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ORIGINAL ARTICLE

Spatial Disparities in the Distribution of Parks and Green Spaces in the USA

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Abstract
Background Little national evidence is available on spatial disparities in distributions of parks and green spaces in the USA.
Purpose This study examines ecological associations of spatial access to parks and green spaces with percentages of black, Hispanic, and low-income residents across the urban–rural continuum in the conterminous USA.
Methods Census tract-level park and green space data were linked with data from the 2010 U.S. Census and 2006–2010 American Community Surveys. Linear mixed regression models were performed to examine these associations.
Results Poverty levels were negatively associated with distances to parks and percentages of green spaces in urban/suburban areas while positively associated in rural areas. Percentages of blacks and Hispanics were in general negatively linked to distances to parks and green space coverage along the urban–rural spectrum.
Conclusions Place-based race–ethnicity and poverty are important correlates of spatial access to parks and green spaces, but the associations vary across the urbanization levels.

Keywords Park · Green space · Neighborhood poverty · Health equity · Environmental justice · Urbanization

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Introduction

Less than a third of U.S. youth and less than a half of U.S. adults meet federal physical activity aerobic guidelines [1, 2]. Having access to places to engage in physical activity may improve physical activity levels among adults and youth [3]. In addition, given recent obesity trends, there has been a growing focus on the significance of the built environment for changing individuals' energy balance and weight status [4]. The literature on urban planning, transportation, and public health research about the association between the built environment and physical activity has suggested that features of neighborhood design such as walkability, access to various activity-promoting resources (e.g., recreational facilities, open space, public parks), aesthetics and green spaces, and land use patterns are important contributors to physical activity and healthy weight in adults and children [5–7]. Non-Hispanic blacks and Hispanics are less likely to meet physical activity recommendations than whites, and poverty is another negative correlate [8–11]. This pattern coupled with the presence of persistent residential segregation by income and race–ethnicity in the USA suggests that differential exposure to the built environment may contribute to socioeconomic and racial–ethnic disparities in physical activity [12, 13]. However, little research has been done to test this hypothesis. Spatial inequality in the built environment is not well understood. National-level analyses are particularly lacking for how neighborhood income patterns and racial–ethnic compositions are linked to built environmental attributes.

Social Inequalities in Access to Parks

Among many built environmental features, access to places linked to higher activity levels has received a great deal of research attention [12, 14, 15]. However, empirical results vary regarding how neighborhoods might differ in availability of physical activity resources. Among a variety of such resources, parks, an area of land set aside by local, state, or federal government for public use, usually having facilities for recreation, are among the most extensively examined. Studies on social inequalities in spatial access of parks have generally produced inconsistent results. Some studies found that non-white residents and those of lower socioeconomic status (SES) had less access to parks [15, 16]. Other studies reported that socioeconomically disadvantaged groups, namely blacks and Hispanics and the poor, are not necessarily deprived of park access [17–20]. A third group of studies found no patterned inequalities in park access given no systematic relationship between racial and/or income factors and park access in their empirical analyses [14, 21, 22]. These different findings suggest that the associations between racial/ethnic and income factors and park accessibility are not uniform but dependent on the types and measures of facilities as well as specific study settings. These contradictive results make the claims of park distributive injustice complicated.

Social Inequalities in Access to Green Spaces

Other than parks, green space, an area of vegetated land, usually for recreational or aesthetic purposes, has also been increasingly recognized as an important neighborhood amenity; and access to green spaces has been viewed as a principal key to enhancing health and well-being [23–27]. However, equity in the spatial distribution of green spaces has not been adequately examined. Several studies have assessed the role of SES in the distribution of green spaces and reported consistently that neighborhoods with higher SES levels enjoy greater accessibility to green spaces [28–31]. In addition, limited evidence shows that neighborhoods with higher percentages of black and Hispanic residents are more likely to have less coverage of green spaces [32].

