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An Analysis of the Suitability of Public Spaces to Physical Activity Practice in Rio de Janeiro, Brazil

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Abstract

Objectives: To assess the physical characteristics of public spaces designed for sport/physical activity/leisure in Rio de Janeiro, Brazil, and their relationship to the socioeconomic indicators. ***Methods:*** Public spaces (n=38) spread across the city were evaluated between December 2011 and January 2012 using the *Physical Activity Resource Assessment* (PARA) instrument. Based on PARA results, a Quality Indicator (QI) was prepared and the sample grouped into "High QI" and "Low QI" using a k-means clustering algorithm. The association between QI and the local Social Development Index (SDI) was tested using a Chi-square test. ***Results:*** The average QI was 13.6 ± 4.91 and the median was equal to 13 points. The High QI group, composed of sites with a QI above median, reached 17.9 ± 2.35 points, while the Low QI group reached 9.3 ± 2.16 points. Pearson's Chi-square tests identified a significant association between QI and SDI when the value of SDI 0.7 was used as a criterion for separation (χ^2= 17.84, p <0.001). In neighborhoods with lower levels of SDI, public spaces usually had a lower QI. ***Conclusions:*** Policies to encourage physical activity need to focus attention on the built environment also, particularly in socially vulnerable areas.

Introduction

Among the factors that influence the practice of physical exercises, the built environment has attracted increasing interest due to the realization that physical activity habits of a population are influenced by the characteristics of the physical environment in which they live (Sallis et al., 2006). Since environmental characteristics affect many people at the same time, they are very likely to present a significant impact on the activity levels of the population (Hallal et al., 2010). In addition, the creation of, or enhanced access to, places for physical activity has been shown to be effective in increasing levels of physical activity (Kahn et al., 2002).

Several studies have examined the association between environmental characteristics and physical activity habits, concluding that the presence of sidewalks in the neighborhood (Brownson et al., 2001; Hallal et al., 2010), access to recreational facilities (Gordon-Larsen et al., 2006; Hallal et al., 2010; Humpel et al., 2002) and aesthetic attributes (Carnegie et al., 2002; Hallal et al., 2010; Humpel et al. 2002) all correlate positively with physical activity participation. In addition, the availability, access and characteristics of places for physical activity appear to be influenced by a neighborhood's socioeconomic level, although further research is needed to better establish this relationship. In general, what these studies indicate is that low socioeconomic areas possess facilities in smaller number and of poorer quality than the average (Estabrooks et al., 2003; Gordon-Larsen et al., 2006; Lee et al., 2005).

In this context, the aim of this study was to evaluate the physical characteristics of public spaces in the municipality of Rio de Janeiro, Brazil, and their relationship with the socioeconomic status of the regions where they are located.

Methods

Public recreational spaces (n=38) spread across the city were selected for assessment, their locations covering various socioeconomic regions of Rio de Janeiro municipality.

The *Physical Activity Resource Assessment* (PARA) instrument (UNDO, 2011) was used to assess these spaces. The instrument identifies and classifies the *features* (structures used specifically for exercise such as exercise stations and fields), *amenities* (supporting structures such as benches) and *incivilities* (elements that could discourage the use of the space

such as litter) present in physical activity resources. The *features* and *amenities* are classified into the following four categories: "not present", "poor", "mediocre", or "good" and *incivilities* classified into: "not present", "little presence", "average presence" or "very present".

Subsequently, in order to establish the quality of the spaces visited, a Quality Indicator (QI) was developed. The QI was calculated by adding the scores assigned to the *features* and *amenities* categories and subtracting the score given to the *incivilities* category from the final sum. The possible minimum and maximum values for QI were -36 and 75 respectively. The public spaces were then divided according to the QI, using a k-means clustering algorithm. Finally, the QI was related to the Social Development Index (SDI) of the neighborhood in which the public space is located, with SDI scores ranging from zero (extremely low SDI) to one (extremely high SDI). This measure was created based on indicators belonging to four categories (basic sanitation, housing quality, schooling and availability of income) and is used to compare the socioeconomic status of particular areas within a municipality in Brazil. For this reason, it only allows comparisons with elements of its own group (Cavallieri and Lopes, 2008). The variation of SDI in the neighborhoods of Rio de Janeiro municipality is between 0.277 and 0.854.

