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Neighborhood contextual characteristics and leisure-time physical activity: *Pró-Saúde* Study

ABSTRACT

OBJECTIVE: To estimate the association between neighborhood contextual variables and leisure-time physical activity.

METHODS: Data were analyzed for 2,674 adults from Rio de Janeiro, RJ, Southeastern Brazil, participating in the longitudinal study in 1999. Leisure-time physical activity in the two preceding weeks was assessed dichotomously. Sex, age, income, education and marital status were analyzed as individual variables. Neighborhood contextual characteristics were the social development index, the Theil index and the proportion of the area occupied by parks, squares and gardens, categorized in quintiles. The unadjusted and adjusted odds ratios and 95% confidence intervals were estimated using multilevel logistic regression.

RESULTS: The prevalence of leisure-time physical activity was higher in residents in neighborhoods with higher indices of social development (between 32.3% and 53.1%) and a greater proportion of parks, squares and gardens (between 35.8% and 53.1%). Regarding the social development index, the adjusted odds ratios for physical activity were 1.22 (95%CI 0.93;1.61), 1.44 (95%CI 1.09;1.89), 1.75 (95%CI 1.31;2.34) and 2.25 (95%CI 1.70;3.00) for residents in neighborhoods in the second, third, fourth and fifth quintiles, respectively, compared with residents in neighborhoods in the first quintile. The odds ratios for the proportion of parks, squares and gardens were 0.90 (95%CI 0.69;1.19), 1.41 (95%CI 1.04;1.90), 1.63 (95%CI 1.24;2.14) and 1.05 (95%CI 0.80;1.38) for residents in neighborhoods in the second, third, fourth and fifth quintiles. After adjusting for the other variables, only the social development index continued to be associated with leisure-time physical activity, with odds ratios of 1.41 (95%CI 1.02;1.95); 1.54 (95%CI 1.12;2.12); 1.65 (95%CI 1.14;2.39) and 2.13 (95%CI 1.40;3.25) for residents in neighborhoods in the second, third, fourth and fifth quintiles.

CONCLUSIONS: Leisure-time physical activity was more common in residents in neighborhoods with higher social development indices. No association was observed between access to leisure areas and income inequality.

DESCRIPTORS: Activities of Daily Living. Leisure Activities. Sedentary Lifestyle. Motor Activity. Green Areas. Environmental Health. Multilevel Analysis.

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INTRODUCTION

The beneficial effects of physical activity on health are well documented in scientific literature.¹⁰ However, a pattern of generally decreasing levels of physical activity in the population has been observed in recent decades, due to increased mechanization of work processes and daily activities. Thus, leisure-time physical activity has come to play an increased role in meeting daily needs for calorie expenditure.^{1,a}

In addition to the influence of individual factors such as age, sex, schooling and others, characteristics of the context in which individuals find themselves, such as the places in which they live and their neighborhoods, can also influence the practice of leisure-time physical activities.¹⁴

Although there is no consensus on a working definition, approaches using neighborhoods as a unit of analysis are increasingly being used in epidemiological studies.^{3,23} In general, neighborhoods are understood as geographically demarcated spaces where, in addition to its physical characteristics, residents share political, cultural and economic circumstances.^{15,16} Florey et al (2007) define neighborhoods as any geographical aggregate which has this meaning for the local residents.⁷

Studies on the influence of neighborhood characteristics on health outcomes show how individual health and life style related behavior is not randomly distributed among regions and populations, that there are dynamic and complex interactions between individuals and their contexts.^{2,9} Multilevel analyses, including multiple hierarchical levels to evaluate outcomes at an individual level, are more appropriate for these types of studies, as they provide a more refined estimate not only of the contribution of variables related to the individual but also those of the context, as well as enabling unforeseen inferences due to better estimation of standard error of the parameters to be estimated.^{3,23}

Despite the significant increase in health research including the neighborhood as a unit of analysis and using a multilevel approach, there is little research on the influence of context factors on leisure-time physical activity.

The aim of this study was to estimate the association between contextual characteristics of the neighborhood and the practice of leisure-time physical activity.

METHODS

The Pró-Saúde study, with a longitudinal design, was conducted with university technical-administrative

workers in Rio de Janeiro, RJ, Southeastern Brazil, and focused mainly on social determinants of health and health-related behavior.⁶ The eligible population was 4,459 workers, of whom 4,030 (90.4%) had participated in the first phase of the study in 1999. Of these participants, 3,141 resided in the municipality of Rio de Janeiro, RJ. In the analyses presented in this study, data relating to 2,674 residents in 144 neighborhoods are included, after excluding those participants for whom data were not provided (home address: 97; leisure-time physical activity: 307) and another 63 who, for health-related reasons, were unable to do some of their regular activities during the period.

