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Research Paper

Using an environmental justice approach to examine the relationships between park availability and quality indicators, neighborhood disadvantage, and racial/ethnic composition

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HIGHLIGHTS

- Detailed audits for 103 public parks in a southeastern U.S. county were completed.
- Park availability was equitably distributed across diverse block groups.
- High disadvantaged block groups were more likely to have park incivilities.
- Associations between park quality and disadvantage varied by minority composition.
- Quality indicators are important when measuring equitable recreation spaces.

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ABSTRACT

Public parks are key community resources that can promote health. Some research has examined whether parks are equitably dispersed across neighborhoods of varying socioeconomic status and racial/ethnic composition, but few studies have examined the interaction of these characteristics. Additionally, the quality of park environments has received limited attention, but is considered integral to utilization of parks. This study examined the relationship between neighborhood disadvantage and park availability and quality and whether neighborhood racial/ethnic composition moderated these associations. A neighborhood disadvantage index was created for all block groups ($n = 255$) in a southeastern U.S. county using Census Bureau data. Detailed audits of all public parks were conducted in 2013 ($n = 103$). Park availability was determined using ArcGIS and four park quality indicators were examined: facilities, amenities, incivilities, and aesthetics. No significant differences were detected between neighborhood disadvantage and number of parks. However, high-disadvantaged neighborhoods had increased park incivilities compared to low-disadvantaged neighborhoods (IRR = 1.93, 95% CI = 1.24, 3.00). Further, neighborhood racial/ethnic composition moderated the associations between park incivilities and amenities and neighborhood disadvantage. Among low-disadvantaged neighborhoods, park incivilities increased as neighborhood minority concentration increased but remained constant in high-disadvantaged neighborhoods. Additionally, among low-disadvantaged neighborhoods, the number of park amenities decreased as neighborhood minority concentration increased but among high-disadvantaged neighborhoods, park amenities increased as neighborhood minority concentration increased. Identifying and rectifying disparities in park quality may be integral to creating equitable park environments across diverse neighborhoods.

1. Introduction

For several decades, environmental justice research and policy has focused primarily on inequitable exposure to hazardous natural environment elements, such as air pollution, water safety, and

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waste sites, among low socioeconomic and racial and ethnic minority groups (Frumkin, 2005). In recent years, environmental health has broadened conceptually to include the built environment, or human-made structures where people live, work, and spend leisure time (Sallis et al., 2006). Elements of the built environment, such as housing, transportation, and parks and green spaces, have increasingly been linked to disparities in health behaviors and outcomes, and thus have also been recognized as integral components of creating healthier communities by promoting healthy behaviors, reducing neighborhood stressors, fostering social resources, and preventing chronic disease (Jackson, Dannenberg, & Frumkin, 2013; Sallis, Floyd, Rodríguez, & Saelens, 2012; Schulz & Northridge, 2004). Given that elements of the built environment have the ability to hinder or facilitate both physical and mental well-being, scholars from a variety of disciplines have expanded the scope of environmental justice research to include exploration of the inequitable distribution of health-promoting features of the built environment (e.g., parks and open green space) among low socioeconomic and racial and ethnic minority groups (Floyd & Johnson, 2002; Taylor, Poston, Jones, & Kraft, 2006). This is in part because disparities in community resources have been hypothesized as one mechanism that contributes to persisting racial and income-related health inequities observed in the United States (Do et al., 2008; Schulz & Northridge, 2004). As researchers have noted a widening health inequality between social classes and racial/ethnic minority groups (Singh & Siahpush, 2006; Williams, Mohammed, Leavell, & Collins, 2010), exploring environmental justice issues may be a needed next step to explain such inequities. Therefore, the purpose of this paper is to explore whether park availability and quality of those resources are equitably distributed according to neighborhood socioeconomic status and racial/ethnic composition.

Public parks and recreational resources are key components of community and neighborhood infrastructure that may promote active living, physical and mental health, and overall well-being across diverse communities (Babey, Hastert, Yu, & Brown, 2008; Bedimo-Rung, Mowen, & Cohen, 2005; Besenyi et al., 2014; Cohen et al., 2007; Coombes, Jones, & Hillsdon, 2010; Kaczynski & Henderson, 2007; Kaczynski, Potwarka, & Saelens, 2008; Wolch et al., 2011). Specifically, public parks offer spaces (e.g., open green space) and facilities (e.g. trails, baseball fields) for individuals to participate in physical activity (Floyd, Spengler, Maddock, Gobster, & Suau, 2008; Kaczynski et al., 2008; Shores & West, 2008). Also, these facilities have demonstrated psychological and social benefits to individuals by reducing stress and mental fatigue (Ward Thompson et al., 2012), creating a sense of wellness (Broyles, Mowen, Theall, Gustat, & Rung, 2011; Stigsdotter et al., 2010), and increasing social interaction and social cohesion among neighbors (Peters, Elands, & Buijs, 2010). Overall, parks are low to no-cost resources for residents that offer both structured and unstructured opportunities for leisure and physical activity.

A growing body of research has examined the distribution of public parks and recreational resources by neighborhood socioeconomic status (SES) or racial/ethnic composition. Findings from these studies have been largely mixed on the direction and magnitude of these associations. Some studies have reported that parks and recreational spaces are less available in low SES and high minority communities (Estabrooks, Lee, & Gyurcsik, 2003; Harris, Paul, Young, Zhang, & Fulton, 2015; Powell, Slater, & Chaloupka, 2004; Taylor et al., 2006). For example, a nationally representative study found that low SES as well as high racial/ethnic minority Census block groups were less likely to have physical activity facilities like parks and recreation spaces compared to high SES and low racial and ethnic minority block groups (Gordon-Larsen, Nelson, Page, & Popkin, 2006). Conversely, other studies have found no differences in park availability across low, medium, and high income neighborhoods or neighborhoods of varying racial composition (Gilliland, Holmes, Irwin, & Tucker, 2006; Nicholls, 2001) or have found a higher availability of park, recreational, or green space in low-income and high minority areas compared to higher-income and low minority areas (Boone, Buckley, Grove, & Sister, 2009; Sister, Wolch, & Wilson, 2010; Vaughan et al., 2013). Although these studies have made valuable contributions to understanding whether the total availability of park resources is equitably distributed across neighborhoods, at least three areas of inquiry merit greater attention: (1) the quality of park and recreational resources; (2) advancements in the indicators used to investigate environmental justice issues; and (3) analyses that examine the interaction between neighborhood SES and racial/ethnic minority composition. These issues are described further below.