In exploring the relationship between both indexes, we first considered using the classical Pearson's correlation coefficient, but the distributional characteristics of the variables did not attend the coefficient assumptions. Therefore, we decided to categorize the values. The QI showed a clear separation between the two groups, but the SDI did not. Then, a ROC analysis was used to determine the most suitable cut-off for the SDI based on the efficiency of the classification, estimated by the mean between sensitivity and specificity, using QI as response variable. The association between QI and SDI classifications was assessed using Pearson's Chi-square tests (α=0.05). All analyses were performed using R software (version 2.15.2).

The assessment was performed by a single observer, between the months of December 2011 and January 2012, during daylight hours only, and was based on the criteria described in the PARA Form Protocol and Operational Definitions.

Results

In the present study, the QIs ranged from 7 to 20 points and the SDI variation was between 0.478 and 0.854. The average QI of the areas assessed was 13.6 ± 4.91 and the median was equal to 13 points. The averages for *features* were similar between the two groups. However, the same pattern was not observed in *amenities* and *incivilities* (Table 1).

<Insert Table 1 about here>

Figure 1 shows the relationship between QI and SDI. The High QI group showed QI above the median value of 13. The graph demonstrates that places with higher QIs are concentrated in neighborhoods that have higher SDIs. In the graph, it is also possible to notice the existence of five misclassifications: three spaces with High QI in areas of low SDI (top left quadrant) and two spaces with Low QI in high SDI areas (bottom right quadrant).

Despite the misclassifications, Chi-square tests confirmed the pattern illustrated in the graph and identified a significant association between QI and SDI when the value 0.7 for SDI was used as the criterion for separation (χ^2=17.84; p<0.001). The area under the curve at the ROC analysis was 0.882 (CI95%: 0.743 – 0.951; p<0.001). The value of 0.7 was selected, showing 89.5% of sensitivity and 84.2% of specificity, with an efficiency of 86.8%.

<Insert Figure 1 about here>

Discussion

Although the public recreational spaces of both groups are similarly distributed and equipped, in the High QI group these are better maintained, presenting a greater quality of *amenities* and a smaller number of *incivilities.* Similarly, Lee et al. (2005), when comparing neighborhoods of low and high purchasing power in the United States, concluded that, despite being similar in relation to the amount of spaces available for physical activity, in neighborhoods of lower socioeconomic status these places had a higher concentration of problems related to maintenance, such as the accumulation of garbage and other debris.

However, the existence of misclassifications suggests that sometimes the social and built aspects of the environment do not follow the same pattern. This finding is explained by

the grade obtained by these five spaces in the category *incivilities*. Three spaces with High QI, although located in relatively deprived areas, presented less incivilities than average. On the other hand, two spaces with Low QI in high SDI areas exhibited more than the average number of incivilities. In the other classifications (*features* and *amenities*), these spaces scored similarly to their counterparts.

Previous research has found that access to facilities is an important environmental factor related to physical activity (Duncan et al. 2005; Humpel et al., 2002). However, Lee et al. (2005) state that assessing the presence or absence of places established for the practice of physical activity may be a simplistic way to investigate the suitability of these resources. For example, the lack of maintenance of the existing places may contribute to their underutilization, mischaracterization of purpose and willingness to misuse (Silva and Versiani, 2012). The fact that our results show that quality of these public spaces is worse in neighborhoods with lower SDIs reinforces such findings and provide further evidence for Lee et al.'s (2005) claims. In sum, residents of the regions with lower SDIs in Rio de Janeiro have at their disposal spaces of lower quality, which, as discussed above, can influence the frequency of physical activity participation. Not surprisingly, the lowest socioeconomic groups have been shown to present lower levels of physical activity among the Brazilian adult population (Dias-da-Costa et al, 2005; Monteiro et al., 2003).

In this sense, MacIntyre (2000), in her study of the social contrasts present in the UK, pointed to a phenomenon called "deprivation amplification". According to the author, the places where individuals who have fewer resources live often have in smaller quantities and quality the very public facilities that could help mitigate their difficulties. Studies in other countries also corroborate this premise (Estabrooks et al., 2003; Gordon-Larsen et al., 2006).

In regards to future applications of this methodology, as there was no previous information about the relationship of PARA scores (and the resulting QI) and social indexes, it is suggested here that future research use social indexes specific to their context to ensure local relevance and validity of QI. Furthermore, future research could attempt to relate the QI with systematic observation evaluation methods to determine more accurate cut-off values.

Conclusions

Results from the present study confirm findings from previous research and demonstrate that the quality of public spaces for leisure time physical activity in Rio de Janeiro is worse in neighborhoods with lower SDIs, whose facilities were of an inferior quality to those located in more affluent regions. These findings indicate, therefore, that it is necessary to develop policies to encourage physical activity that focus also on the built environment, especially in areas that are more socially vulnerable. Furthermore, this study presents a user-friendly tool that can be used to inform policies in this field.