The Environmental Justice Framework

The environmental justice framework is a useful conceptual paradigm for studying the spatial distribution of parks and green spaces [17, 18]. The framework embraces the principle that all people and communities, regardless of their sociodemographic background, are entitled to equal distributions of environmental amenities, and no group should be disproportionately affected by environmental hazards [33, 34]. As in other social science inquiries related to place [35–38], race and class occupy a central position in theoretical and empirical investigations of uneven distribution of environmental "*goods*" or "*bads*" across social groups [17, 39–42]. An emphasis on race and class as possible antecedents of environmental inequalities is consistent with Weber's notion of "life chances," addressing race and class dynamics leading to individuals' life circumstances and social mobility trajectories [43, 44]. In addition, this emphasis on race and class accords with a fundamental cause theory, which contends that race and class are both fundamental causes of health disparities because they are closely bound up with a wide range of resources that promote health and hazards that harm health [45, 46]. Empirically, environmental inequality research has focused heavily on exploring disproportionate burdens on low-income and minority groups by residential proximity and exposure to environmental hazards, and less research has been conducted to investigate spatial inequalities of underexposure to "environmental goods," such as parks and green spaces [19, 47].

Research on environmental inequalities in park and green space accessibility is primarily conducted in local settings influenced by local contexts. National evidence is not readily available to provide a general picture of the availability of places for adults and youth to be physically active in places such as parks and green spaces. Moreover, most studies on park and green space access focused on urban settings. The potential urban-rural differences in park and green space accessibility could differ widely across levels of urbanization, just like those often observed neighborhood effects on health [48]. Similarly, the associations between park and green space and neighborhood SES and racial/ethnic contexts could also vary across the urban–rural strata. These aspects are less understood.

This study thus fills a critical gap by examining ecological correlations of spatial accessibility of parks and green spaces with SES and racial and ethnic composition among all the census tracts in the USA, stratified on the levels of urbanization. On the basis of previous work, we hypothesized that socioeconomically deprived neighborhoods or those areas with concentrations of minority populations were underexposed to parks and green spaces as “environmental goods” [47], empirically testing the suitability of the environmental justice framework for positive environmental outcomes.

Method

Data and Measures

This study is a nationwide ecological study of cross-sectional associations of neighborhood spatial access to parks and green spaces with census tract-level SES and racial and ethnic composition in the conterminous USA. We excluded Alaska and Hawaii from the analyses because of their unique landscape features making measures of spatial access to parks and green spaces incomparable to those for the conterminous USA. Neighborhood percentages of Non-Hispanic whites, blacks, Hispanics, and others were constructed from the 2010 census data. Neighborhood SES was indexed by the percentage of residents living under the federal poverty level from the 2006–2010 American Community Survey. Excluding non-residential (no population) census tracts (496) and census tracts with missing values in poverty rates (280), 71,763 census tracts were used in the analyses. Measures of census tract urbanization levels were obtained from the 2010 ESRI Tapestry Segmentation database [49]. In the Tapestry database, the level of urbanization of a census tract was determined by a variety of factors, including its population density, the size of city, and location in or outside a metropolitan area. The original 11 urbanization levels were Urban Principal Centers I and II, Metro Cities I and II, Urban Outskirts I and II, Suburban Periphery I and II, Small Towns, and Rural I and II [50]. The two levels for each group designate the relative affluence within the group, with I being more affluent than II. We then regrouped these 11 urbanization levels into six categories including Urban Principal Centers, Metro Cities, Urban Outskirts, Suburban Periphery, Small Town, and Rural.

The 2010 park GIS data were created by NAVTEQ from the Homeland Security Infrastructure Program (HSIP) Gold 2011 database [51]. The park data were further complemented by the park GIS data in 2010 ESRI ArcGIS 10.1 Data DVD [52]. The final park dataset included those parks in HSIP Gold 2011 as well as those that only appeared in ESRI park GIS dataset. The final park GIS data in the study included 62,318 parks in the conterminous USA, with 1,217 national parks (1.95 %), 4,521 state parks (7.25 %), and 56,580 local parks (90.80 %). Park size (square miles) and radius (miles) and within-park geometric centroids were generated in ArcGIS. Both large national parks (i.e., mainly composed of natural spaces) and local parks (i.e., outdoor areas set aside for recreation) were included. Neighborhood spatial access to parks was measured by population-weighted distance to parks using the method developed by Zhang and colleagues [53]. A brief description of this method follows.