First, in a widely-acknowledged conceptual framework that details how parks can positively influence health behavior, quality is recognized as an under-studied yet critical component of public parks and recreational spaces (Bedimo-Rung et al., 2005). Examining park quality is important because research has indicated that the quality, including facilities and amenities of park environments contribute to whether residents visit and are active in those settings (Giles-Corti et al., 2005; Stanis, Schneider, Shinew, Chavez, & Vogel, 2009). Indeed, a recent study found that park quality indicators such as cleanliness and perceived benefits of parks were related to physical activity and body mass index (Bai, Stanis, Kaczynski, & Besenyi, 2013). As well, a review of studies that examined relationships between park use and park characteristics noted that specific park facilities, like play structures and walking trails, as well as positive aesthetic features were critical for drawing park visitors and facilitating physical activity (McCormack, Rock, Toohey, & Hignell, 2010). Despite such findings, little research has examined whether there are disparities in the quality of park resources, in addition to park availability, across neighborhood SES and racial/ethnic minority composition. For example, one study in Kansas City found that lower income census tracts had higher availability of parks but that the parks in those areas were more likely to contain incivilities (e.g., vandalism, excessive litter) and fewer aesthetic features (e.g., artistic features, water feature) than those in medium and high income census tracts (Vaughan et al., 2013). Similarly, a study examining racial and income-related disparities in neighborhood recreational resources found that although high poverty areas had more accessibility to such spaces, parks and playgrounds were perceived as less safe and comfortable for participation in outdoor physical activity, which could detract from actual park visitation (Franzini et al., 2010). Since the primary focus of most previous research has been on the presence or availability of park facilities, increased attention is needed to determine if the quality of parks and recreational facilities, including characteristics such as facilities and amenities, are equitably distributed across communities by SES and race/ethnicity (Floyd, Taylor, & Whitt-Glover, 2009; Taylor et al., 2006).

Another issue when examining the distribution of built environment resources across neighborhood environments is the inconsistency in how neighborhood socioeconomic characteristics are measured. The most common approach is to use single economic indicators such as median household income or education to assess if a neighborhood is “advantaged” or “disadvantaged” (Gordon-Larsen et al., 2006; Powell, Slater, Chaloupka, & Harper, 2006; Vaughan et al., 2013). Only a few studies have used indices that combine multiple socioeconomic indicators, even though they may be more appropriate (Crawford et al., 2008; Estabrooks et al., 2003). Socioeconomic indices include several variables that represent different aspects of advantage or disadvantage for a given area. For neighborhood disadvantage, indices usually include a number of measures related to poverty, including income, education levels, and employment. Combining multiple socioeconomic measures better represents the concentration of neighborhood disadvantage; persistent and concentrated disadvantaged neighborhoods

lack essential economic resources (i.e., employment and quality educational opportunities) and have poorer mental and physical health than advantaged areas (Elo, 2009; Williams et al., 2010). Neighborhood SES indices have been used to examine the relationship between neighborhood disadvantage and other health-related topics (Finch et al., 2010; Kirby & Kaneda, 2005), including access to healthcare and various health outcomes; however, only rarely have these indices been used in community-level environmental justice research (Boone-Heinonen et al., 2011).

Lastly, neighborhood racial/ethnic minority composition has been examined as a predictor of park availability in environmental justice studies. This is often defined as the percentage of racial/ethnic minority residents within a defined area (Gordon-Larsen et al., 2006; Vaughan et al., 2013). Some research has included the percentage of minority residents as one of the measures in a socioeconomic disadvantage index (Sampson, Raudenbush, & Earls, 1997), whereas others have included racial composition as a separate variable in addition to economic indicators (Boone et al., 2009; Kamel, Ford, & Kaczynski, 2014; Vaughan et al., 2013). Few studies, however, have examined the extent to which racial/ethnic minority composition modifies the association between neighborhood SES and park availability or park quality (Abercrombie et al., 2008).

In the United States, racial/ethnic minorities and predominantly-minority communities experience a higher burden of morbidity and mortality compared to Whites and predominantly-White communities. Racial health disparities persist even after accounting for individual and neighborhood SES indicators (Fang, Madhavan, Bosworth, & Alderman, 1998; Kershaw, Osypuk, Do, De Chavez, & Diez Roux, 2015). This pattern suggests that racial health disparities are not only a result of higher rates of individual or family poverty among racial/ethnic minorities but also the high rates of residential racial segregation experienced by racial/ethnic minorities, particularly Black Americans (Williams et al., 2010). Racially segregated communities have fewer economic, educational, and recreational resources than non-segregated communities and also suffer from concentrated poverty (Williams & Collins, 2001; Williams et al., 2010). Given this complex relationship, treating neighborhood disadvantage and racial/ethnic minority composition as conceptually and analytically the same construct may not be the most accurate way to examine the distribution of built environment resources. For example, it is possible that park availability and quality are lower for neighborhoods with high concentrations of socioeconomic disadvantage but a low concentration of minority residents compared to neighborhoods that have high concentrations of both socioeconomic disadvantage and racial/ethnic minority residents. Thus, in our analysis we explored whether racial/ethnic minority composition moderates the relationship between neighborhood socioeconomic disadvantage and park availability and quality as doing so may provide a more nuanced picture of the distribution of park and recreational resources across diverse neighborhoods (Abercrombie et al., 2008).

To address these identified gaps in the literature, the purposes of our study were to (1) examine the relationship between neighborhood socioeconomic disadvantage and park availability and quality, and (2) examine whether the relationship between neighborhood socioeconomic disadvantage and park quality varies by neighborhood racial/ethnic minority composition.

2. Methods

2.1. Study setting and sample

This study occurred in a semi-urban county in the southeastern United States with a 2012 total population of 474,266, of which 77.1% was Non-Hispanic White, 18.5% was African American, and 8.5% was Hispanic or Latino (United States Census Bureau, 2012). The county represented about 750 square miles in land area. In 2012, the median household income of the county was $48,886 and approximately 15.0% of residents lived below the U.S. federal poverty threshold. In addition, approximately 85% of the county population has a high school degree and over two-thirds of the population was home owners (United States Census Bureau, 2012).

