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Multiply-deserted areas: environmental racism and food, pharmacy, and greenspace access in the Urban South

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ABSTRACT

Unequal access to important resources like grocery stores, pharmacies, and parks in the urban built environment has been a significant social problem under study by social scientists. Drawing from work in urban and environmental justice studies that conceptualize racism as a structural factor that shapes environmental inequality, I assess spatial inequality in urban cities across the southern USA. Utilizing data from the U.S. Census, U.S. Department of Agriculture (USDA), the National Provider Identifier (NPI) registry, and county and state government websites, I examine the relevance of race and class to the existence of neighborhoods as single or multiple resource deserts, coined multiply-deserted areas (MDAs). Results indicate that predominantly Black neighborhoods are more than twice as likely to be resource deserts, even after adjusting for class. Additionally, predominantly Black neighborhoods are nearly three times as likely to have more intense, compounded resource scarcity than other neighborhoods. Moreover, results indicate a race and class interaction effect such that a predominantly Black neighborhood has increased odds of being a multiply-deserted area as median household income increases. The findings implicate yet another route through which racism shapes inequality and demonstrate a need to address racial differences in access to resources across socioeconomic status.

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Urban; desert; spatial inequality; black neighborhoods; environmental justice

Access to various resources for neighborhood residents in cities is an increasingly timely topic of interest across the social sciences (Hager et al. 2017; Small and McDermott 2006; Walker, Keane, and Burke 2010). Research in this area demonstrates spatial inequality across racial and socioeconomic lines in the quantity and quality of essential and/or health-related resources, and areas with a shortage of these resources are known as '[resource] deserts' (Pruitt and Colgan 2010; Qato et al. 2014; Sister, Wolch, and Wilson 2010). Not unlike other spheres of environmental inequality in the USA, deserts exist most frequently in neighborhoods with a concentration of poverty, racial/ethnic minorities, and global Southern immigrants (Walker, Keane, and Burke 2010; Zenk et al. 2006). As these patterns of neighborhood-level resource scarcity have the potential to impact health and life outcomes, understanding the routes and structural roots of these patterns is necessary for developing tangible solutions.

The term *desert* was first introduced in the policy arena by scholars describing food desert communities in which there is little or no access to healthy food choices (Beaumont et al. 1995; Deener 2017). This pattern of resource scarcity in areas of socioeconomic decay is replicated for other resources, including pharmacies, parks, and healthcare services (Hendrickson, Smith, and Eikenberry 2006; Ko and Ponce 2013; Qato et al. 2014; Sister, Wolch, and Wilson 2010; Walker, Keane, and Burke 2010). With few exceptions, current research on resource deserts assumes they exist in isolation in communities and/or examines these types of deserts in isolation (Cohen et al. 2016; Small and McDermott 2006; Smiley et al. 2010). While examining single resources reveals the racialized and classed patterns of specific resource inequality, an inquiry into whether and how neighborhoods exist as deserts of multiple resources can reveal a more comprehensive understanding of spatial inequality and its impact. Drawing from urban and environmental justice studies that conceptualize racism as a structural factor that shapes inequality, this study examines sociodemographic patterns of resource scarcity in the urban South. Focusing on access to supermarkets, parks/trails, and pharmacies, this study contributes knowledge on spatial inequality by examining the relationship between neighborhood racial and socioeconomic demographics and the existence of said neighborhoods as single or multiple resource deserts. This study focuses on urban cities in the southern USA, an under-researched region in this area of scholarship.

Background and theory

The demography of inequality & deserts

After the Great Migration and the postmodern era, racial/ethnic minorities and the working poor became increasingly concentrated and isolated in low-income

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urban, center-city neighborhoods. More recently, upward social mobility or displacement from gentrification processes has led to an exodus of Black families to 'inner ring suburbs' on the outskirts of cities (Clark 2017; Massey and Tannen 2018). Despite this more recent shift of wealth (and whiteness) to city centers and racial minorities to city outskirts, many urban centers remain racially segregated and socially isolated along racial and economic lines. Racial and economic segregation is implicated in the emergence of economically disadvantaged neighborhoods, which in turn limit residents' access to quality jobs, education, safety, social networks, and health care (Morenoff and Sampson 1997; Rieniets 2009; Williams and Collins 2016; Wilson 1987, 2009). Racial segregation is driven largely by structural, institutional, and individual racism (Charles 2003; Imbroscio 2021; Massey and Denton 1993; Rothstein 2017) as demonstrated by fair-housing audits and mid-to-late twentieth-century financial redlining practices (Massey 2005; Yinger 1995).