The final park access measure was the population-weighted distance (PWD) to the closest seven parks. Six sequential calculations were involved in creating this measure: (1) A Euclidean straight line distance between a 2010 census block centroid and a park centroid was calculated, from which the park radius was subtracted to reduce the effects of large park size. (2) The access potential from a census block to a park was calculated as the ratio of park size and the squared distance between them. (3) A sum of a census block’s access potentials to its nearest seven parks was calculated as its spatial park access index. Cognitive research on choice set formation [54] indicated that seven is the most likely size for a spatial destination choice set. (4) The access probability from a census block to a park was calculated as the ratio of the access potential between them and the census block’s park access index (the sum of all seven access potentials). (5) PWD to parks for a census block was calculated as the sum of census block population multiplied by access probability and distance for all its seven nearest parks. (6) A census tract’s PWD to parks was calculated as a sum of block PWD to parks multiplied by block population divided by total census tract population. The key advantage of this new measure of spatial access to park is that it simultaneously takes seven parks into account, adjusting for the uneven population distributions within a census tract and the differential probability of residents’ accessing the parks within or close to their neighborhood. In addition, the measure also avoids the edge or boundary effects of traditional container-based park access measures [53]. To test the sensitivity of our results using different types of park access measures, we constructed additional park measures based on Euclidean distance to the closest one, five, or nine parks (data not shown). These additional park measures were all strongly correlated with our park measure based on seven closest parks (with correlation coefficients greater than 0.95). Our key conclusions on park access remained unchanged in the analyses of using these different park access measures. We thus chose to present results on PWD to the closest seven parks to take advantage of the innovative approach to measuring spatial access to parks [53].

A measure of green space accessibility was derived from the 2006 National Land Cover Database (NLCD2006) with a 16-class land cover classification scheme that has been applied consistently across all 50 states and the District of Columbia at a spatial resolution of 30 m [55]. The NLCD2006 was created following rigorous procedures and with high quality controls [56]. The green space accessibility is defined as the percentage of vegetated land within a census tract, including developed open space, grass, shrub, and forest areas, and excluding those areas for intensive agricultural uses (pasture/hay and cultivated crops).

Analyses

Linear mixed regression models weighted on census tract population count were implemented using SAS proc MIXED to test our hypotheses. A county-level random effect was included in these models to adjust for within-county correlations among census tracts from the same county. The two outcomes, namely distance (PWD) to parks and percentage of green space, were modeled on four covariates including percentage of residents living in poverty, percentage of blacks, percentage of Hispanics, and percentage of other races, stratified by census tracts' urbanization level. Because the socioeconomically disadvantaged racial/ethnic minorities are mainly blacks and Hispanics, and also due to the compositional heterogeneity, the group of other races was included as a control variable in the analyses but will not be discussed. To allow for more intuitive interpretation of coefficients of the linear mixed regression models, we rescaled all the four covariates such that one unit corresponds to a 10 percentage point change.

Results

Table 1 shows descriptive statistics of outcome variables and covariates examined in this study. The median distance to parks was 0.5 miles (interquartile range, 0.3–0.7 miles) in principal urban centers. With the area becoming less urban and more rural, distance to parks monotonically increased. In rural census tracts, the median distance to parks was 6.2 miles (interquartile range, 3.5–10.2 miles). The pattern on percentage of green space was opposite, the more rural, the greater coverage of green spaces. While the median percentage of green spaces was only 2.8 % (interquartile range, 0.0–12.3 %) in principal urban centers, the corresponding figure for rural areas was 54.9 % (interquartile range, 29.9–75.1 %). As to poverty and racial/ethnic factors, principal urban centers had the highest percentages of poverty and non-white residents. Suburban areas had the lowest level of poverty. Percentages of blacks and Hispanics did not follow a strict gradient from suburban periphery to rural areas, although they seem to be least present in rural areas. Percentages of whites follow a dose–response relationship with less urban areas having a higher percentage of white residents.

