Reconsidering Access: Park Facilities and Neighborhood Disamenities in New York City

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ABSTRACT *With increasing concern about rising rates of obesity, public health researchers have begun to examine the availability of parks and other spaces for physical activity, particularly in cities, to assess whether access to parks reduces the risk of obesity. Much of the research in this field has shown that proximity to parks may support increased physical activity in urban environments; however, as yet, there has been limited consideration of environmental impediments or disamenities that might influence individuals' perceptions or usage of public recreation opportunities. Prior research suggests that neighborhood disamenities, for instance crime, pedestrian safety, and noxious land uses, might dissuade people from using parks or recreational facilities and vary by neighborhood composition. Motivated by such research, this study estimates the relationship between neighborhood compositional characteristics and measures of park facilities, controlling for variation in neighborhood disamenities, using geographic information systems (GIS) data for New York City parks and employing both kernel density estimation and distance measures. The central finding is that attention to neighborhood disamenities can appreciably alter the relationship between neighborhood composition and spatial access to parks. Policy efforts to enhance the recreational opportunities in urban areas should expand beyond a focus on availability to consider also the hazards and disincentives that may influence park usage.*

KEYWORDS *Built environment, Parks, Spatial accessibility, GIS*

Increasing concerns about persistently rising obesity rates have led to research on a variety of factors that might contribute to overweight and obesity. Prior studies on the risk of obesity have found that individual-level factors have limited ability to explain patterns of obesity or disparities in such patterns. Recent research on environmental factors has focused, in part, on the recreational opportunities available in the neighborhood—with increased attention to the location and features of parks and the association between park access and physical activity and, in turn, the risk of overweight or obesity.

Previous research has repeatedly shown that proximity and access to parks and outdoor recreational opportunities is positively correlated with active behaviors.^{1–5} Moreover, research examining the distribution of environmental conditions—both

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negative (e.g., pollutants, crime) and positive (e.g., recreational opportunities, open space)—has examined whether and how environmental disparities contribute to social and health disparities.^{6,7}

Although concern about the inequitable distribution of parks and open space is not new, geographic information systems (GIS) software and data have enabled a significant expansion of research on disparities in the recreational opportunities and their implications for obesity. A set of studies over the past decade has advanced our understanding of how access to parks varies across neighborhoods and whether park access varies across neighborhoods of differing racial/ethnic and socioeconomic compositions.^{8–10} Despite this growing body of work, however, a key question has been neglected: whether and how the social context of the neighborhood, particularly negative characteristics or disamenities of the neighborhood environment, influence access to parks. By focusing exclusively on spatial dimensions of park availability and characteristics of parks, such as facilities, size, and quality, previous research has neglected to study other neighborhood contextual factors likely to influence whether and how nearby residents access and utilize outdoor space. For example, high neighborhood crime rates and hazardous traffic patterns may reduce park usage and decrease the potential benefits of a park. In short, physical proximity to a park may provide the potential for park usage, but neighborhood disamenities may reduce park usage for physical activity. Thus, it is important to consider both spatial access and neighborhood disamenities in thinking about racial/ethnic and socioeconomic disparities in park access and the role of parks in health promotion.

To address this gap in our knowledge, this study presents a series of analyses to examine how adjustments for spatial variation in characteristics such as crime, traffic, and noxious land uses affect measured disparities in access to parks in New York City. In doing so, we provide evidence to help explain the paradoxical finding that Blacks and Hispanics have higher rates of obesity in New York City despite having more accesses to parks and recreational facilities.¹¹ Examining this wider set of contextual factors, we demonstrate that the parks that Blacks and Hispanics have access to are disproportionately adjacent to disamenities, including crime, lack of traffic safety, and noxious land uses, compared to the parks accessible by Whites.