Individual data were collected using questionnaires which the workers completed themselves at their workplace. Data and process quality were guaranteed using methods such as a pilot study, instrument reliability (test-retest) and independent double entry procedures.⁵

Leisure-time physical activity was evaluated dichotomously and self-reported by participants using the question: "In the last two weeks have you done some kind of physical activity to improve your health, physical condition or with aesthetic or leisure objectives?" Other individual variables considered were sex, age in years (< 30, 31-40, 41-50, > 50); *per capita* household income in minimum wages (MW), at the time: R\$ 136 and US\$ 77.71 (< 3 SM, 3 to 6 SM, > 6 SM); schooling (up to completed elementary education, completed high school, completed higher education or above) and marital status (single, in a stable relationship, separated/widowed).

Data from the Parks and Gardens Foundation^b and the 2000 Demographic Census, conducted by the Brazilian Institute of Geography and Statistics (IBGE), were used to construct the contextual variables of the neighborhoods. The variables analyzed and categorized into quintiles were: social development index in 2000, Theil index in 2000, and proportion of the area occupied by parks, squares and gardens in 1999.

The social development index is an index conceptually similar to the Human Development Index (HDI). It is composed based on indicators covering four dimensions: access to basic sanitation, housing quality, head of household's level of schooling and available income. The higher the index, the higher the social development in the specific area. The Theil index measures inequality in *per capita* household income distribution. It is calculated based on the logarithm of the ratio between arithmetic and geometric means of individual income. The higher the value, the greater the concentration of

^a Committee on Physical Activity, Health, Transportation and Land Use. Does the built environment influence physical activity? Examining the evidence – special report. Washington (DC); 2005.

^b Governo do Estado do Rio de Janeiro. Fundação Parques e Jardins - Diretoria de Planejamento, Julho de 1999, Tabela 1199. Rio de Janeiro; 1999 [cited 2013 Mar 17]. Available from: <http://www.armazemdedados.rio.rj.gov.br/>

income. The proportion of the area occupied by parks, squares and gardens was in indicator created for this study in order to estimate environmental conditions favoring doing leisure-time physical activity through the proportion (%) of each neighborhood occupied by urban parks, squares and gardens.

Interdependence between individuals residing in the same neighborhood was considered, hierarchical models were adopted with individuals nested in the neighborhoods. The adjusted and unadjusted Likelihood ratios (LR) and their respective 95% confidence intervals were estimated for individual and contextual variables using three groups of multilevel logistic regression models with random intercept. In group 1 models, unadjusted LR were estimated; in group 2, each contextual variable was adjusted, separately, for the individual variables; and in model 3 they were mutually adjusted. The Restricted Iterative Generalized Least Squares algorithm and second order Penalized Quasi-likelihood method of estimation were used.

After adjusting the models, the variance partition coefficients were calculated for the blank and the final model

(model 3), according to the simulation method proposed by Goldstein et al.¹¹ Fit was analyzed by diagnosing residues at the two levels of analysis. All procedures were carried out using the MLWin program, version 2.02.

The number of individuals per neighborhood varied between 1 and 214, with a mean of 17.3 individuals. The population studied was predominantly made up of female workers, aged between 31 and 40, having completed higher education, *per capita* household income above six minimum wages and in stable relationships (Table 1).

The prevalence of leisure-time physical activity was estimated at 42.9%, being higher among men, those having completed higher education and those with *per capita* household income above six minimum wages. Higher prevalence was also found in individuals residing in neighborhoods with higher Theil and social development indices and with greater proportions occupied by parks, squares and gardens (Table 2).

The research was approved by the Research Ethics Committee of the *Hospital Universitário Pedro Ernesto*

Table 1. Distribution of individual variables between participants in the Pró-Saúde study. Rio de Janeiro, RJ, Southeastern Brazil, 1999.