Table 2 presents the results of mixed linear regression models to test our hypotheses that higher percentage of poverty and greater concentration of ethnic minority residents are negatively associated with access to parks, thus positively with distance to parks. Inconsistent with our hypotheses, percentages of blacks and Hispanics were both negatively correlated with distance to parks. For example, in metro cities, a 10 percentage point increase in the percentage of Hispanic residents corresponded to a 0.03 mile shorter distance to the parks around the census tract. This pattern largely held across urbanization levels except for a few cases in which the coefficients were not significant (e.g., in principal urban centers). As to poverty, the same pattern was observed: higher poverty tracts were closer to parks. In principal urban centers, a 10 percentage point increase in poverty prevalence was associated with 0.02 mile shorter distance to parks. One anomaly to this pattern was found for rural tracts, with a 10 percentage point increase in poverty rate linked to 0.67 mile *longer* distance to parks.

Table 3 presents the results of models testing the hypotheses that green space accessibility is negatively linked to poverty and blacks and Hispanics. Consistent with the hypotheses, poverty and ethnic minority concentration were negatively associated with green space coverage in most areas. For example, in principal urban centers, a 10 percentage point increase in the percentage of black residents corresponds to a 0.30 percentage point reduction in green space coverage. This pattern held across urbanization levels except for census tracts located in the suburban periphery where the association was in the same direction but did not reach statistical significance. As to poverty, similar patterns were observed; higher poverty tracts were less covered by green spaces. In principal urban centers, a 10 percentage point increase in poverty was associated with a 1.72 percentage point reduction in green space accessibility. A noteworthy departure to this pattern was found again for rural tracts, with a 10 percentage point increase in poverty linked to 2.32 percentage point *increase* in green space coverage.

Discussion

Because areas with higher percentages of blacks and Hispanics or low-income individuals are often correlated with greater exposure to environmental hazards or higher risk of obesity [57], it was hypothesized that these groups would be underexposed to parks and green spaces as "environmental goods." However, findings from this nationwide ecological study show that on a national scale, variations of spatial distribution of parks and green spaces do not follow a straightforward inequality paradigm, namely predicting environmental disadvantage following socioeconomic deprivation.

Spatial Disparities in Distance to Parks

For spatial access to parks, measured by population-weighted distance to the seven closest parks, we found that non-rural census tracts of higher poverty and greater

Table 1 Summary statistics of neighborhood park, green space and socio-demographics by urban–rural strata

Characteristics	Urbanization levels	Mean	Median	(Quartile 1st, 3rd)
Distance to parks (miles)	Principal urban centers	0.7	0.5	(0.3, 0.7)
	Metro Cities	1.2	0.8	(0.5, 1.4)
	Urban Outskirts	2.0	0.8	(0.5, 1.8)
	Suburban Periphery	2.3	1.3	(0.7, 2.7)
	Small Town	6.1	4.0	(1.7, 8.6)
	Rural	7.5	6.2	(3.5, 10.2)
Green space (%)	Principal urban centers	10.5	2.8	(0.0, 12.3)
	Metro Cities	31.3	26.9	(10.5, 48.0)
	Urban Outskirts	29.1	23.7	(9.6, 44.0)
	Suburban Periphery	39.9	37.0	(19.7, 57.9)
	Small Town	46.7	44.4	(22.6, 69.5)
	Rural	52.6	54.9	(29.9, 75.1)
Poverty rate (%)	Principal urban centers	21.1	17.4	(9.3, 29.8)
	Metro Cities	13.4	9.4	(4.6, 18.2)
	Urban Outskirts	19.3	16.7	(8.4, 27.7)
	Suburban Periphery	9.1	6.9	(3.7, 12.0)
	Small Town	16.8	15.7	(11, 21.1)
	Rural	13.3	11.9	(7.6, 17.3)
Non-Hispanic whites (%)	Principal urban centers	33.3	24.8	(6.6, 58.2)
	Metro Cities	61.4	68.0	(43.1, 83.6)
	Urban Outskirts	55.9	64.3	(25.8, 84.7)
	Suburban Periphery	77.6	84.2	(68.7, 92.0)
	Small Town	78.1	85.7	(67.3, 94.9)
	Rural	84.0	91.6	(77.5, 96.2)
Non-Hispanic blacks (%)	Principal urban centers	22.0	6.5	(2.1, 30.1)
	Metro Cities	15.4	5.7	(1.8, 17.9)
	Urban Outskirts	18.4	5.4	(1.5, 21.1)
	Suburban Periphery	7.5	2.7	(0.9, 8.2)
	Small Town	7.0	1.4	(0.4, 7.0)
	Rural	7.2	0.8	(0.3, 6.5)
Hispanic (%)	Principal urban centers	12.8	7.2	(3.3, 15.8)
	Metro Cities	8.5	6.1	(3.7, 10.3)
	Urban Outskirts	6.4	3.9	(2.2, 6.6)
	Suburban Periphery	5.7	3.9	(2.5, 6.6)
	Small Town	4.3	2.4	(1.7, 3.9)
	Rural	3.2	2.0	(1.4, 3.0)
Non-Hispanic other races (%)	Principal urban centers	31.9	20.6	(7.3, 55.1)
	Metro Cities	14.7	8.4	(3.7, 19.6)
	Urban Outskirts	19.3	6.8	(2.7, 23.5)
	Suburban Periphery	9.3	4.6	(2.2, 11.3)
	Small Town	10.7	3.9	(1.5, 12.3)
	Rural	5.6	2.3	(1.2, 5.2)

