Environmental Equity and Access to Parks in Greater Montreal: An Analysis of Spatial Proximity and Potential Congestion Issues.

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Calls to provide and ameliorate access to parks have drawn increasing attention from city governments, urban planners, public health agencies and researchers (Giles-Corti et al., 2016). This is because the presence of parks can provide urban inhabitants with ecological, environmental, and social benefits (Bedimo-Rung et al., 2005; Moore et al., 2010). Nevertheless, there seems to be a consensus on the discrepancy in access to good quality and large parks among different groups. Rigolon (2016) in a literature review of 49 urban park accessibility studies (predominantly North American studies with a few exceptions), notes that park acreage and quality are consistently less in areas inhabited by ethnic minorities and low-income groups.

Furthermore, when considering the need for better quality parks and the methods of assessing park access, the variety of quality indicators in park studies has led to several knowledge gaps (Rigolon, 2016). First, a large omission from urban park studies is the notion of park crowding. Carrying capacity is useful in determining the potential congestion of parks based on population density, while functional density can vary with

users' perceptions of comfortable crowds (Cohen et al., 2010). No research to date operationalizes these two concepts into empirical indicators and variables. Second, few of these studies are conducted in Canadian parks, nor in larger metropolitan areas.

Therefore, this study sought to address these gaps with three different methods of assessing park proximity and park congestion in a large metropolitan area. The goal is to evaluate environmental equities for four population groups, i.e., children, seniors, low-income individuals, and visible minorities, in Greater Montreal, by integrating the supply (hectares or park facilities) or the potential demand (population surrounding the park). By doing so, this study can provide entryways to further research on functional density in Greater Montreal parks and provide a more robust snapshot of park access.

Methodology

This study focuses on the 82 municipalities of Greater Montreal governed by the Montreal Metropolitan Community (Communauté métropolitaine de Montréal, in French) and inhabited by 3.8 million people over 4374 km2 in 2016. There are five zones: Montreal, Laval, Longueuil, the North Shore, and the South Shore. Two databases were used for this study and integrated into GIS. First, primary data on Greater Montreal municipal parks was collected in 2016. The data includes details on park location, surface area, and the location of different facilities collected on field visits. Second, sociodemographic data were extracted from the 2016 Census of Statistics Canada at the dissemination area (DA) level for four population groups: children, seniors, low-income individuals, and visible minorities (chosen according to the environmental equity literature).

Two types of spatial access measures are then computed. These measures are respectively associated with two different conceptualizations of the potential spatial accessibility (Apparicio et al., 2017): immediate proximity and potential congestion based on supply and demand. First, to evaluate the immediate proximity, the shortest walking distance between DAs and parks (“the closest park”) is calculated by using the street network and excluding highways. Second, to evaluate the potential park congestion based on supply (either park area or park facilities) and demand (population), the enhanced two-step floating catchment area (E2SFCA) method with a continuous gradient function is used (Apparicio et al., 2017; McGrail, 2012). Once these measures were calculated, they were cross-tabulated by the measures’ quintiles (as done previously by Martori et al., 2019). This demonstrated in all of its complexity, the potential spatial accessibility in function of the immediate proximity and the potential congestion of park area and park facilities. The method of classification by quantiles can be explained by the different population variables and percentages of accessibility.

To assess the levels of access inequity, the previous measures of accessibility were used in linear and multinomial regressions. These statistical analyses are conducted in the R software (R Core Team, 2021). The three measures of accessibility (closest park and the two gradient E2SFCA) were introduced as dependent variables in separate multiple linear regressions. For the independent variables, the four groups of population (seniors, children, low-income, and visible minorities) were used to verify the existence of environmental equity in terms of accessibility. Then, two multinomial logistical models of regression intersecting the accessibility variables show if there is more or less probability

of accessing a park of quality by belonging to one the population categories. All regression models are performed using the *VGAM* package (Yee, 2015).

Results

The results present both similarities and differences, as well as the magnitude of inequities, in regard to park proximity and potential park congestion over the Greater Montreal area. When comparing both the weighted t-tests and linear regressions, there are similar tendencies. Children tend to live further from parks but have better facility provision. Seniors do not have differential access but in the linear regressions, have generally favorable associations to the park measures. However, in the weighted t-tests, low-income and visible minorities are in the same situation: while they live closer to parks, they suffer from park congestion due to limited park space and facilities. Furthermore, when analyzing the linear regressions, the low-income group holds the strongest and negative associations with park congestion measures. The visible minority group follows the same tendency but to a lesser degree. Lastly, the multinomial logistic regressions provide a more complex and nuanced portrait of park access. This analysis can be used to tackle a specific problem of park access, e.g., low level of park proximity and high level of potential congestion park, for a specific group. The results here do not reveal inequity in accessing parks for seniors. In contrast, the visible minority population is only group which tends to live in areas characterized by both low accessibility and high potential congestion.

Discussion and Conclusion

These findings are in line with recent park equity research, in which authors demonstrate that having a park close by does not always translate to an equitable distribution as park quality can also be unequally distributed (Rigolon, 2016). Furthermore, in the context of COVID-19, Montreal parks became important places where standards of accessibility and quality could be tested in a time when many were restricted in movement and social distance remained mandatory. This allows us to witness certain dynamics especially in densely built neighborhoods with limited public spaces. The concepts of carrying capacity and functional density are of particular interest because they come into play as individuals living in denser areas where the carrying capacity of parks is surcharged might mean that people will choose not to visit the park. For example, the city of Montreal has stated that a high increase of park use due to the pandemic has led to an acceleration of park degradation (Goudreault, 2020). It is worth mentioning that these environmental inequities could be exacerbated in areas where people live in high-built density areas without access to a private open space, such as backyards.

Our findings support the relevance of using several accessibility measures in park planning that draw on two dimensions of park access, i.e., park proximity and potential park congestion. The case of Greater Montreal clearly shows the disparities between the inner city and the suburbs along geographic accessibility levels, population size, and profiles. There is a need to integrate proximity and congestion when evaluating park access to provide appropriate solutions to inequities. This approach can help plan parks in a way that facilities can reflect and be updated in relation to the surrounding population and increase use without overcrowding.

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