The units of analysis for this study were all of the census block groups in the county ($n = 255$). Block groups are the next to smallest geographical unit recognized by the U.S. Census Bureau. They are consistently small, generally permanent subdivisions of a county that usually contain from 600 to 3000 people and block group size varies depending on the population density of the area (United States Census Bureau, 2014). Census block groups are smaller units than census tracts and have been used as rough approximations of neighborhoods in previous studies (Frank et al., 2012; Gordon-Larsen et al., 2006; Kirby & Kaneda, 2005).

At the onset of the project, parks were identified for enumeration and location through park lists provided by local parks and recreation agencies and planning/geographic information systems (GIS) departments. Ultimately, 103 parks (ranging from 0.12 to 293.24 acres in size) in the county were included in an edited GIS file after an in-person audit determined that the parks were usable for recreation, publicly accessible, free of cost, and located within the county boundary. The final compilation of parks represented approximately 2523.9 total acres of parkland in the county, which included a wide array of park sizes (e.g., small pocket parks and large community parks), park facilities (e.g., playgrounds, sports fields), amenities (e.g., bathrooms, water fountains), and varying levels of observed incivilities (e.g., excessive litter) and aesthetic features (e.g., artistic features).

2.2. Data collection and measures

2.2.1. Neighborhood socioeconomic disadvantage

The primary independent variable in this study was neighborhood socioeconomic disadvantage, which was conceptualized as geographic areas with varying degrees of educational and economic resources (Kirby & Kaneda, 2005; Sampson et al., 1997). To measure neighborhood socioeconomic disadvantage, we used data from the American Community Survey (ACS), which is operated by the United States Census Bureau and is administered annually to a random selection of housing units and residents of group quarters in every county of the United States to assess a variety of demographic and socioeconomic conditions (United States Census Bureau, 2014). ACS 5-year estimates (2008–2012) were available at the block group level and were downloaded from the ACS website for all block groups in the county.

Based on prior research, we created a neighborhood socioeconomic disadvantage index using four ACS variables available at the block group level (Kirby & Kaneda, 2005; Turney & Harknett, 2010). Specifically, a principal component factor analysis with oblique rotation was estimated to examine whether four socioeconomic variables used in previous disadvantage indices – percent unemployed, percent of the population under 125% of the federal poverty threshold, percent less than high school education, and percent of renter occupied housing – provided a good representation of neighborhood socioeconomic disadvantage in this study setting (Kirby & Kaneda, 2005; Sampson et al., 1997). All factors loaded higher than 0.70, with the exception of less than high school education, which still loaded close to 0.50 indicating a good empirical and conceptual fit. We standardized each variable and summed the indicators to create a neighborhood socioeconomic disadvantage index (Kirby & Kaneda, 2005; Turney & Harknett, 2010). Using the index, we categorized block groups into low (<-1 SD), medium (≥ -1 to ≤ 1

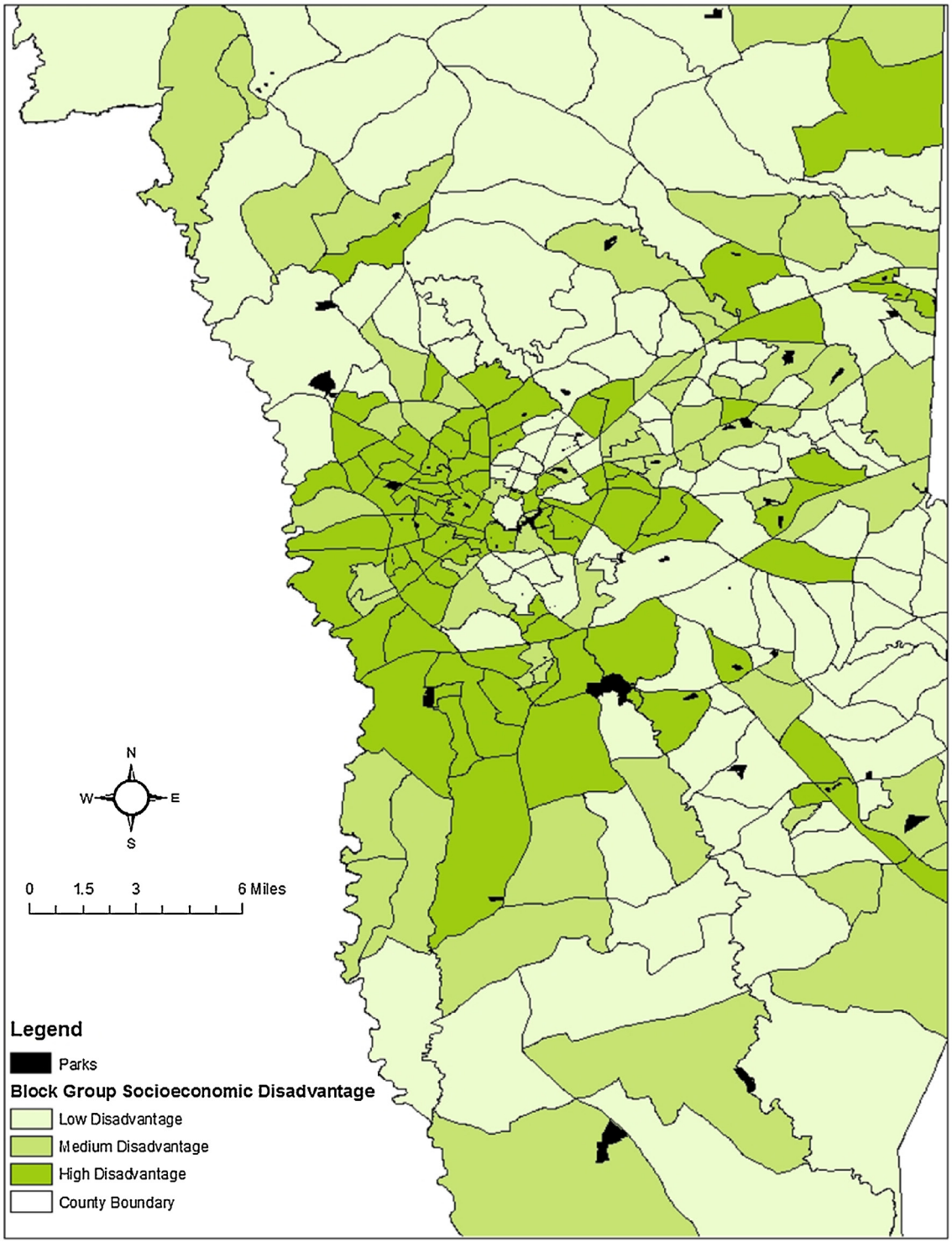

Fig. 1. Map of study area: block group socioeconomic disadvantage and parks.