Sample sizes: All census tracts in the conterminous USA excluding Alaska and Hawaii (48 states) in the 2010 U.S. census. Principal Urban Centers, 11,079 tracts; Metro Cities, 17,067 tracts; Urban Outskirts, 12,654 tracts; Suburban periphery, 15,857; Small Town, 3,648; Rural, 11,458 tracts; total conterminous USA, 71,763

concentration of blacks or Hispanics were closer to parks. Although this finding runs counter to our hypothesis, it is consistent with several local studies examining park accessibility from an environmental justice standpoint where an unexpected positive association of higher percentages of blacks or Hispanics in census tracts with better park accessibility is documented [17, 18]. Thus, our study confirms that the observed local patterns that neighborhoods with greater proportions of poverty, blacks, and Hispanics are not less exposed to parks also holds at the national level, suggesting that the observed role of class and race in contributing to unequal distribution of "environmental bads" is

Table 2 Linear mixed regression model coefficients for distance to parks

Urbanization Level	Covariate	Coefficient	Standard error	*p* value
Principal urban centers (*N*=11,079 tracts)	Poverty rate (%)	−0.020	0.006	<0.001
	Non-Hispanic blacks (%)	−0.001	0.003	0.709
	Hispanic (%)	−0.005	0.003	0.152
	Non-Hispanic others races (%)	−0.018	0.005	<0.001
Metro Cities (*N*=17,067 tracts)	Poverty rate (%)	−0.122	0.008	<0.001
	Non-Hispanic blacks (%)	−0.010	0.005	0.031
	Hispanic (%)	−0.028	0.007	<0.001
	Non-Hispanic others races (%)	−0.021	0.011	0.067
Urban Outskirts (*N*=12,654 tracts)	Poverty rate (%)	−0.074	0.019	<0.001
	Non-Hispanic blacks (%)	−0.058	0.012	<0.001
	Hispanic (%)	−0.063	0.014	<0.001
	Non-Hispanic others races (%)	0.555	0.028	<0.001
Suburban Periphery (*N*=15,857 tracts)	Poverty rate (%)	−0.108	0.024	<0.001
	Non-Hispanic blacks (%)	−0.060	0.015	<0.001
	Hispanic (%)	−0.180	0.018	<0.001
	Non-Hispanic others races (%)	−0.246	0.031	<0.001
Small Town (*N*=3,648 tracts)	Poverty rate (%)	0.020	0.104	0.850
	Non-Hispanic blacks (%)	−0.172	0.077	0.026
	Hispanic (%)	−0.312	0.071	<0.001
	Non-Hispanic others races (%)	0.428	0.134	0.001
Rural (*N*=11,458 tracts)	Poverty rate (%)	0.672	0.059	<0.001
	Non-Hispanic blacks (%)	0.010	0.041	0.815
	Hispanic (%)	−0.677	0.057	<0.001
	Non-Hispanic others races (%)	−0.061	0.089	0.491

Sample sizes: All census tracts in the conterminous USA excluding Alaska and Hawaii (48 states) in the 2010 U.S. census

not necessarily applicable to some “environmental goods,” such as spatial access to parks.