Variable	n	%
Leisure-time physical activity ^a		
Yes	1,148	42.9
No	1,526	57.1
Sex		
Male	1,136	42.5
Female	1,538	57.5
Age (years)		
20 to 30	427	16.0
31 to 40	1,086	40.6
41 to 50	874	32.7
> 50	286	10.7
Schooling		
Up to elementary education completed	491	18.4
Completed high school	955	35.7
Completed higher education or more	1,207	45.1
Per capita household income (MW)		
< 3 MW	572	22.5
3 to 6 MW	954	37.6
> 6 MW	1,014	39.9
Marital status		
Single	593	22.8
In a stable relationship	1,535	57.4
Separated or widowed	474	17.7

MW: minimum wage

^a In the two weeks preceding the study.

Table 2. Prevalence of leisure-time physical activity according to individual and contextual variables of the neighborhood. Rio de Janeiro, RJ, Southeastern Brazil, 1999.

Variable	n	Prevalence (%)
Sex		
Male	550	48.4
Female	598	38.9
Age (years)		
20 to 30	174	40.7
31 to 40	472	43.5
41 to 50	385	44.1
> 50	117	40.8
Schooling		
Up to elementary education completed	176	35.8
Completed high school	383	40.1
Completed higher education or more	580	48.1
Per capita household income (MW)		
< 3	197	34.4
3 to 6	368	38.6
> 6	519	51.2
Marital status		
Single	257	43.3
In a stable relationship	671	43.7
Separated or widowed	182	38.4
Theil index (quintiles)		
0.26-0.36	177	41.6
0.37-0.40	221	39.4
0.41-0.45	186	35.6
0.46-0.51	256	46.0
0.52-1.11	308	50.6
Social development index (quintiles)		
0.37-0.54	172	32.3
0.55-0.60	187	35.9
0.61-0.65	227	42.0
0.66-0.72	221	47.2
0.73-0.85	341	55.4
Proportion (%) of area occupied by parks, squares and gardens (quintiles)		
0-0.15	195	36.9
0.16-0.747	186	35.8
0.76-2.97	205	48.2
3.05-7.37	350	53.1
7.41-74.87	212	39.2

MW: Minimum wage

(Record 224/1999). Participation was voluntary and all information was confidential, as was explained to participants before they signed the informed consent form.

RESULTS

In the unadjusted models (group 1 models), individuals in neighborhoods in the fourth and fifth quintiles of the social development index, and in the third and

fourth quintiles of the proportion of area occupied by parks, squares and gardens had a significantly higher chance of doing leisure-time physical activity, compared to those residing in neighborhoods in the first quintile of these variables. When individual variables were included (group 2 models), associations between the social development index, proportion of area occupied by parks, squares and gardens and leisure-time physical activity decreased, although they remained significant.

The association between the Theil index and leisure-time physical activity lost statistical significance (Table 3).

In model 3, which included all of the individual and contextual variables, only the social development index remained associated with leisure-time physical activity, showing an increase in the likelihood ratio with increase in the quintile. Thus, residents in neighborhoods in the fifth quintile of the social development index are twice as likely (LR = 2.13; 95%CI 1.40;3.25) to do leisure-time physical activity as those residing in neighborhoods in the first quintile (Table 3).

The percentages of unexplained variance attributable to differences between neighborhoods were 3.6% in the blank model, and 0.03% for individuals in the reference categories of the variables included in model 3 (young, male, single, higher levels of income and of schooling; and residing in neighborhoods with lower Theil indices, higher social development indices and higher proportions of areas occupied by parks, squares and gardens). Residue analysis, at both the first and second levels, showed normal distribution.

DISCUSSION

Great economic and social contrasts exist in Rio de Janeiro. Whereas some neighborhoods have high social

development indices, others have levels well below the municipal mean. On the other hand, the city has plentiful seafont and many parks and squares, providing conditions favorable to doing leisure-time physical activity. However, the access of the population to such environmental conditions is not homogeneous.

In this study, doing leisure-time physical activity varied significantly according to neighborhood. It was more prevalent among residents in neighborhoods with better social conditions and access to public areas of leisure, regardless of individual attributes. However, after simultaneous adjustment, socio-environmental characteristics grouped in the social development index were shown to be more important than physical characteristics in determining the practice of leisure-time physical activity. The Theil index, associated with physical activity in the unadjusted models, lost its statistical significance after adjusting for individual variables, suggesting that inequality in income distribution is not associated with doing leisure-time physical activity.

There is relatively little data on Brazilians' leisure-time physical activity, although what there is agrees with the findings presented in this study. Data from the 2011 Surveillance System for Chronic Disease Telephone Survey (VIGITEL) indicate a prevalence of 30.0% for leisure-time physical activity in the state capitals, with

Table 3. Adjusted and unadjusted likelihood ratios (LR) for individual sociodemographic variables and contextual variables of the neighborhood de chances. Rio de Janeiro, RJ, Southeastern Brazil, 1999.