SD), and high (>1 SD) neighborhood socioeconomic disadvantage. Fig. 1 provides an illustration of the study area. Block groups are shaded based on their level of socioeconomic disadvantage and park locations based on size and location are shaded black.

2.2.2. Park availability and park quality

Park availability was one of the dependent variables in this study. Using GIS, the parks shape file that contains polygons representing the total area and boundaries of all parks was overlaid with all county block groups. Park availability was defined as the number of parks that were within or that intersected the boundary of the block group (Abercrombie et al., 2008; Kamel et al., 2014; Vaughan et al., 2013).

Several quality aspects were assessed for all parks in the county using the Community Park Audit Tool (CPAT) (Kaczynski, Wilhelm Stanis, & Besenyi, 2012). The CPAT is a comprehensive measure recently developed in Kansas City, Missouri to capture key attributes of park environments ranging from park amenities and facilities to overall number of quality indicators that may be related to active use of these settings. This tool also includes

Table 1
Park quality measures captured by the Community Park Audit Tool.

Quality indicator variable	Items
Park facilities	Number of: Baseball fields, basketball courts, dog parks, fitness stations, green spaces, lakes, playgrounds, skate parks, splash pads, sports fields, swimming pools, tennis courts, trails, volleyball courts, and other (write-in additional facilities)
Park amenities	*Neighborhood*: Bike lanes, bike racks, car parking, external trail, sidewalks, visibility, transit stops *Quality*: Animal waste bags, benches, drinking fountains, grills, restrooms, rules posted about animals, picnic shelters, picnic tables, shade, trash cans, vending machines *Safety*: Emergency devices, lights, roads throughout park, park monitored, traffic signals
Park incivilities	Dangerous spots, excessive animal waste, excessive litter, excessive noise, graffiti, poor maintenance, threatening behaviors, vandalism
Neighborhood incivilities	Evidence of threatening persons/behavior, excessive litter, excessive noise, graffiti, heavy traffic, inadequate lighting, lack of eyes on the street, poorly maintained properties, vacant or unfavorable buildings, vandalism
Park aesthetic features	Artistic feature, historical or educational feature, landscaping, meadow, trees throughout park, wooded area, water feature

assessment of areas immediately surrounding the perimeter of the park for specific characteristics such as neighborhood amenities (e.g., sidewalks) and quality concerns (e.g., traffic) (Kaczynski et al., 2012). The CPAT was developed collaboratively with researchers, parks and recreation representatives, community stakeholders, and local residents to ensure the tool was user-friendly for a wide array of potential individuals interested in auditing local park environments. In a recent study, the CPAT displayed good reliability (Kaczynski et al., 2012). Two research assistants who were trained in using the CPAT conducted park audits in the county from September 2013 to January 2014.

Park facilities were conceptualized and captured as activity areas in the park offering different opportunities for active and passive use (e.g., playgrounds, soccer fields, tennis court). The CPAT contained a list of 14 common park facilities and data collectors were to capture the total number of each facility that was present. Also, the audit tool provided designated space for the park auditor to write in if a specific activity area was not listed on the audit tool. Likewise, the CPAT contained a comprehensive list of 23 amenities, which are park features that can enhance park use/visitation (e.g., restrooms, drinking fountains, benches). Similar to the auditing of park facilities, data collectors captured the presence and number of various park amenities. The total list of facilities and amenities included on the CPAT can be found in Table 1.

Three additional quality aspects of the park environment were captured by multi-item indices from the CPAT: park incivilities (e.g., excessive litter, poor maintenance), neighborhood incivilities (e.g., evidence of threatening behavior, poor lighting), and park aesthetic features (i.e., artistic feature, evidence of landscaping) (Kaczynski et al., 2012). The park incivility index, neighborhood incivility index, and park aesthetic features index comprised 9, 11, and 8 items, respectively, and are presented in Table 1. The total number of items observed for each index was summed to create a count score for park incivilities, neighborhood incivilities, and park aesthetic features per park. Because park and neighborhood incivilities both represented negative aspects of park quality, we combined the two indicators into a comprehensive park incivility count variable. Park aesthetic features represented positive aspects of park environments and, thus, were analyzed separately. For more information on the CPAT, including detailed descriptions of the audit tool and measures, please visit the following Active Living Research website: http://activelivingresearch.org/community-park-audit-tool-cpat.

2.2.3. Neighborhood-level covariates

The block group total population, area of the block group in square miles, and total youth population were covariates included in all models. Data detailing the racial and ethnic composition of each block group was elicited from the 2008–2012 American Community Survey. The Census Bureau measures race with one question asking respondents to self-identify their race including an option to choose multiple categories from the following: White, Black or African American, American Indian or Alaska Native, Asian, and Native Hawaiian or Other Pacific Islander. Ethnicity is also self-identified via a single question that asks whether the respondent is 'Hispanic, Latino, or Spanish Origin'. The total percentage of all racial and ethnic minorities (i.e., all persons other than those identifying as Non-Hispanic White) was used to define the minority status of each block group. As in other studies, we combined all racial and ethnic minorities into one category because there were very few block groups that included racial and ethnic minorities other than African American at proportions greater than 5% (Vaughan et al., 2013).

2.3. Analytic approach

First, descriptive information was obtained for all block groups and all parks in the study area to understand the distribution of the number of parks and all park quality variables including park facilities, amenities, incivilities, and aesthetics across all block groups. Bivariate analyses were conducted to examine the association between the park availability and park quality measures and categories of neighborhood socioeconomic disadvantage (not shown). Two types of count variable regression models, negative binomial and Poisson, were used to examine the two study purposes.

For both park availability and number of park facilities, there was an excess number of block groups containing zero parks, indicating over-dispersion (i.e., conditional variance greater than mean). To account for the over-dispersion, we used negative binomial regression to estimate park availability and park facilities (Hardin & Hilbe, 2012). We confirmed that negative binomial regression was a better fitting model than a Poisson regression model by examining the Chi-square likelihood ratio test. Finally, we also tested whether it was necessary to utilize the zero-inflated negative binomial to further account for the excess zeros found for park availability and facilities, but found that negative binomial regression was the best fitting model. The remaining dependent variables – park amenities, park incivilities, and park aesthetics – were examined using multivariate Poisson regression since the dependent variables were count variables and the data indicated a Poisson distribution where the means and variances for each variable were approximately equal (Hardin & Hilbe, 2012). Model fit was also compared to negative binomial for this set of dependent variables and results confirmed that Poisson regression was the best analytical approach.