That said, the shorter distance to local parks associated with urban areas of higher poverty and higher minority concentration can only speak for spatial access to local parks but not for “social access”—a term recently coined to refer to sociodemographic features such as safety, traffic, and walkability that may directly affect park utilization [58]. Indeed, the physical availability of parks does not guarantee park utilization. Even though a neighborhood may have multiple well-equipped large parks nearby, its residents would not be likely to extensively utilize the parks if they are viewed as unsafe [59] or as settings spawning antisocial behaviors such as gang activities and drug exchange. Land use patterns, park features (facilities), and events held at parks are additional factors found to influence park utilization [7, 60]. A recent study directly examined the spatial versus social access of parks in New York City, finding that the apparent advantage of low-income individuals in spatial access to parks disappeared once neighborhood disamenities such as crime, pedestrian safety, and toxic industrial land uses were accounted for, suggesting that high spatial access might be discounted by low social access in poor neighborhoods [58]. Franzini et al. found that the parks in non-white neighborhoods of three large cities were less safe, less comfortable, less pleasurable for outdoor physical activity, and had less favorable social processes manifested in low collective efficacy and weaker social ties [61]. And Boone found minority residents in Baltimore had access to smaller facilities, although they appeared to be closer to parks [17]. Therefore, the benefits of built environments in non-white neighborhoods are likely offset by social characteristics [18, 61].

In contrast to findings in urban areas, the role of poverty in spatial access to parks was completely opposite in rural areas, which was in accordance with the expectation that poorer areas had less spatial access to parks. From policy perspectives, these findings seem to suggest that in urban areas we may want to focus on social betterment in neighborhoods of higher poverty and minority concentration as well as park quality improvement rather than build more parks in deprived neighborhoods; on the other hand, in rural areas, we may need to build more local parks in high-poverty rural communities to provide the presence of parks

Table 3 Linear mixed regression model coefficients for percentage of green space

Urbanization level	Covariate	Coefficient	Standard error	*p* value
Principal urban centers (*N*=11,079 tracts)	Poverty rate (%)	−1.718	0.124	<.001
	Non-Hispanic blacks (%)	−0.303	0.073	<.001
	Hispanic (%)	−1.078	0.070	<.001
	Non-Hispanic others races (%)	−0.508	0.113	<.001
Metro Cities (*N*=17,067 tracts)	Poverty rate (%)	−3.394	0.146	<.001
	Non-Hispanic blacks (%)	−0.788	0.088	<.001
	Hispanic (%)	−3.324	0.124	<.001
	Non-Hispanic others races (%)	−2.100	0.217	<.001
Urban Outskirts (*N*=12,654 tracts)	Poverty rate (%)	−2.770	0.175	<.001
	Non-Hispanic blacks (%)	−0.372	0.105	<.001
	Hispanic (%)	−1.871	0.121	<.001
	Non-Hispanic others races (%)	1.419	0.240	<.001
Suburban Periphery (*N*=15,857 tracts)	Poverty rate (%)	−3.189	0.252	<.001
	Non-Hispanic blacks (%)	−0.222	0.155	0.153
	Hispanic (%)	−3.115	0.191	<.001
	Non-Hispanic others races (%)	−2.199	0.333	<.001
Small Town (*N*=3,648 tracts)	Poverty rate (%)	0.078	0.498	0.875
	Non-Hispanic blacks (%)	−1.060	0.362	0.003
	Hispanic (%)	−1.260	0.329	<0.01
	Non-Hispanic others races (%)	1.103	0.629	0.080
Rural (*N*=11,458 tracts)	Poverty rate (%)	2.316	0.254	<.001
	Non-Hispanic blacks (%)	−1.228	0.186	<.001
	Hispanic (%)	−3.346	0.260	<.001
	Non-Hispanic others races (%)	−0.241	0.396	0.542

Sample sizes: All census tracts in the conterminous USA excluding Alaska and Hawaii (48 states) in the 2010 U.S. census

as initial efforts on enhancing park spatial access to promote physical activities and combat obesity which is a bigger problem in rural America.