Defining 'desert' neighborhoods in terms of physical access and availability highlights the *spatial* component of deserts, where space and geographical location become barriers to accessing resources. Resource access and availability issues that characterize desert neighborhoods are usually the result of disinvestment or underdevelopment. Current research on urban deserts suggests that disinvestment and resource inequality strike areas with racial minorities, low economic appeal, high poverty, and high crime rates (Gaskin et al. 2012; Kwate et al. 2013). While spatial inequality in the form of limited or no access to resources can exist for different types of resources, supermarkets, pharmacies, and parks/trails are uniquely important for the health and well-being of neighborhood residents. These resources have both direct and indirect implications for health outcomes, particularly for people whose health is influenced by other social determinants (Payne-Sturges et al. 2006).

Food desert research explores access to healthy and affordable foods in neighborhoods, and this area of research has received fervent attention from government actors and activists while informing local, state, and national urban planning policies (Walker, Keane, and Burke 2010). Food deserts are more prevalent in areas with high concentrations of poverty as well as neighborhoods with high concentrations of racial/ethnic minorities (Richardson et al. 2012; Walker, Keane, and Burke 2010). Moreover, research on access to food destinations demonstrates that poorer residents tend to lack access to transportation to chain supermarkets and generally pay more for groceries from local groceries (Chung and Myers 1999; Lamichhane et al. 2013; Raja, Ma, and Yadav 2008). Likewise, Black neighborhoods have fewer supermarkets, poorer quality foods in local stores, and Black residents travel farther to grocery stores[1] (Block and Kouba 2006; Moore and Diez Roux 2006).

Pharmacy desert research has gained momentum in recent years as scholars more deeply interrogate the health–place connection. Pharmacy deserts are more prevalent among neighborhoods with a high concentration of Black residents compared to predominantly white or more racially heterogeneous neighborhoods (Chisholm-Burns et al. 2017; Qato et al. 2014). Likewise, Philippe et al. (2012) find that poorer urban areas have less geographic access to pharmacies than middle-class or low-poor neighborhoods, and the pharmacies in these poor neighborhoods have limited to no availability of commonly prescribed medications. Though measuring access to pharmacies to fill prescriptions is a relatively new area of research, factors influencing medication adherence have long been considered (Rolnick et al. 2013; Shrank et al. 2006). For example, research by Welty, Willis, and Welty (2010) examining the association between limited transportation and medication adherence among epilepsy patients shows that both ability to drive and distance to the pharmacy are associated with medication adherence. Interestingly, living farther than four miles from a pharmacy was associated with greater difficulty getting medications filled on time. This association between spatial access to pharmacies and important health-related behavior highlights how physical ability might impact access. Thus, a fuller examination of how race and class predict access to pharmacies will fill gaps in this unique area of medical desert research and provide more insights into the barriers faced by individuals experiencing poor health.

Racial and socioeconomic patterns of access to urban green space have also been examined in contemporary environmental justice research (Jennings, Johnson Gaither, and Schulterbrandt Gragg 2012). Recent research on green space has centered around fair access to natural resources and the uneven distribution of urban green space. As such, racial and socioeconomic disparities in spatial access to greenspace and tree cover in metropolitan cities are well-established, though nuanced (Dai and Wang 2011; Gould and Lewis 2012; Heynen, Perkins, and Roy 2006; Jesdale, Morello-Frosch, and Cushing 2013; Sister, Sister, Wolch, and Wilson 2010). For example, Saporito and Casey (2015) find that low-income areas with a critical mass of marginalized racial/ethnic groups have much less vegetation (i.e. parks, grass, tree cover) than whiter, wealthier areas, and this disparity is even greater in more racially or economically segregated cities. Furthermore, neighborhoods with a higher proportion of African Americans, renters, and low-income residents have drastically fewer trees on public right of ways (Landry and Chakraborty 2009). Even environmental non-profit organizations plant more trees in poor white neighborhoods than in poor Black neighborhoods (Watkins et al. 2017). In contrast, a study of park access in Baltimore, Maryland by Boone et al. (2009) demonstrates more access to smaller parks within walking distance for Black Americans relative to whites, but that whites have more access to larger parks within walking distance relative to Blacks. As there is now empirical evidence of the positive impact of access to greenspace on physical and mental health as well as what factors might mediate this association (Jennings, Larson, and Yun 2016; Lachowycz and Jones; Kate and Jones 2013), further research into how active green spaces such as parks and walking trails are distributed across neighborhoods is necessary.