We assessed two models for each of the five dependent variables. For Model 1, we assessed the association between neighborhood socioeconomic disadvantage and park availability and the four park quality variables, after adjusting for block group population, block group size, youth population within the block group, and percent minority residents in the block group. For Model 2, we investigated if the relationship between neighborhood socioeconomic disadvantage and the park availability and park quality

Table 2
Characteristics of block groups ($n = 255$) across the county in 2013.

	Mean or %	SD	Range
Block group characteristics ($n = 255$)			
Population (N)	1776.2	864.8	(297.0, 4566.0)
Size (sq. miles)	3.1	6.9	(0.2, 68.5)
Median age (years)	38.6	7.5	(20.1, 63.2)
Youth population under 18 years (%)	23.0	7.4	(1.9, 45.2)
Racial/ethnic minority composition (%)	31.5		
Less than high school education (%)	16.9	12.9	(0, 63.2)
Unemployment (%)	6.4	4.4	(0, 23.0)
Population below 125% poverty (%)	23.0	16.7	(0, 76.1)
Rent occupied housing (%)	34.0	23.2	(0, 100)
Socioeconomic disadvantage index			
Low disadvantage (%)	44.3		
Medium disadvantage (%)	23.5		
High disadvantage (%)	32.2		
Park characteristics of all block groups			
Number of parks per block group	0.48	0.82	(0, 5)
Park facilities	2.9	5.5	(0, 29)
Park amenities	4.0	5.9	(0, 20)
Park incivilities	1.8	2.0	(0, 11)
Park aesthetic features	3.0	1.5	(0, 6)

variables varied by neighborhood racial composition by interacting neighborhood disadvantage with neighborhood percent minority. Incidence rate ratios were obtained for each set of analyses, which were derived by the exponentiation of the beta coefficients from the negative binomial and Poisson regression models and represent the expected or predicted counts for the dependent variables. All analyses were completed using Stata (v13) (*Stata Statistical Software: Release 13*, 2013).

3. Results

3.1. Sample characteristics

The block group characteristics for the county are presented in Table 2. On average, about 1800 individuals resided in each block group in the county with a median age of 39 years. Block groups ranged from 0 to 98.6% in the proportion of racial/ethnic minorities that resided in each area, with an average of about 30% racial/ethnic minorities. On average, about 20% of the total block group population had less than a high school education and nearly one quarter fell below 125% of the federal poverty line (23%). Of all block groups in the county, approximately 44% fell into the low disadvantage category, and 24% and 32% fell into the medium and high disadvantage categories, respectively.

Of all the block groups in the county, one-third contained at least one park ($n = 85$). There was an average of about 20 acres of parkland and 0.5 parks per block group. In addition, there were approximately three park facilities and four park amenities observed across block groups. Likewise, less than one park incivility and about one park aesthetic feature was observed across the entire sample (Table 2).

3.2. Park availability

Table 3 presents the results from the negative binomial regression models used to examine the relationship between neighborhood socioeconomic disadvantage (low (<−1 SD), medium (≥−1 to ≤1 SD), and high (>1 SD)) and park availability. No significant differences were detected between levels of neighborhood disadvantage and number of parks per block group, after adjustment for covariates (Model 1). As well, percent minority did not moderate the relationship between neighborhood socioeconomic disadvantage and park availability (Model 2).

Table 3
Negative binomial regression models predicting number of parks among the county block groups ($n = 255$).

	Number of parks (park availability)	
	Model 1 IRR (95% CI)	Model 2 IRR (95% CI)
Neighborhood socioeconomic disadvantage		
Low disadvantage (referent group)	1.00	1.00
Medium disadvantage	1.05 (0.59, 1.86)	0.96 (0.50, 1.84)
High disadvantage	1.33 (0.69, 2.60)	1.25 (0.62, 2.52)
Population of block group	1.00 (0.99, 1.00)*	1.00 (0.99, 1.00)*
Size of block group (sq. miles)	1.03 (1.00, 1.05)	1.03 (1.00, 1.05)
Youth population under 18 years (%)	0.99 (0.97, 1.02)	0.99 (0.97, 1.02)
Racial/ethnic minority composition	1.01 (1.00, 1.02)	1.02 (0.99, 1.04)
Interactions		
Medium disadvantage × Racial/ethnic minority composition	–	0.78 (0.33, 1.82)
High disadvantage × Racial/ethnic minority composition	–	0.88 (0.44, 1.76)

* $p < 0.05$.

To account for park locations that were near, but not intersecting, the block group boundary, we conducted a sensitivity analysis to test whether adding a quarter-mile 'shadow buffer' around the periphery of each block group would yield different results than the original analysis. No differences were detected in the relationship between neighborhood disadvantage and park availability, after adjusting for all covariates.

3.3. Park quality

Four indicators of park quality were assessed by levels of block group disadvantage for block groups with parks present (Table 4). These included park facilities and amenities, park and neighborhood incivilities, and park aesthetic features. As shown in Model 1, the incidence rate for park incivilities increases about 93% for high disadvantaged block groups compared to low-disadvantaged block groups (IRR = 1.93, 95% CI = 1.24, 3.00), after adjustment for covariates (Table 4). Additionally, Model 2 revealed a statistically significant interaction between high disadvantage block groups and percent minority. As displayed in Fig. 2, among low-disadvantaged neighborhoods, the incidence rate of having park incivilities increased as the percentage of racial/ethnic minority residents in a block group increased, whereas the incidence rate of having park incivilities remained constant regardless of racial/ethnic minority composition within high-disadvantaged block groups. No differences in park aesthetic features were found for neighborhood socioeconomic disadvantage and neighborhood racial/ethnic minority composition did not modify this association.

Likewise, no differences were detected in the number of park facilities or park amenities by neighborhood socioeconomic disadvantage (Table 4). However, Model 2 for park amenities revealed a statistically significant interaction between high disadvantaged block groups and percent racial/ethnic minority composition. Specifically, among low disadvantaged block groups, there was a decreased incidence of park amenities as the percentage of racial/ethnic minority residents residing in the block group increased. However, for high disadvantaged block groups, the incidence rate of park amenities increased as the percentage of racial/ethnic minorities residing in the block group increased (Fig. 3).

