-time and transport-related physical activity with individual and environmental factors, among young and old adults living in the district. This study had 890 participants age 18 years or over who had been living in Ermelino Matarazzo for at least 6 months. Sampling was performed through a 3-stage cluster design: census tract selection (random selection of 35 tracts, distributed according to the educational level of the head of the household), random selection of households from selected tracts and random selection of adults and older adults in the selected household. Further details on the sampling process can be obtained from the papers by Salvador.[6,7]

Measures

Physical Activity Assessment. To evaluate the practice of leisure-time and transport-related physical activity, the long version of the International Physical Activity

Figure 1 — Map of the public administrations district in São Paulo city and Ermelino Matarazzo (EM) district.

Questionnaire (IPAQ) was used. This questionnaire has been validated in several countries around the world, including Brazil,[8] and has already been used in another health survey in the municipality of São Paulo.[9] The overall physical activity was calculated as the sum of transport-related and leisure activity, and vigorous activities were multiplied by 2.

Perceived Environment Evaluation. Perceived environment data were collected by means of an adapted version of the Neighborhood Environmental Walkability Scale (NEWS, Brazilian version). This new version was validated by Florindo et al.[10] The final adapted version was discussed with specialists in the field of environment and physical activity in Brazil, and was composed of 38 questions. Analysis of the test-retest reliability with 1-week interval indicated good results for scores (correlation coefficient ≥ 0.70).

Statistical Analysis

To evaluate the effect of the independent variables on physical activity, it was decided to use Poisson regression, to avoid overestimated associations through the use of logistic regression.[11]

The outcome variables were determined through classification of at least 150 minutes of (leisure-time or transport-related) physical activity. The classification of the state of the environment according to perception (dichotomous questions and scores) was considered to be the predictor variable through which the factors extracted from the exploratory factor analysis were categorized. The control variables were sex, schooling, age, time living in the home, and number of cars per household.

Initially, chi-square test calculations were performed on all variables of the perceived environment with the dependent variable. To produce bivariate analyses, the variables used were those for which p values < 0.20.[12] These variables were compared individually with the dependent variable and those variables with *P*-values < 0.05 were included in the multivariate model. The final model was composed only of the variables that remained significant after adjustment for the control variables. Sample weighting factors were produced based on age groups and sampling fractions within the census tracts using information from the 2000 Brazilian census. The SPSS version 15.0 and STATA version 9.1 software were used.

Ethical Issues

This study was approved by the Research Ethics Committee of the School of Public Health, University of São Paulo.

Results

The results from the sociodemographic variables showed that the sample was mainly composed of women, individuals 25–59 years old, and individuals with up to 8 years of schooling. These results were very similar to those from the whole population of the municipality of São Paulo (Table 1).

Physical activity prevalence was higher for transport-related activity than for leisure time. This characteristic may be due to the region's characteristics of low socioeconomic level. However, the prevalence of individuals who were sufficiently active (ie, at least 150 minutes of physical activity per week) in the leisure domain was similar to the prevalence in the national survey[9] (Figure 2).

The chi-square analyses on perceived environment compared with achieving at least 150 minutes of physical activity per week showed that the significant variables

Table 1 Descriptive Characteristics of São Paulo City Population and Ermelino Matarazzo Population, 2007

Variables	São Paulo* %	Ermelino Matarazzo %
Gender		
Men	46.4	41.3
Women	53.6	58.7
Age		
18–24 years	17.5	20.5
25–59 years	68.5	67.0
60+ years	14.0	12.5
Education		
0–8 years	59.9	60.9
9–11 years	25.4	28.2
12+ years	14.7	10.8

* SEADE Foundation, 2007.

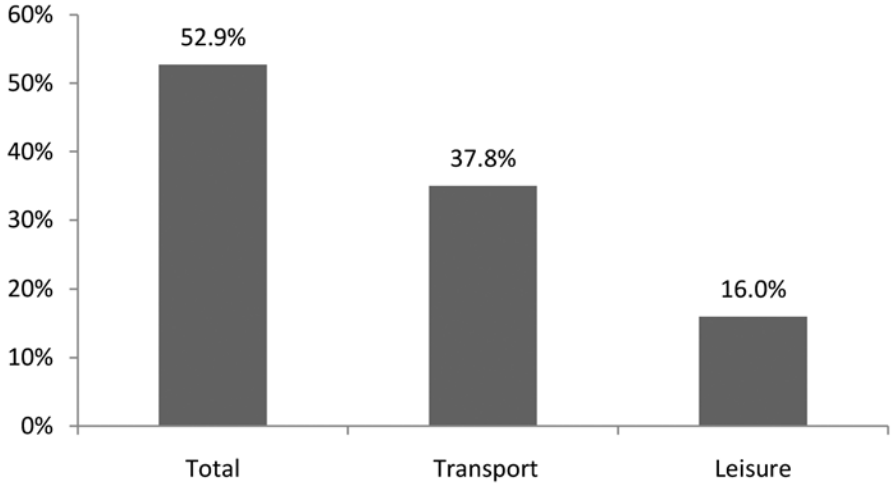

Figure 2 — Proportion of people that practice at least 150 minutes per week of physical activity (PA) in overall PA, transport-related PA, and leisure-time PA, Ermelino Matarazzo, São Paulo, 2007. * weighted analyses