BACKGROUND

Much of the recent attention in public health to parks and open space is motivated by the assumption that differentials in park access affect exercise and recreation and, thus, body size. Previous research on access to parks has shown that geographic proximity to various forms of open space has a positive effect on physical activity levels.^{4,12,13} Moreover, recent research has documented the relationship between park access and lower rates of obesity and other health problems.^{14–16}

Another dimension of variability in previous studies is in how parks are characterized. Some studies have examined proximity to or density of parks and open space by area income and/or racial composition.^{9,10,17} For the most part, these studies have documented disparities by socioeconomic characteristics in access to parks and other sites for physical activity. For example, one study documented that low- and middle-income neighborhoods have significantly fewer physical activity resources than higher income areas.¹⁰ Another, using data from Los Angeles, found the lowest levels of park resources in areas with concentrations of low-income residents.⁹ This same study found that areas with more African Americans, Latinos, and Asians in the city had lower rates of park access as compared with predominantly White areas.

The evidence of such disparities has not been uniform, however.¹⁸ Some have found that poor and predominantly minority areas have *greater* access to parks. A multisite study of the presence and density of physical activity resources found that minority and low-income neighborhoods had higher densities of public recreation facilities, even after population was taken into account.⁸ Similarly, a recent study of New York City found that areas of the city with higher percentages of Black and Latino residents had greater access to physical activity sites.¹¹ And a recent study of Phoenix found that disadvantaged subpopulations have better access to neighborhood parks.¹⁹

A third group of studies has found no relationship between neighborhood characteristics and park space. For example, a study of Tulsa, Oklahoma, found that although playgrounds were not evenly distributed across the city, variations in their location were not predicted by any socio-demographic variables.¹⁷ A recent study of Baltimore found that racial variation in access to parks depended upon the specific park measure assessed.²⁰ These sets of papers suggest the benefit of examining park access while taking into account other features of the neighborhood environment, such as environmental risks or park quality, that might influence usage.

Conclusions about disparities in access to parks and their relation to health are valid only to the extent that park access measures are valid proxies for the accessibility of recreational opportunities. In addition, informed by research in geography and urban planning,^{17,21} public health studies have used GIS-based measures such as network distance and kernel density measures that more appropriately represent local accessibility than administratively defined units.^{22,23}

Disamenities that Might Influence Park Use

In addition to the spatial accessibility of parks and recreational opportunities, there are other features of the environment that might negatively influence the use of parks and open space. Research from the perspective of environmental justice has called attention to the inequities in the spatial distribution of both amenities and hazards in the environment. Specifically, much of this research has documented the disproportionate exposure of the less well-off and racial and ethnic minorities to environmental hazards such as pollution, as well as the limited access of these same groups to environmental amenities.^{9,24} There is also evidence that fear of crime and other safety-related concerns discourage neighborhood walking or other forms of outdoor physical activity.^{25,26} Concerns about various factors related to safety may inhibit use of parks, which may lead potential users to avoid parks altogether or seek other parks.

A small number of studies have considered the influence of perceived or measured safety with respect to park access and usage.^{27,28} However, only one paper has explicitly considered the implications of these neighborhood conditions for the measurement of economic and racial/ethnic disparities in the park access,¹⁹ an analysis that found that while low-income, African American, and Latino neighborhoods had better walking access to parks, this advantage was offset by higher crime. In addition to problems of poor safety, noxious land uses such as industrial facilities or vacant lots may deter walking and thus discourage use of parks. Industrial facilities are sometimes unsightly and may involve odors or noise or generate heavy truck traffic. Vacant lots are often unkempt and may prompt concern about safety because of the lack of “eyes on the street.”²⁹

Because variation in characteristics such as crime, traffic safety, and land use may be correlated with neighborhood poverty and racial/ethnic composition,

adjusting park access measures for these characteristics may affect our conclusions about disparities in the neighborhood environment. To address this question, we conduct a series of analyses using data for New York City, comparing disparities in access to parks and features of parks before and after adjustment for crime, pollution, and traffic safety.

METHODS

The unit of analysis in this study is the Census tract, with all 2,172 populated New York City Census tracts included in our models. For each tract, we constructed multiple measures of the spatial accessibility of parks. Using data drawn from the 2000 US Census Summary File 3, we created a measure of the percentage of the population of a tract that was African American and a separate measure to assess the percentage Hispanic/Latino. To describe economic composition, we used data on poverty rates defined as the proportion of residents living below the federal poverty line.