Table 4
Multivariate Poisson and negative binomial regression models predicting park quality indicators among county block groups with parks ($n = 85$).

	Park and neighborhood incivilities		Park aesthetic features		Park facilities		Park amenities	
	Model 1 IRR (95% CI)	Model 2 IRR (95% CI)	Model 1 IRR (95% CI)	Model 2 IRR (95% CI)	Model 1 IRR (95% CI)	Model 2 IRR (95% CI)	Model 1 IRR (95% CI)	Model 2 IRR (95% CI)
Neighborhood socioeconomic disadvantage								
Low disadvantage (referent group)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Medium disadvantage	1.38 (0.90, 2.12)	1.14 (0.74, 1.76)	1.01 (0.81, 1.26)	0.98 (0.73, 1.32)	1.16 (0.80, 1.70)	1.29 (0.90, 1.87)	1.03 (0.90, 1.19)	1.11 (0.91, 1.37)
High disadvantage	1.93* (1.24, 3.00)	1.70* (1.17, 2.48)	0.93 (0.70, 1.25)	0.88 (0.63, 1.20)	1.12 (0.67, 1.89)	1.11 (0.68, 1.80)	0.99 (0.83, 1.18)	1.01 (0.79, 1.28)
Population of block group	1.00 (0.99, 1.00)	1.00 (0.99, 1.00)	1.00 (1.00, 1.01)	1.00 (1.00, 1.01)	1.00* (1.00, 1.00)	1.00* (1.00, 1.00)	1.00 (1.00, 1.00)	1.00 (0.99, 1.00)
Size of block group (sq. miles)	1.02 (1.01, 1.03)	1.02 (1.01, 1.03)	1.00 (1.00, 1.01)	1.00 (1.00, 1.01)	0.99 (0.97, 1.00)	0.98* (0.97, 1.00)	0.99* (0.98, 0.99)	0.99* (0.98, 0.99)
Youth population under 18 years (%)	1.00 (0.98, 1.02)	1.00 (0.98, 1.02)	1.00 (0.99, 1.01)	1.00 (0.99, 1.01)	1.00 (0.98, 1.03)	1.00 (0.98, 1.03)	1.01 (1.00, 1.02)	1.01 (1.00, 1.02)
Racial/ethnic minority composition	1.00 (1.00, 1.01)	1.50 (1.01, 2.22)	1.00 (1.00, 1.01)	0.89 (0.70, 1.13)	1.00 (0.99, 1.00)	0.98 (0.97, 1.00)	1.00 (1.00, 1.00)	0.99 (0.98, 1.00)
Interactions								
Medium disadvantage × Racial/ethnic minority composition	–	0.70 (0.45, 1.10)	–	0.89 (0.61, 1.30)	–	1.09 (0.72, 1.65)	–	1.10 (0.85, 1.43)
High disadvantage × Racial/ethnic minority composition	–	0.65* (0.43, 0.99)	–	1.15 (0.88, 1.52)	–	1.53 (0.95, 2.47)	–	1.26* (1.01, 1.58)

* $p < 0.05$.

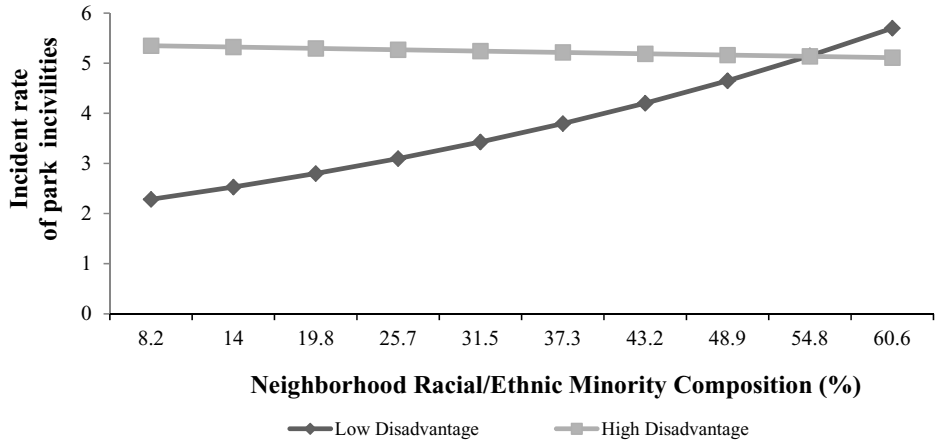

Fig. 2. Number of park and neighborhood incivilities for low disadvantaged and high disadvantaged neighborhoods by neighborhood percent racial/ethnic minority composition. *Notes*: Adjusted for block group population, block group area, percent youth population, and percent racial/ethnic minority. Incident rates are exponentiated coefficients from Poisson or negative binomial models, thus representing the expected rate, or count, of the dependent variable.

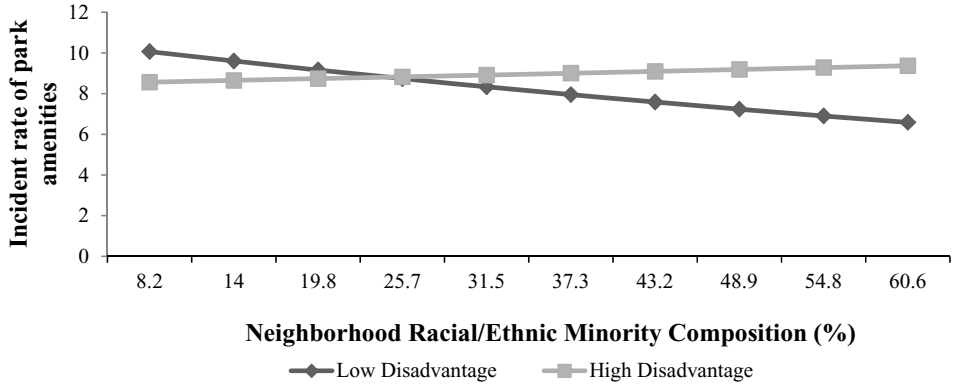

Fig. 3. Number of park amenities for low disadvantaged and high disadvantaged neighborhoods by neighborhood percent racial/ethnic minority composition. *Notes*: Adjusted for block group population, block group area, percent youth population, and percent racial/ethnic minority. Incident rates are exponentiated coefficients from Poisson or negative binomial models, thus representing the expected rate, or count, of the dependent variable.