($P < .20$) were the quality of the green areas ($P = .141$), accumulation of garbage in the streets ($P = .069$), open-air sewers ($P = .084$), drivers who respected pedestrians and pedestrian crossings ($P = .154$), good perception of safety during the day ($P = .015$), good perception of safety during the night ($P = .022$), invitation from friends/neighbors to practice physical activity ($P = .009$), having a pet dog ($P = .070$), pharmacy score ($P = .051$), church score ($P = .197$), bakery score ($P = .144$), street fair score ($P = .177$), supermarket score ($P = .112$), traffic safety score ($P = .105$), general safety score ($P = .029$), pet score ($P = .197$), pollution control score ($P = .053$), and quartiles of leisure area access ($P = .055$).

The significant variables ($P < .05$) in the bivariate analysis, which thus were considered in the multivariate model, were: safety during the day, safety during the night, quartiles of leisure area access, pollution score, supermarket score, general safety score and receiving invitations from friends/neighbors (Table 2). After adjusting for sex, age, schooling, time living in the home, and number of cars per household, the variables of perceived environment that explained the practice of at least 150 minutes per week of physical activity were: receiving invitations from friends/neighbors to practice physical activity, low level of environmental pollution, and high scores for general safety (Table 3).

Discussion

The results from the current study showed that individuals who felt safer for walking, cycling, or practicing physical activity during the day or during the night and who perceived that the streets close to their homes were well lit at night had a greater chance of attaining the recommendations for physical activity practice.

Other studies conducted in high-income countries have shown that a good perception of safety was correlated with the recommended practice of at least 30 minutes per day of moderate activities, 5 times per week, or 20 minutes per day of vigorous activities at least 3 times per week.[13,14]

Good perception of safety has been shown to be equally important for practicing physical activity even in predominantly rural environments in high-income countries, which shows that the question of violence has gone beyond the limits of urban regions. A study by Addy et al[15] investigated the associations between perceptions of the physical and social environment and physical activity practices among 1194 American adults from rural regions. The results showed that the recommended level of physical activity practices was associated with the perception of districts with greater safety.

Although a good proportion of the studies investigating the association between environment with physical activity have been cross-sectional, an intervention study conducted by Sallis et al[13] analyzed whether changes in the environment might influence changes in physical activity practices and 861 individuals were followed up for 6 months. Their physical activity practices were evaluated by means of 7-day recall questionnaires, and the NEWS (scale for perceived environment) was applied before and after the intervention. The results showed that the women who reported low crime rates in the districts where they lived practiced more minutes of physical activities per week than the other women did.

Regarding the relationship between a good perception of safety and the practice of walking, whether commuting or as a leisure activity, or both, other studies have found results similar to those in the current study.[4,16–18]

The hypotheses from these results can be confirmed through a more refined measurement of the practice of walking, as was done by Bennett et al.[16] These authors studied the association between the perception of safety and the practice of walking among 1180 adults from 12 public communities in the city of Boston, United States.

Table 2 Bivariate Models of Recommended Practice of Overall Physical Activity Among Adults, Ermelino Matarazzo District, Municipality of São Paulo, Southeastern Brazil, 2007 (n = 890)

		Bivariate model		
Environment variables	**Reference**	**PR**	**95% CI**	***P***
Good perception of safety during the day	No	1		0.019
	Yes	1.28	1.04–1.56	
Good perception of safety during the night	No	1		0.011
	Yes	1.26	1.06–1.51	
Supermarket score	Absent	1		0.049*
	Presence > 10 min	1.21	0.83–1.51	
	Presence < 10 min	1.29	0.96–1.74	
Quartiles of leisure area access	Worst quartile	1		0.047*
	Third quartile	1.32	1.05–1.66	
	Second quartile	1.17	0.92–1.48	
	Top quartile	1.38	1.11–1.73	
Pollution control score	Poor	1		0.015*
	Regular	1.15	0.88–1.52	
	Good	1.13	0.89–1.44	
	Excellent	1.42	1.11–1.82	
General safety score	Poor	1		0.009*
	Regular	1.18	0.90–1.54	
	Good	1.20	0.88–1.64	
	Excellent	1.53	1.14–2.06	
Quality of the green areas	Poor	1		0.832
	Regular/Good	1.01	0.92–1.11	
Accumulation of garbage in the streets	Yes	1		0.078
	No	1.16	0.98–1.36	
Church score	Absent	1		0.919
	Presence > 10 min	0.72	0.58–089	
	Presence < 10 min	0.81	0.63–1.04	
Receiving invitations/neighbors from friends	No	1		0.006
	Yes	1.26	1.07–1.47	
Open-air sewers	Yes	1		0.094
	No	1.17	0.97–1.14	
Drivers who respected pedestrians	No	1		0.179
	Yes	0.85	0.67–1.08	
Pharmacy score	Absent	1		0.105
	Presence > 10 min	4.96	1.29–19.12	
	Presence < 10 min	5.61	1.57–20.05	
Bakery score	Absent	1		0.146
	Presence > 10 min	2.84	0.31–25.43	
	Presence < 10 min	3.60	0.40–32.40	