Data on parks were provided by the New York City Department of Parks and Recreation through the Parks Inspection Program (PIP). PIP is a comprehensive data collection and measurement system used by the Parks Department to provide information on the condition of New York City parks. Data for PIP are created by a team of trained evaluators who use digital cameras and handheld devices to record conditions of the city's parks. We accessed these data to create measures of 1,795 park properties in New York City. In the case of some of the city's larger parks (e.g., Central Park), we use park "zones," which are city-defined subdivided areas of parks. Whether a park is large enough to be divided into zones is determined by the New York City Parks Department. For further details about the classification of parks and how these data were created, please see the [Appendix](#).

Previous studies have noted the need for more accurate measures in examining available opportunities at parks.¹¹ We examine 4 dimensions of parks in our analysis: the number of parks accessible from a tract, the number of acres of parkland accessible from a tract, the total number of facilities in the parks accessible from a tract, and the number of unique facility types accessible from a tract. Each of these measures is described in greater detail below.

For the first 2 measures, number of parks and acreage of parks, a quarter-mile straight-line distance buffer was created around the population-weighted centroid of each Census tract. Parks accessible to a tract (the *number of parks or park zones*) are those that intersect a quarter-mile straight-line distance buffer around the Census tract centroid. The *number of acres* of accessible parkland is defined as the average total area, in acres, of parks that similarly intersect quarter-mile buffers around tracts. We use the total area of the park rather than the area of the tract buffer and park intersection because we consider tract inhabitants with a part of a park within walking distance to have access to the entire park.

Spatial access to park facilities was measured using data on the location of park entrance points. For this set of parks, in our analysis, we used park access points generated and provided by the New York City Parks Department. These geographic data were checked and cleaned for accuracy by comparing their locations against high-resolution aerial photography. We then digitized additional access points based on the same aerial photography for cases in which it appeared that the original data file was not an accurate representation of access points. Figure 1 illustrates access points within a quarter mile of the tract centroid. To calculate the *total number of*

FIGURE 1. Image of census tract and corresponding park access points.

facilities, we included any facility (court, field, etc.) falling within a quarter mile of a park access point (straight-line distance) when the park access point fell within the quarter-mile buffer around the tract polygon. A list of all facilities included in this measure can be found in the [Appendix](#). Finally, the *total number of types* is defined as the number of unique facility types that the tract has access to using park access points and quarter-mile buffers around tracts.

Given the skewed distribution of these data in their original form, their use without transformation would potentially bias the analytical techniques we use. For 2 measures—number of parks and number of park features—we take the square root of the original value. For the variable of park acreage, we take the natural log of the original value. The number of facility types is used in its untransformed state in our analysis.

Area Safety and Desirability

Our measures of neighborhood safety near parks include indicators of crime and traffic hazards, as well as noxious land uses. We assumed that hazardous or unpleasant conditions were more likely to deter use of a park if they occurred within close proximity; thus, we assigned each tract the noxious use, crime, or traffic safety values. For all 3 of these measures, we use kernel estimation techniques as a way to smooth trends in point data. Kernel smoothing is often used as a means for examining how levels of some event vary continuously across a study area based on the patterning of a sample of points, resulting in a smoothed map of values.³⁰

We used data on homicides to represent the risk of serious crime. We obtained point data on homicides occurring in 2003–2005 from a public *New York Times* web site.³¹ We estimated a spatially smoothed kernel density grid using inverse distance weighting for homicide point locations, combining data for all 3 years, and calculated the average density of homicides for each tract. The benefit of this method is that it better captures the effect of a murder on a community, with greatest effects at the specific location of the event and substantial-though-diminishing effects the farther away a point is from the site of the homicide. That is to say that the spatially smoothed kernel density surface allows

for the influence of a homicide to affect an entire area rather than a single point, though the effect of the homicide decreases the farther one moves from the original point where the homicide occurred.

Using a similar approach, we measured traffic hazards with data on the locations of automobile accidents resulting in pedestrian injuries or fatalities, with data geocoded to the nearest street intersection. These data were obtained for 2002–2005 through a Freedom of Information Letter submitted to the New York City Department of Transportation by a local nonprofit organization, Transportation Alternatives. We estimated a kernel density grid for accident point locations and calculated the average density of accidents for each tract.