4. Discussion

The scope of environmental justice studies has broadened to examine whether health-promoting built environment features are equitably distributed across neighborhoods of various socioeconomic status and racial/ethnic minority composition. However, studies regarding parks and recreation resources have often not considered park quality or park features, used only a single indicator of SES, or analyzed racial/ethnic minority composition as a moderator between neighborhood SES and park availability and quality. In this study, we found no difference in park availability across neighborhoods with varying levels of socioeconomic disadvantage. However, high disadvantaged neighborhoods were about two times more likely to have park incivilities than low disadvantaged neighborhoods. Also, neighborhood racial/ethnic minority composition moderated the relationship between neighborhood disadvantage and park incivilities and park amenities.

Our study suggests that park and recreational resources are fairly equitably distributed across neighborhoods in this southeastern United States county, regardless of SES. These findings echo results from some previous research that found no differences in the availability of physical activity resources, including parks and recreation facilities, by neighborhood SES (Gilliland et al., 2006; Nicholls, 2001). Although our study did not identify any disparities in the availability of public parks in terms of neighborhood socioeconomic disadvantage, we uncovered that only one-third of the neighborhoods had a park present, which indicates that key outdoor recreation opportunities may be lacking across geographic areas of the county. Similarly, Gilliland and colleagues reported no difference in the prevalence or density of public recreational spaces by neighborhood SES, but used spatial analyses to determine that several areas of the mid-sized Canadian city they studied lacked public recreational spaces (Gilliland et al., 2006). At the same time, our findings diverge from other research that has identified differences in the availability of park and recreational resources across areas of varying SES. Some studies have demonstrated that higher income neighborhoods have more parks or recreational resources (Gordon-Larsen et al., 2006; Wolch, Wilson, & Fehrenbach, 2005), while other researchers found the opposite (Boone et al., 2009; Sister et al., 2010; Vaughan et al., 2013).

One contributing factor to the mixed evidence regarding park availability across diverse socioeconomic areas may be differences in the conceptualization and measurement of neighborhood SES. Often, studies have used either education or median household income as the primary independent variable when assessing such relationships (Gordon-Larsen et al., 2006; Vaughan et al., 2013). Different socioeconomic indicators may have different implications when considering economic and cultural capital and how these are leveraged in different communities (Elo, 2009). Research has demonstrated that areas that lack economic capital have fewer total recreation resources, which may indicate an increased importance for freely-accessible park spaces in such settings (Gordon-Larsen et al., 2006). Evidence has shown that public funds directed toward parks and open space lag behind in low-income communities of color (Floyd et al., 2009; Wolch et al., 2005). Cultural capital, which is often assessed via educational attainment, could be utilized by neighborhood residents to advocate for improved park and recreation space. Thus, research findings and potential implications of environmental justice studies could vary based on the chosen socioeconomic indicator. This study created and used an index of neighborhood disadvantage comprised of four socioeconomic indicators to better capture both the overall economic and cultural capital of neighborhoods.

Despite the equitable distribution of the number of parks in this study, we found some differences in the quality of those parks based on block group socioeconomic status and racial/ethnic composition. Neighborhoods of higher socioeconomic disadvantage were nearly two times more likely to have more incivilities in and immediately surrounding park facilities compared to low disadvantaged neighborhoods. A similar study conducted in Kansas City, Missouri found that low-income neighborhoods contained parks with increased number of quality concerns, or incivilities than those in high-income neighborhoods (Vaughan et al., 2013). Parks with higher incivilities, such as poor maintenance, may discourage park visitation and park use due to undesirable characteristics and potential safety concerns. In a review of qualitative research assessing relationships between characteristics of park use and physical activity, the researchers concluded that park condition was important for adults, adolescents, and children such that negative qualities like graffiti, lack of maintenance, vandalism, litter, uncleanliness, and animal feces negatively impacted perceptions of parks and park visitation (McCormack et al., 2010). These influential park quality indicators directly align with the park incivilities measure used in this study to detect differences between low and high disadvantaged neighborhoods (Table 1). In addition, quality indicators, such as attractiveness and maintenance of park environments have been positively associated with health promoting behaviors, like physical activity (Giles-Corti et al., 2005), and in one study, pleasing aesthetic park environments were equally or more important than park proximity for adults to meet national recommendations for health enhancing levels of physical activity (Sugiyama, Francis, Middleton, Owen, & Giles-Corti, 2010). This may be of particular concern in high disadvantaged or high minority neighborhoods given that parks have been identified as key resources for physical activity in such communities (Cohen et al., 2007) and persistent income related health disparities (Elo, 2009). Future interventions and management practices could focus on increasing the quality of parks and recreational space in socioeconomically disadvantaged communities that have more park incivilities present in order to provide more equitable health-promoting environments.

Neighborhood SES and racial/ethnic composition have been the key indicators used in previous studies that have examined whether built environment resources, like parks, are equitably distributed. Although both of these neighborhood factors are independently associated with park availability and park quality (Gordon-Larsen et al., 2006; Harris et al., 2015; Vaughan et al., 2013), there is reason to suspect that the effect of neighborhood SES on park availability and quality varies by neighborhood racial/ethnic composition. Our results provide preliminary evidence that among low-disadvantaged neighborhoods, park incivilities increased as the racial/ethnic minority composition of the neighborhood increased, whereas park incivilities remained constant for high disadvantaged neighborhoods, regardless of neighborhood racial composition. This association highlights the role that neighborhood racial composition may play in the equity of quality park environments, irrespective of neighborhood socioeconomic status. Evidence has demonstrated a historical pattern regarding the distribution of many types of resources in racial minority communities. For example, schools that have higher concentration of racial/ethnic minority students often have overcrowded classrooms, poorer quality school supplies (e.g., books), and provide fewer advanced classes (Darling-Hammond, 2004; Peske & Haycock, 2006). Similarly, our study demonstrated that there were increased incivilities, one indicator of lower park quality, in high minority areas, even regardless of socioeconomic disadvantage. It is plausible that such quality concerns, combined with other contextual influences, may deter residents from using park facilities. Given the interaction found between neighborhood disadvantage and racial composition, future studies should also consider the complex relationship between SES, race, and neighborhood features, particularly when examining how

environmental resources, like parks, influence park use/visitation, health behaviors, and health outcomes.