Conflict of interest statement

All authors declare that they have no conflict of interest.

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Table 1

Results of the assessment of the places visited, according to the groups[a]. Rio de Janeiro, RJ, Brazil, 2011-2012.

		Quality Indicator			
	n	Total (mean ± sd)	Features[b]	Amenities[c]	Incivilities[d]
High QI group	19	17.9 ± 2.35	8.9	15.6	6.6
Low QI group	19	9.3 ± 2.16	8.3	11.5	10.5

[a]High QI group: QI>median; Low QI group: QI<median

[b] 13 *features* scored on a 4-point scale where 1="not present", 2="poor", 3="mediocre", and 4="good"

[c] 12 *amenities* scored on a 4-point scale where 1="not present", 2="poor", 3="mediocre", and 4="good"

[d] 12 *incivilities* scored on a 4-point scale where 1="not present", 2="little presence", 3="average presence", and 4="very present"

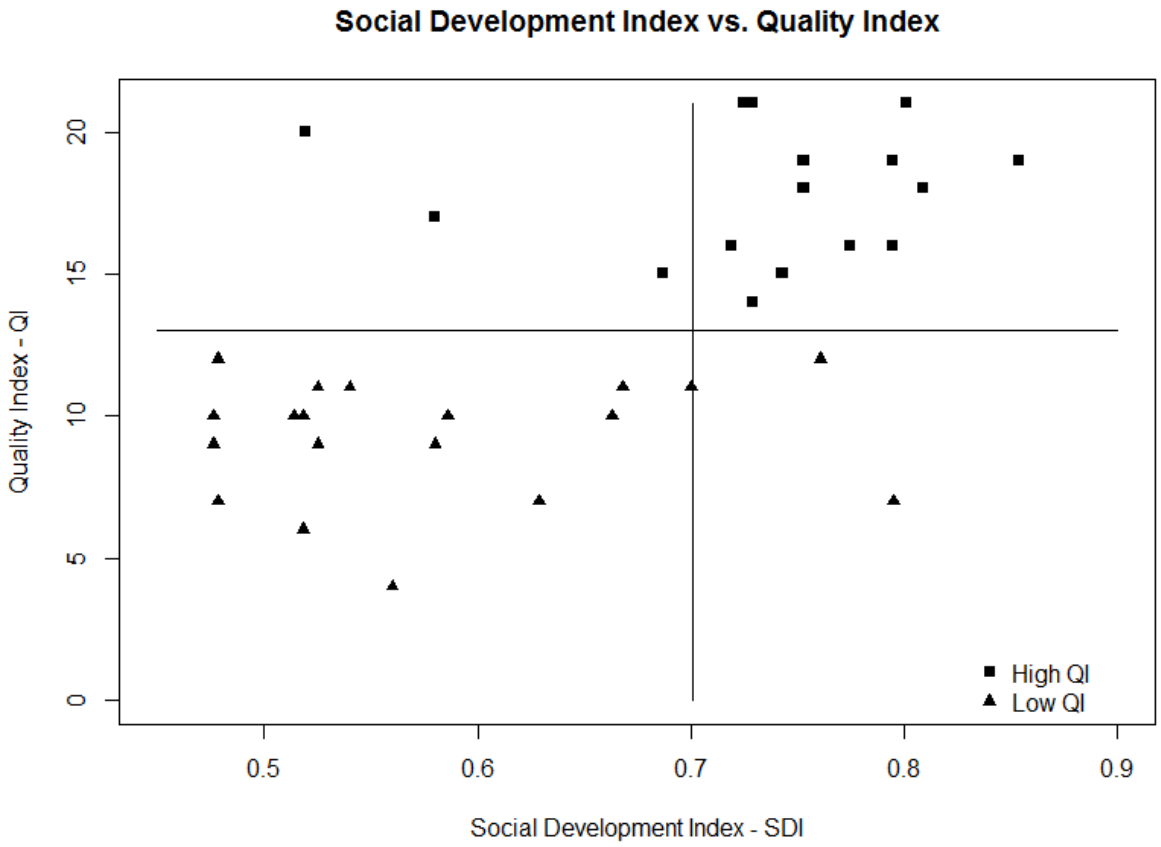

Figure 1. Relationship between the Quality Indicator of the places and the Social Development Index in their respective neighborhood. Rio de Janeiro, RJ, Brazil, 2011-2012.