Additionally, to capture another dimension of park disamenity, we developed a measure of noxious land uses in the environment. To do so, we created a measure of the average kernel density of the square footage of tax parcels with noxious uses, defined as industrial and manufacturing (based upon the Land Use field in New York City's GIS database, MapPLUTO—classes 06 and 11), as well as vacant lots, and assigned this density value to the tract.

We use ordinary least squares regression to examine the effects of neighborhood characteristics on access to parks and open spaces. We estimate identical models for each of the 4 physical park access measures described in the previous section. In the initial set of models, we examine the relationship between the socio-demographic characteristics of neighborhoods and the measures of park size, number of facilities, and number of parks. We then extend these analyses by including measures of neighborhood disamenities to examine whether and how the relationships observed in the first set of models change.

RESULTS

Data on the distribution of park measures and these demographic characteristics of tracts are presented in Table 1. The upper panel of the table contains information about the characteristics of parks. On average, a tract in New York City has multiple parks within a quarter mile of the tract's center, with a median value of 3 and a mean of 4 parks. The average acreage of parkland within a quarter mile of the tract shows a highly skewed distribution, with a median value of 5.2 and a mean value of more than 60. The total number of facilities and total number of facility types are also presented in the table.

The second panel of Table 1 shows the distribution of transformed park measures, which are used as the outcomes in our analysis. The third panel of the table presents information about the distribution of the socio-demographic characteristics of tracts used in our analysis. The data presented on the racial characteristics attest to the racial diversity of the city, with the measure of foreign-born residents offering evidence of the high levels of immigration that the city has experienced.

Results presented in Table 2 examine the relationship between the socio-demographic characteristics of a neighborhood and the availability of parks and recreation facilities. The figures presented in Table 2 show that the relationships between neighborhood characteristics and park access are consistent with those found by Maroko et al.¹¹ The first column of the table shows results from the model examining the measure of the number of parks in a quarter-mile buffer. Both the percentage of the population that is African American and the percentage that is Latino are positively related to the number of parks in the area. Similarly, the

TABLE 1 Count of accessible park, by tract composition—all New York City tracts

	Mean	SD	Median	High	Low
Park measures					
No. of Parks	3.99	2.82	3	18	0
Park acreage	60.76	142.32	5.21	2,106.86	0
No. of facilities	16.90	15.23	13	117	0
No. of facility types	4.03	2.11	4	12	0
Transformed park measures					
Square root (no. of parks)	1.87	0.73	1.73	4.24	0
Ln (park acreage)	3.61	1.95	3.03	8.96	0
Square root (no. of facilities)	3.69	1.86	3.61	10.82	0
Demographic measures					
Percent White	44.74	31.15	40.42	100	0
Percent African American	27.86	32.27	10.11	100	0
Percent Hispanic	25.03	22.90	16.02	100	0
Percent foreign-born	34.94	16.58	33.35	100	0
Percent poverty	20.55	14.59	17.18	100	0
Population density	18.66	13.99	15.41	89.99	0.02

percentage of the population of an area that lives below the poverty line is also positively associated with the number of parks, a finding also consistent with previous analyses. The percentage of the population that is foreign-born, in contrast, is negatively related to the square root of the number of parks in an area.

The findings of the relationship between socio-demographic characteristics of neighborhoods and the number of parks in the area are consistent with some of the other outcome measures presented in Table 2. Areas that have higher proportions of African American and Latino residents have a significantly greater number of park facilities and greater number of types of park facilities. Similarly, both outcome measures are positively related to the percentage of residents whose incomes fall below the poverty line.

The final outcome presented in Table 2, the measure of park acreage accessible to residents of a neighborhood, has a different relationship to neighborhood characteristics than the other outcomes. For this outcome, the greater the percentage of residents who are African American, who are Latino, and who are poor, the lower is the amount of park acreage. Similarly, areas with higher percentage of residents born outside the United States have less park acreage, as do areas with higher population density.