Spatial Disparities in Green Space Coverage

For green space accessibility, we found census tracts of higher poverty or greater percentages of blacks or Hispanics were underexposed to green spaces, supporting the commonly accepted hypothesis that disadvantaged neighborhoods tend to lack health-promoting and activity-inviting environmental resources. The policy implication of this finding is straightforward, that is, to make concerted efforts in increasing greenness in deprived urban neighborhoods as one way to mitigate detrimental effects of neighborhood disamenities often found in such neighborhoods [62]. However, this pattern does not hold in rural areas where a positive association between poverty and green space coverage was detected. In other words, the urban disadvantage of deprived areas in green space access does not extend to rural areas. The underlying reason of this contradiction is unknown. One may be tempted to think this pattern was due to low-income rural areas containing more agricultural fields. But the greenness measure used in this study specifically excluded green spaces for intensive agricultural uses. In any event, given that rural residents generally have to travel farther to a park, figuring out how to better utilize their local green space resources might be one way to go to promote physical activity and stem overweight problems, particularly in high-poverty communities in rural America.

Future Work

To better understand the processes underlying these observed patterns, more national-level ecological assessments should be conducted, and more work needs to be done to understand urban–rural differences in these associations. As previously stated, park and green space development is deeply imbued with political, social, and ecological considerations [17, 47, 63]. Historic and contextual investigation is necessary to discover the stories behind the development patterns of parks and green spaces to reveal long-term, sociopolitical processes leading to today's spatial patterns. Although place-specific historic studies are encouraged and have emerged in the literature [16, 17, 43, 64], in-depth qualitative studies of complex processes underlying surface patterns do not seem feasible on a national scale.

Future nationwide studies should also attempt to investigate disparities in detailed features and use patterns of parks across racial–ethnic groups. Additional built environment attributes should be further examined in relation to the social and cultural contexts in future work.

Study Limitations

Important limitations of the present study are noteworthy. First, the cross-sectional ecological design of this study precludes us from making any causal inferences from the observed associations and exploring temporal trends in these associations. The study is subject to endogeneity issues. It is possible that neighborhoods better covered by green spaces attract better-off residents thereby producing an apparent positive link between neighborhood sociodemographic advantage and access to green space. Second, we adopted an innovative approach to measuring spatial access to local parks. Merits of this measure are that it takes into account both the park sizes and the population count of the census tract, and it is not constrained to the closest park. Evidence shows closest parks may not be the most utilized; and in a car-oriented culture, like the one in the USA, facilities spreading over relatively large areas (e.g., a 5-mile window) may still be relevant to behaviors [65]. However, the validity and reliability of this measure have not been well tested. More work testing the psychometric properties of this measure is warranted. In addition, commercial databases, which were the sources of park data used in this study, are not without weaknesses. Information was not available on features of parks such as facilities, attractiveness, ownership (public or private), and use patterns. Therefore, our park measure was not able to differentiate between types of parks and park quality. Third, there is a time lag between the green space data obtained from the 2006 National Land Cover Database and the census data collected in 2010. It can be argued, however, that green space coverage is not likely to experience substantial changes over a 4-year time frame.

Conclusion

In summary, in this nationwide ecological study, we expanded the environmental justice and health equity research by addressing spatial distributions of environmental benefits of parks and green spaces at the census tract-level and stratified our analyses on urbanization levels in the conterminous USA. The patterns revealed from our study are mixed with respect to our a priori hypotheses. Whereas race and class are indeed important factors, they do not always operate in expected ways. Our conclusion about spatial access to parks in urban areas is consistent with previous observations from the USA and elsewhere—poorer and minority-concentrated neighborhoods do not always lack health-promoting resources and are sometimes in favorable situations compared with more advantaged, non-minority neighborhoods [61, 66, 67]. That said, the findings on urban green space coverage from the present study are entirely consistent with the environmental justice framework. Patterns in rural areas are different and need to be further investigated. Clearly, there is a continued need for promoting equity in spatial distribution of environmental benefits which, presumably, would contribute to greater health equity across different sociodemographic groups in the long run.

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