(continued)

Table 2 *(continued)*

Environment variables	Reference	Bivariate model		
		PR	95% CI	*P*
Street fair score	Absent	1		0.092
	Presence > 10 min	1.52	0.49–4.72	
	Presence < 10 min	1.77	0.59–5.31	
Traffic safety score	Poor	1		0.189
	Regular	0.97	0.81–1.16	
	Good	0.76	0.59–0.99	
	Excellent	1.02	0.77–1.35	
Having a pet dog	Not have	1		0.165
	Having and not walking	0.82	0.63–1.05	
	Having and walking	0.93	0.68–1.29	

* *P* trend.

Abbreviations: PR, prevalence ratio.

Table 3 Multiple Model and Final Multiple Poisson Regression Model of Recommended Practice of Overall Physical Activity in Adults, Ermelino Matarazzo District, Municipality of São Paulo, Southeastern Brazil; 2007 (n = 890)

Environment variables	Reference	Multiple model			Final model**		
		PR	95% CI	*P*	PR	95% CI	*P*
Pollution control score	Poor	1		0.043*	1		0.027*
	Regular	1.15	0.89–1.53		1.22	0.93–1.60	
	Good	1.13	0.88–1.39		1.16	0.89–1.52	
	Excellent	1.42	1.07–1.76		1.46	1.10–1.92	
General safety score	Poor	1		0.027*	1		0.038*
	Regular	1.18	0.9–1.6		1.15	0.89–1.50	
	Good	1.20	0.85–1.61		1.16	0.90–1.50	
	Excellent	1.53	1.08–1.99		1.35	1.04–1.75	
Receiving invitations from friends/neighbors	No	1		0.008	1		0.017
	Yes	1.26	1.06–1.47		1.22	1.03–1.43	

* *P* trend; ** Model adjusted for sex, age, education, time lived in current home, and number of cars per household.

Abbreviations: PR, prevalence ratio.

Their physical activity practices were evaluated by using pedometers for 7 consecutive days, along with applying scale for perceptions of safety and self-efficacy relating to physical activity. After adjusting for age, body mass index, skin color, and whether the individual worked, good perception of safety at night was a significant predictor for a greater mean number of steps per day among the women. Furthermore, the individuals who reported feeling unsafe at night presented lower chances of self-efficacy regarding physical activity practices, both among women and among men.

Although Forde[19] indicated that there might be discrepancies between perceptions of violence and violence measured objectively, in attempting to correlate these variables with physical activity practices, and that perceptions of violence should be discussed and assessed cautiously, 2 recent studies have shown that both perceived violence and objectively measured violence are correlated with physical activity practices.[20,21] These studies showed that the chances that people are physically more inactive are greater in regions with higher crime rates and in which people report greater lack of safety.

Another issue that can be discussed is that a good perception of safety is correlated with improvement and maintenance of the environment in urban districts. Wood et al[22] argued that good maintenance made it possible to increase social networks and have better social control, which in turn also provided people with a better feeling of safety.

It is emphasized that the majority of the available evidence was obtained from a high-income country. Therefore, the results from the current study are very relevant because they come from a middle-income country and from a peripheral region of the city of São Paulo that has high rates of violence, compared with other, developed countries. According to data from the mortality information system of the municipality of São Paulo, deaths due to external causes (traffic accidents, falls, drowning, electric shocks, exposure to fire, suicide, and homicide) are the second largest cause of mortality for all age groups in the municipality. Worse still, among all the specific characteristics of mortality due to external causes, death due to homicide is the leading cause in 67% of the city's districts in 2007. This indicates that violence is a serious problem in several areas of the city.

Clearly, this gives rise to great concern in relation to promoting physical activities, considering that the results from different studies show that safety and the issue of violence influence the practice of physical activities as a whole and particularly the practice of walking. Nevertheless, walking is the type of activity that is most feasible for people to practice and for promotion within the scope of public health.