Taken together, although different geospatial approaches to measuring park access were used, the results presented in Table 2 confirm some prior research on the

TABLE 2 Associations of neighborhood composition and density with park availability, park facilities, and park acreage

	Sqrt (no. of parks)	Sqrt (no. of facilities)	No. types of facilities	Ln (park acreage)
Percent Black	0.123*** (0.046)	0.404*** (0.123)	0.309** (0.143)	−0.542*** (0.138)
Percent Latino	0.564*** (0.081)	0.587*** (0.218)	1.176*** (0.253)	−0.569** (0.241)
Percent foreign-born	−0.804*** (0.097)	−1.991*** (0.261)	−2.245*** (0.303)	−1.078*** (0.289)
Percent in poverty	1.211*** (0.124)	2.847*** (0.335)	1.857*** (0.388)	−1.945*** (0.369)
Sqrt population density	−0.015 (0.010)	−0.043 (0.028)	−0.067** (0.033)	−0.111*** (0.031)
Observations	2,172	2,172	2,172	2,108
R ²	0.263	0.177	0.155	0.130

p*<0.05, *p*<0.01, ****p*<0.001

relationship between socio-demographic characteristics of neighborhoods and park access. Specifically, neighborhoods with higher concentrations of traditionally disadvantaged social groups have access to more parks with a greater number of facilities and greater number of types of facilities. In the next phase of this analysis, we look at whether these relationships persist once we take into account potential disamenities in the neighborhood environment.

Examining Models with Measures of Neighborhood Disamenities

Table 3 shows the results of models that include the neighborhood disamenities as predictors, along with the predictors included in Table 2. With the inclusion of these new variables in the model, some of the relationships between neighborhood socio-demographic characteristics and park access are changed. The most substantial changes are in the relationship for the measure “Percent Black.” While the percentage of a neighborhood’s residents who are Black was positively related to the number of parks measure in Table 2, the relationship is *negative* once the neighborhood disamenity measures are included. Additionally, for both measures related to park facilities, while Percent Black was positively and significantly related to the outcomes in Table 2, neither relationship is significant in Table 3. The apparent advantage that African Americans have in respect to physical access to parks is diminished or even reversed once neighborhood disamenities are adjusted for.

The other relationships in Table 3 change less dramatically. Across all 4 outcomes, the effect of the measure of the percentage of residents who are Latino decreases in magnitude and, for some outcomes, in statistical significance as well. The first column of the table shows results from the model examining the measure of the number of parks in a quarter-mile buffer. Both the percentage of the population that is African American and the percentage that is Latino are positively related to the number of parks in the area. Similarly, the percentage of the population of an area that lives in poverty is also positively associated with the number of parks. The percentage of the population that is foreign-born, in contrast, is negatively related to the square root of the number of parks in an area.

Another Way of Incorporating Measures of Neighborhood Disamenities

Another means of examining how consideration of environmental disamenities alters the picture of socio-demographic disparities in access to parks excludes parks in neighborhoods with high levels of crime, vehicular accidents, or pollution. We make the assumption that parks in the upper end of the distribution of these problems are less accessible and/or less attractive to potential users. For this portion of the analysis, we assumed that parks in the highest quintile of homicide, pedestrian–auto fatalities, or pollution were unavailable to potential users. Although a strong assumption, it is likely that poor safety or environmental conditions might reduce park usage. The data with these parks removed can be reanalyzed by neighborhood characteristics—and the results can be compared to the results of analyses of the full park dataset.

Figure 2a shows 4 sets of 2 bars (1 for the full parks dataset and 1 for the reduced parks dataset) looking at the amount of park acreage accessible to a neighborhood by quartile of neighborhood poverty. Examining only the darker bars of the figure, the data show a relationship such that areas with more poor residents have lower levels of park acreage—a finding consistent with the results presented in

TABLE 3 Adjusted associations between neighborhood composition, density, safety, and land use mix with park availability, park facilities, and park acreage

	Sqrt (no. of parks)	Sqrt (no. of facilities)	No. types of facilities	Ln (park acreage)
Percent Black	−0.106** (0.054)	0.0111 (0.147)	0.049 (0.171)	−0.454*** (0.163)
Percent Latino	0.334*** (0.085)	0.445* (0.232)	0.945*** (0.270)	−0.211 (0.253)
Percent foreign-born	−0.759*** (0.097)	−1.965*** (0.264)	−2.118*** (0.308)	−1.040*** (0.291)
Percent in poverty	0.871*** (0.128)	2.431*** (0.350)	1.604*** (0.408)	−1.475*** (0.384)
Sqrt population density	−0.016 (0.011)	−0.085*** (0.031)	−0.070* (0.036)	−0.152*** (0.034)
Avg. Homicide Density	0.044*** (0.006)	0.073*** (0.015)	0.045** (0.018)	−0.027 (0.017)
Avg. Ped. Fatality Density	−0.0157 (0.019)	−0.090* (0.052)	−0.136** (0.061)	−0.205*** (0.057)
Noxious Usage Density (100,000s)	0.004*** (0.001)	−0.003 (0.002)	0.002 (0.003)	−0.015*** (0.003)
Observations	2,172	2,172	2,172	2,108
R ²	0.29	0.187	0.159	0.15