This study also demonstrated that neighborhood racial/ethnic minority composition modified the association between socioeconomic disadvantage and park amenities. Among low disadvantaged block groups, the number of park amenities decreased as the percentage of racial/ethnic minorities residing in the neighborhood increased, whereas for high disadvantaged block groups, the number of park amenities increased as the percentage of racial/ethnic minorities in the neighborhood increased. Amenities were defined as features that enhanced the park experience, such as restrooms, benches, and drinking fountains and have been considered key elements of interest for park visitors (McCormack et al., 2010). The interaction detected between neighborhood disadvantage and racial/ethnic minority composition could be a result of specific efforts to improve certain aspects of park quality in the most disadvantaged neighborhoods in the county (i.e., high minority and low socioeconomic status). For example, local efforts to construct community centers, including public park and recreation space, often focus on the most disadvantaged neighborhoods. Such parks and community centers often contain several park facilities and amenities to make the park more user-friendly. These findings could be utilized by park planners and developers when considering the location of new parks spaces as well as renovations or updates to existing park spaces to ensure that resources are equitably distributed.

A key step that could be critical to creating equitable quality of park environments across diverse neighborhoods is determining collective park standards through a democratic process including examining national recommendations and using local expertise of parks and recreation staff and input from public residents (Chieh-Lu, Absher, Graefe, & Hsu, 2008). This kind of process would invoke another major principle of environmental justice: 'meaningful involvement'. Experts recommend a community-engaged approach toward development of such policies or standards to both allow essential stakeholders and residents to be key players in the identification, planning, and implementation of projects or efforts around environmental justice and to help ensure that needs are being met in diverse neighborhoods (Floyd et al., 2009). Such strategies would capitalize on the expertise and experiences of a diversity of local residents to reach a common goal. This may be particularly important for projects related to parks and recreation because historically in the United States, minorities and poor people have often been excluded from park development in terms of consideration, decision-making, and use of park spaces (Byrne & Wolch, 2009). Parks have the ability to enhance the sense of community and quality of life and serve as a vessel for neighborhood pride and improvement (Cohen, Inagami, & Finch, 2008; Kazmierczak, 2013). However, to achieve such goals, collaboration among diverse residents with a specific goal of equitable environments will be necessary.

Previous scholars have also noted that examining the distribution of parks and recreation resources is highly contextual based on multiple factors including historical, political, and economic trends (Miyake, Maroko, Grady, Maantay, & Arno, 2011). Historical trends in city and county planning and development as well context-specific policy and management practices of parks and recreation agencies are likely contributing factors to variations in park availability and quality in different cities, states, and countries (Jacobs, 1961; Southworth, 2005). Parks and recreation agencies differ in organizational structure, management practices, and funding patterns across various contexts, which may contribute to how park space is delineated and maintained in various communities (Boone et al., 2009). For example, a study in Los Angeles, California reported that parks and recreation funding patterns were concentrated in more affluent neighborhoods, which could potentially exacerbate racial and socioeconomic inequalities in the availability and quality of parks in certain cities (Wolch et al., 2005). Similarly, many communities have parks and recreation departments that are consistently underfunded to meet national standards (Kaczynski & Crompton, 2006). Future research efforts should examine the policies and practices of a diversity park and recreation departments to understand similarities and differences among organizations and how discrepancies in policies, procedures, and funding decisions may manifest in the distribution, quality, and maintenance of park and recreational facilities. This may provide more insight into the fundamental causes that lead to inequalities in parks and recreation resources across neighborhood settings (Schulz & Northridge, 2004).

4.1. Limitations

Several limitations to this study should be noted. First, the study design was cross-sectional, thus making it difficult to attribute causality to any study findings. Second, although some studies have found that how individuals define their neighborhood better aligns with smaller areas, like block groups (Coulton, Jennings, & Chan, 2013), others have found that there is wide variation in the definition and delineation of neighborhood space (Coulton, Korbin, Chan, & Su, 2001; Diez Roux & Mair, 2010; Foster & Hipp, 2011). Neighborhood measurement has consistently presented a dilemma when examining the effects of place on health, but U.S. Census data provide a readily-available and cost-effective resource that is frequently used in such investigations. Third, this ecological assessment of the distribution of park availability and park quality in a southeastern U.S. county may not be generalizable to other settings. Likewise, our study only included publicly and freely accessible parks (i.e., excluded state parks due to the fee usually associated with park entry). Other definitions of parks and recreation spaces may have resulted in the inclusion of different facilities, which could influence the results and implications of the study.

Finally, although we used a reliable audit tool to capture detailed information about the park environment, including facilities, amenities, incivilities, and aesthetic features (Kaczynski et al., 2012), we weighted all park facilities or quality concerns equally. It is possible that some residents would weigh the importance of park facilities or quality concerns differently. Future research may consider weighting certain park characteristics more heavily than others based on the perceptions of a 'high-quality' park by local residents or other empirical evidence. In addition, much research has noted the importance of perceptions of and experiences in parks that contribute to park use and park-based physical activity (Bai et al., 2013; McCormack et al., 2010). Though the original development of the audit tool involved extensive feedback from a diversity of stakeholders about important features of parks, this study did not include assessments of local residents' perceptions of parks. Additional research efforts should also seek to examine park-use patterns related to environmental justice and use both objective and subjective data sources to better understand how park and recreation environments influence health and health behaviors.

5. Conclusions

This study used a comprehensive measure of neighborhood disadvantage, detailed observational park audits, and spatial techniques in GIS to identify disparities in park access and quality based on neighborhood socioeconomic disadvantage and racial/ethnic minority composition. Overall, we found an increased incidence of park incivilities among high disadvantaged neighborhoods. This study also demonstrated that the relationship between two park quality indicators – park incivilities and amenities – and

neighborhood disadvantage varied by neighborhood racial composition. These findings suggest that future research needs to take into account multiple aspects of the park environment, rather than just availability, when examining whether these resources are equitably distributed or when defining park and play deserts across diverse communities. It is also recommended that measuring and analyzing the quality of park and recreation features should extend to research that examines how these resources impact health behaviors and outcomes. Parks are one community resource that can promote both physical and emotional health (e.g., physical activity, sense of community) across diverse communities, but such processes may require meaningful involvement of diverse stakeholders. Overall, improvements in multiple dimensions of park quality may be integral to creating equitable park environments in disadvantaged communities.

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