These results point toward broader reflections and discussions within the sphere of health promotion. For example, prevention of violence and promotion of a culture of peace is one of the important items within Brazil's National Health Promotion Policy (2006) that correlates with the results from the current study, for promoting physical activities more effectively.

The results from the current study showed that when people perceive that the environment is less polluted, without garbage on the streets, without smoke pollution, and without open-air sewers close to their homes, they are more likely to meet the recommendations for physical activity.

Comparisons with other studies presented certain difficulties, because some variables that are significant pollution problems in middle-income countries (eg, open-air sewers and garbage) are generally less common or even not a problem in high-income countries.

The findings of Hoehner et al[23] showed that people who strongly agreed that there was garbage on the streets were less likely to practice walking for transport. It is important to note that this result was confirmed through objective evaluation of segments, since the results showed that higher quartiles of street segments presenting garbage were inversely associated with transport-related walking.

The pollution also has a relationship with other important problems for public health. For example, indicators of environmental pollution such as open-air sewers, accumulations of garbage on the streets and smoke pollution have been correlated with the appearance and worsening of infectious diseases and chronic noncommunicable disease.[24–26]

The results from the current study showed that when people received invitations from friends/neighbors to join them in practicing physical activity, they were more likely to achieve the recommendations for physical activity practice.

Social support for healthcare has been widely defined as resource that is provided by other people.[27,28] Social support and social networks are present within the interpersonal nature of relations and interactions between individuals. They may facilitate or restrain the adoption of healthy behavioral patterns, provide access to materials and resources, contribute toward individual and community efforts, and protect against negative health-related outcomes.[27,28]

Many studies have shown that factors relating to social support are very important for physical activity practice.[4,22,26,29–38] All of this evidence from high-income countries indicates that social support is a very important variable in relation to practicing physical activities. The results from the current study also corroborate this hypothesis. The relevance of this evidence shows the importance of investing in social environments that stimulate social interaction between individuals, since this may give rise to social networks that are important for practicing physical activity.

As expected, this cross-sectional epidemiological study presents a temporal limitation, in that no cause-effect relationship can be established. This problem may exist in evaluating environmental perceptions and their relationships with physical activity practices because these evaluations were made at the same time. Moreover, for example, individuals' environmental perceptions depend on good knowledge of the district where they live, or the environment might undergo changes without people noticing this. This may have been minimized in the current study because the analyses took into account the length of time for which people had been living in their homes. To confirm the temporality of some of the evidence obtained in this study, follow-up studies of experimental or cohort type, for example, would be needed. Through these, it would be possible to measure the characteristics of the environment and the physical activity levels before and after a given intervention or follow-up period. Studies that use objective measurements of the environment might lessen this problem.[39–41] It should be noted that few studies of this type have analyzed the relationship between the environment and physical activity practices. Another problem that may have influenced the results was the concept of proximity. In the current study, places were deemed to be close if people could reach them from their homes by walking for no more than 10 minutes (ie, a distance equivalent to 800 m). Distances of 400 m to 1500 m (5–15 minutes) have been found to be significantly associated with the practice of transport-related walking.[39] Nonetheless, even though these mean time-distance equivalents are well known, the proportion of individuals that has a well-established

notion of time and distance is not exactly known. Another limitation relates to the subjective nature of the evaluation of physical activity practices. Despite evidence confirming the validity of the questionnaire used in this study, the ideal would be to evaluate these practices by means of accelerometers. Lastly, the problem relating to the validity of the perceived data and the true relationship with the contextual environmental data can be cited. Nevertheless, although other studies have shown that contextual indicators are associated and follow in the same direction as perceived indicators, in the relationship with physical activity practices,[20,21] more recent studies have shown that there is low concordance between objectively measured data and perception data when the aim is to correlate the environment with physical activity practices.[40,41]

These results show that adequate security and good social support from friends are also important for physical activity practices in middle-income countries like Brazil. On the other hand, the levels of environmental pollution such as garbage, air pollution and lack of sewage treatment are more exclusive and important, and need to be low for physical activity to be practiced in regions of low socioeconomic level such as the Ermelino Matarazzo district.

The results from the current study serve to provide a better understanding of environmental factors that were associated with the practice of physical activity, among a sample of adults living in a region of low socioeconomic level. They are applicable to regions that have social and economic conditions similar to those of the Ermelino Matarazzo district. These results show that promotion of physical activities in regions like this one needs to be envisaged as a complex intersectoral phenomenon that requires involvement from professionals within the fields of physical activity and health, safety, environment, engineering, architecture, sociology, and psychology. For promotion of physical activity practices that is more efficient among populations of low socioeconomic level, it is essential to invest in public safety, prevention and combating of environmental pollution and social support networks.

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