p*<0.05, *p*<0.01, ****p*<0.001

the previous tables. When we exclude those parks with the highest levels of homicide, traffic fatalities, and pollution, these disparities become even starker, as evidenced in the series of lighter bars in the figure. These results suggest that lower income neighborhoods have even less access to parks once spatial access is discounted for negative social conditions.

Figure 2*b* presents a similar analysis, examining the number of total park facilities by poverty quartile, with the darker bars showing the unadjusted values and lighter bars for adjusted park measures. Here, the story is even more striking. Focusing first on the darker bars, Figure 2*b* shows an inverse relationship between level of poverty and the total number of park facilities. That is, areas with poorer residents have more park facilities in their neighborhoods. However, when we exclude those parks with the highest levels of homicide, traffic fatalities, and pollution, the relationship is inverse, such that poorer neighborhoods have *fewer* park facilities. The data presented in Figure 2*a, b* offer further evidence of the importance of accounting for disamenities when examining the relationship between neighborhood socio-demographic characteristics and park access.

CONCLUSION

Research using GIS measures of access to parks has greatly enhanced our understanding of the availability of exercise and recreational opportunities in urban environments. However, in order to fully realize the benefits of GIS, it is important to address a number of conceptual and methodological issues. As this paper has highlighted, one set of issues concerns the difference with spatial access and what we might call social access. Spatial access describes the physical availability or distance to park space and recreational facilities. When considering disparities in spatial access across neighborhoods with differing socio-demographic compositions, one might consider discounting or weighting apparent spatial access for population-level differences affecting the ability to physically traverse space. For instance, in measuring spatial access, one might consider differences in neighborhood transportation systems or population level of disability that interferes with mobility. Here, we have sought to develop and address the notion of social access, which

FIGURE 2. **a** Poverty and park acreage, overall and after exclusion of parks with the worst crime, traffic, and noxious land usage problems: $*p<0.05$, $**p<0.01$, $***p<0.001$. Tests of significance are within category of adjustment, with Most Poor as the reference group. **b** Poverty and park facilities, overall and after exclusion of parks with the worst crime, traffic, and noxious land usage problems: $*p<0.05$, $**p<0.01$, $***p<0.001$. Tests of significance are within category of adjustment, with Most Poor as the reference group.

describes how neighborhood-level differences in disamenities, for instance crime, pedestrian safety, and noxious land uses, might dissuade people from using parks or recreational facilities. In studies of neighborhood disparities in park access, high spatial access might be discounted or nullified by low social access—the disproportionate concentration of crime, pedestrian accidents, and noxious land uses in some neighborhoods.

The analyses presented here offer 2 contributions to our understanding of neighborhood-level disparities in park access. One is substantive: our results demonstrate that adjustment of analyses for differences in neighborhood social access measures affects our understanding of apparent disparities in spatial access to recreational opportunities. While areas of the city with large African American and Latino populations have higher spatial access to parks and facilities, their apparent

advantage is diminished when neighborhood conditions likely to dissuade people from using parks are considered. We measured this diminished advantage as spatial access that has been discounted for higher crime, lower pedestrian safety, and more noxious land uses.

This study also makes a methodological contribution by demonstrating a straightforward, easy-to-implement method of adjusting physical park access measures for differences in neighborhood conditions. These techniques can help researchers in other settings and in other analyses of spatial disparities account for features of the environment that are often overlooked and that may materially affect whether residents use or perceive that they have good access to a neighborhood resource. These techniques are also appropriate for use by policymakers as well.