Variable	Models 1 ^a		Models 2 ^b		Models 3 ^c	
	LR	95%CI	LR	95%CI	LR	95%CI
Theil index (quintile)						
0.26-0.36	1		1		1	
0.37-0.40	1.00	0.68;1.43	1.00	0.73;1.40	1.17	0.85;1.62
0.41-0.45	0.76	0.53;1.10	0.78	0.56;1.09	0.86	0.63;1.18
0.46-0.51	1.15	1.02;1.66	1.13	0.81;1.56	1.11	0.81;1.52
0.52-1.11	1.51	1.02;2.26	1.35	0.95;1.93	1.17	0.86;1.59
Social development index (quintile)						
0.37-0.54	1		1		1	
0.55-0.60	1.19	0.91;1.57	1.22	0.93;1.61	1.41	1.02;1.95
0.61-0.65	1.53	1.17;2.02	1.44	1.09;1.89	1.54	1.12;2.12
0.66-0.72	1.91	1.41;2.57	1.75	1.31;2.34	1.65	1.14;2.39
0.73-0.85	2.75	2.08;3.63	2.25	1.70;3.00	2.13	1.40;3.25
Proportion (%) of the area occupied by parks, squares and gardens (quintile)						
0-0.15	1		1		1	
0.16-0.747	1.00	0.72;1.30	0.90	0.69;1.19	0.87	0.65;1.16
0.76-2.97	1.60	1.14;2.26	1.41	1.04;1.90	1.20	0.90;1.69
3.05-7.37	2.02	1.49;2.74	1.63	1.24;2.14	1.11	0.76;1.62
7.41-74.87	1.19	0.88;1.61	1.05	0.80;1.38	1.09	0.79;1.47

^a Unadjusted LR.

^b LR adjusted for sex, age, per capita household income, schooling and marital status.

^c LR adjusted for sex, age, per capita household income, schooling, marital status and other contextual variables.

this being higher among men (40.0%) compared with women (22.0%) and increasing as level of schooling increased, in both sexes.^c

The highest levels of prevalence observed in this study (42.9%) may be explained by characteristics of the population studied (economically active and with higher levels of schooling). Moreover, individuals who reported having done leisure-time physical activity in the two weeks preceding the study were classed as active; in contrast, in surveys such as VIGITEL^c, individuals classed as active in leisure-time were those who did at least 30 minutes of mild or moderate activities five days a week or more and/or at least 20 minutes of vigorous activities three days a week or more. Thus, individuals who practice leisure-time physical activity more sporadically and at lower intensities were classified as active, therefore producing higher levels of prevalence of physical activity in leisure-time.

Traditionally, initiatives promoting health by encouraging physical activity have been based on educational measures which emphasize changes in the behavior of the individual. This approach, however, focused exclusively on the individual, has been shown to be insufficient to increase the population's levels of leisure-time physical activity. Increasing attention is now being paid to the role of profound changes in characteristics of physical, social and manmade environments – varying from spaces such as buildings and parks to the infrastructure of neighborhoods and cities, such as water supply or energy grids – with especially strong influence on patterns of the population's physical activity, it being recognized that increasing sedentarism is not restricted to the sphere of individual choices.^{1,19}

From this broader perspective, international studies, especially those conducted in the United States, Australia and European countries from 2000 onwards, have shown that some contextual characteristics of the region in which the individual lives have been consistently associated with doing leisure-time physical activity. Residents of neighborhoods with: access to places appropriate for doing leisure-time physical activity, better traffic conditions, pavements, cycle lanes and trails; security, illumination; transport facilities, trees and pleasant landscapes; parks, leisure areas, boardwalks and green areas in close proximity are more likely to be physical active.^{13,14,17,19,20} On the other hand, residents in neighborhoods which prioritize the accumulation of motorways and automobile use, which makes doing physical activity unsafe – due to the lack of pavements and pedestrian crossings or due to high rates of violence –, have a greater chance of being sedentary.^{18,19,21}