One primary implication of our findings is the importance of expanding the frame typically used to examine the relationship between socioeconomic characteristics of neighborhood residents and access to park resources in a neighborhood. In our models presented in Table 2, the findings are generally counter to the usual assumptions regarding racial/ethnic and socioeconomic disparities in access to desirable neighborhood resources. The environmental justice literature generally finds that minority and lower-income neighborhoods have higher exposure to noxious uses of physical space and other negative environmental characteristics such as liquor stores and fast-food restaurants, and lower access to positive resources like supermarkets. The one finding that is consistent with the usual environmental justice paradigm is that neighborhoods with higher minority populations have lower acreage of park space. This, combined with the finding that minority neighborhoods have higher numbers of parks, indicates that minority neighborhoods have more small parks. Since neighborhood-level access to large, but not small parks, has been found to be associated with lower BMI, even after controlling for individual- and neighborhood-level socio-demographics, the lower park acreage observed in minority neighborhoods may indicate an environmental justice concern. Maroko and colleagues have found that in New York City, minority and lower socioeconomic groups have higher spatial access to parks and recreation facilities.³² While using different measures of spatial access, our results are similar to that of Maroko and colleagues. However, when we account for features of the environment that are likely to negatively influence park usage, the relationship between neighborhood socio-demographic characteristics and spatial access to parks is quite different.

The data and methods used in this study have a number of strengths. Few studies examining these relationships are able to include multiple measures of park characteristics. Similarly, we were able to draw on multiple sources of rich contextual data to examine the environments surrounding parks. However, there are limitations that should be noted. The primary limitation of our analysis is that we do not have direct measures of individuals' park usage or their perceptions of environmental risk and threat. In addition, the buffer approach used to measure park number and acreage is subject to the limitations of the "container effect" in which all residents of a defined neighborhood are assumed to have equal access to any resource falling within the neighborhood boundary and no access at all to resources falling outside the boundary. In future research, use of more sophisticated spatial measures will provide more precise estimates of spatial accessibility.

The corresponding policy implication from these findings is that public health and park advocates need to move beyond a traditional focus on expanding spatial access to parks as a priority. Efforts to increase the number of parks or park facilities will likely not be sufficient. Rather, current efforts to expand recreational

opportunities should be themselves expanded to incorporate efforts to reduce crime and pollution and make streets safer. As elsewhere, ethnic minority and lower-income populations in New York City are at highest risk for obesity despite these populations having higher spatial access to parks and recreation facilities, as well as streets that, from an urban design perspective, are more walkable. An expansion of the concept of park access to include safe walkable streets around parks and greater safety from crime may allow the higher spatial access minority and lower income populations have to parks and recreation facilities to translate into lower disparities in physical activity and obesity.

In conclusion, we propose that the incorporation of what we term “social access” measures into studies of neighborhood disparities and park access can alter our understanding of which populations have higher or lower access to parks. Social access can be considered a modifier of spatial access; that is, without the presence of parks there is no access, but the value of spatial access may be diminished if social conditions dissuade residents from using the parks. The approaches employed here can be adapted for environmental justice studies of other types of positive neighborhood amenities.

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APPENDIX: CREATING MEASURES OF PARKS IN NEW YORK CITY

In the PIP data provided by the New York City Parks Department, there are 4,815 park properties with information. Park properties can be standalone parks, park zones (which is a specific PIP designation), playgrounds, or other park areas.

However, many of the park properties coded in the PIP data file are ones we would expect to have minimum effect on physical activity. Specifically, parks with one of the designations listed below were excluded from our analysis, resulting in a total number of park properties of 1,795.

EXCLUDED PARK DESIGNATIONS

- Cemetery
- DOT Adopt-A-Highway
- Greenstreet
- Greenthumb garden
- Greenthumb
- Highway property
- Island
- Natural area
- Park strip
- Parking lot
- Pier
- Private property

Sitting area/triangle/mall

Undeveloped parkland

Four additional, unclassified park types were also excluded.

Park Facilities

The following park facilities were included in both facility measures in this analysis:

- Baseball fields
- Basketball courts
- Football fields
- Golf courses
- Handball courts
- Hockey fields
- Pools
- Soccer fields
- Tennis courts
- Tracks
- Volleyball courts
- Bicycle routes
- Recreation centers

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