Although they are scarce, in general, Brazilian studies show associations between leisure-time physical activity and contextual characteristics of the neighborhood. Data on the adult population of the Brazilian capitals for 2006, collected by VIGITEL^c, show direct association between doing leisure-time physical activity and the proximity of the respondent's residence to places propitiating leisure-time physical activity.⁸ Another study,²² conducted with the elderly in Sao Paulo, SP, Southeastern Brazil, showed that leisure-time physical activity was associated, among men, with the perception of safety, the presence of courts and gyms and the proximity of banks or health centers. For women, living close to churches and the presence of squares and gyms in the area of the residence was associated with increased leisure-time physical activity. On the other hand, a study with the adult population in Sao Paulo who participated in VIGITEL^c did not find an association between the density of parks and public facilities/equipment for doing physical activity in the area of residence and leisure-time physical activity.¹²

In a study conducted in 11 countries (Belgium, Brazil, Canada, Columbia, China, the United States, Japan, Lithuania, Norway, New Zealand and Sweden) using standardized methods for collecting information on physical activity and characteristics of the neighborhood, five of seven variables on the context were associated with physical activity in all of the countries, meaning that the results from economically advantaged countries could be generalized for those with mid or low income.²¹ The contextual variable most strongly associated with doing leisure-time physical activity was the presence of pavements in the majority of streets in the neighborhood.²¹ This result reinforces the idea that simple, non-onerous strategies may stimulate diverse leisure activities such as walking, running, skating and cycling.^{18,20,21}

Regarding green areas and public parks in particular, when location, access and maintenance and security are convenient, studies show direct associations with leisure-time physical activity due to low (or no) cost. The presence of pleasant, natural spaces, sharing the space with other physical active individuals and greater social interaction and cohesion. Moreover, places where there are more trees and green areas are associated with lower levels of crime, assault and violence.^{1,24}

The presence of parks in the neighborhood is linked to benefits which go beyond physical and mental health. It is also related to social (e.g., increasing social interaction), economic (e.g., increased number of near-by restaurants and shops) and environmental (e.g., reduced air pollution) benefits.^{1,24} On the other hand, access to such spaces is not egalitarian: in the United States,

^c Ministério da Saúde. Secretaria de Vigilância em Saúde. Vigitel Brasil 2011: vigilância de fatores de risco e proteção para doenças crônicas por inquérito telefônico. Brasília (DF); 2012. p. 132.

racial minorities, the poor, elderly and women have less access to spaces which propitiate leisure-time physical activity.^{1,17,19} Diez-Roux et al found an association between access to leisure areas and doing leisure-time physical activity among Afro-American and Latinos, although there was no association found for Whites,⁴ showing the complexity of interactions between context and individual behavior. Inequalities in access may explain findings related to racial/ethnic and socioeconomic inequality in this respect, e.g., obesity.¹⁹

Certain limitations may have influenced the results of this study. First, the choice of neighborhood by physically active people may have been influenced by facility of access to environments favorable to doing leisure-time physical activity. Second, although the proportion of the area occupied by parks, squares and gardens serves as a marker of access to leisure environments, other spaces related to leisure-time physical activity such as beaches and cycle lanes were not analyzed, as they were not included in the available databases, which may have weakened the association between this variable and leisure-time physical activity. Third, as the neighborhoods in Rio de Janeiro are so heterogeneous, the capacity to distinguish “inter-neighborhood” differences was decreased, as indicated by the variance partition coefficients in the blank model. However, choosing to use smaller, and therefore more homogeneous, units of analysis would mean a much reduced number of individuals within each unit. Finally, the period to which leisure-time physical activity referred – only the two weeks preceding

the study – does not guarantee that it was a consistent habit; moreover, the analysis did not incorporate analysis of type, frequency, intensity or duration of leisure-time physical activity. On the other hand, the experience of a population residing in a heterogeneous region and with economic, ethnic-racial and social contrasts provided a wider understanding of interaction existing between health-related behavior and environmental effects in determining leisure-time physical activity.

To sum up, the data suggest that increasing access to public leisure spaces is an important measure in promoting health at the collective level. However, better social conditions can have a stronger influence on an individual’s possibility of doing leisure-time physical activity, irrespective of individual attributes and their potential access to leisure spaces. These results are in agreement with theories on the dynamic interaction between individuals and the context in which they live, which postulate that the majority of health-related behaviors and outcomes are not randomly distributed among regions or populations.²

In the case of leisure-time physical activity, contextual components were shown to be just as, if not more, determining as individual components. Thus, it can be concluded that the focus on an active lifestyle, although very much based on educational actions at an individual level, needs also to be aimed at improving contextual aspects such as urban environments and, above all, social conditions.

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