Multiply-deserted areas in the urban south

A multiply-deserted area (MDA) is a community or neighborhood in which there is a shortage of multiple social, economic, and/or health-related resources. Capitalism creates patterns of resource shortages in which poor communities are not deserted in an isolated manner – food deserts do not exist separately from healthcare deserts but are likely co-occurring with other desert types in impoverished urban neighborhoods. Thus, framing resource-scarce, urban neighborhoods as MDAs provides a multilayered, cumulative perspective on neighborhood deprivation. Moreover, acknowledging the inherent racist and capitalist ideologies that guide the economic and historical processes that directly and indirectly situate certain groups in these under-resourced spaces calls attention to the state-sanctioned violence and infrastructural exclusion afoot alongside a 'socially constructed racist housing market' (p. 34) (Deener 2017; Imbroscio 2021). I posit that this compounded material depravation negatively impacts the quality of life of neighborhood residents. The potential physical, economic, social, and psychological consequences of living in MDAs highlight the need for scholars engaging issues of spatial inequality to broaden their focus into the simultaneous institutional and environmental racism faced by low-income and Black communities.

While much of the scholarship on food, pharmacy, and greenspace deserts in urban cities has explored access to each of these resources in isolation, examining whether and how neighborhoods lack access to *multiple* resources can reveal a more complex understanding of spatial inequality than observing single resources. In one study of neighborhood access to multiple organizational resources (i.e. childcare, grocery stores, banks, pharmacies, convenience stores), Small and McDermott (2006) find that increases in poverty rates are related to increases in smaller resource establishments (e.g. small grocers) and decreases in larger grocery stores and establishments. Additionally, increases in the Black neighborhood population are associated with decreases in resource establishments in general. Smiley et al. (2010) examine multiple health-related resources (e.g. supermarkets and parks) in block groups in three US cities and find that neighborhoods with higher proportions of Black residents tend to have lower densities of each of these resources. More recently, Anderson (2017) examines how the distribution of health-related organizations throughout zip code areas differs by the racial/ethnic composition of such areas and finds that Black residential clustering in these areas is inversely related to the number of health-related organizations, including food resources, physical fitness facilities, healthcare resources, civic associations, and social service organizations. Small and McDermott (2006), Smiley et al. (2010), and Anderson (2017) each examine the density of resources in their studies of spatial inequality. However, neighborhood resource density and absolute access/resource proximity in neighborhoods are two distinctly different ways of conceptualizing spatial access, each with its theoretical and methodological advantages and disadvantages. Building on these works, I focus on proximity/distance-based access in neighborhoods. Moreover, I focus on supermarkets/grocers, pharmacies, and parks/walking trails as each are important resources with direct implications for health and well-being.

In this paper, I examine thousands of census tracts (i.e. neighborhood proxies) across 17 counties in the southern USA, adding breadth to this area of research that has traditionally focused on northeastern and midwestern urban places. Economic and sociohistorical research on urban cities across America suggests that the USA is vastly different from the southeastern USA, not only in the 'way' and 'when' urbanization occurred but also in terms of per capita income and economic performance/vitality at the regional, state, and county level (Baker 2020; Goldfield 1997; Michney 2009; Nunn, Parsons, and Shambaugh 2018). Moreover, the sociodemographic makeup of southern urban cities based on immigration/emigration patterns, housing and urban policies of the 20th century, and the rise of the Black upper-middle class in cities like Atlanta, GA and Fort Washington, MD is distinct from urban cities in other parts of the USA (Kirk 2005; Inwood 2011; Pendergrass 2013). Specifically, Black residential location (in the past and today) is not only a function of their political and economic status but also the degree of residential segregation of cities, all of which have been shaped by racial dynamics and processes that are historically specific to the southern USA (Roscigno and Tomaskovic-Devey 1994). Additionally, similar work by Small and McDermott (2006) suggests that regional contexts differentially shape access to resources – they find that impoverished neighborhoods in the southern and western USA generally have more resource establishments than the poor neighborhoods in the Northeast and Midwest. Thus, examining patterns of resource inequality in urban neighborhoods in the South is merited.

Theoretical framework and hypotheses

Racism is often manifested through institutionalized racial discrimination that causes wide-scale social, economic, and environmental disinvestment of communities of color (Delgado and Stefancic 2017). This comprehensive disinvestment results in the emergence of poverty and simultaneously occurring resource deserts that create contexts for further resource desertion. I use two models of inequality employed in environmental justice research to explain environmental inequality: economic inequality and environmental racism. These models bring to bear larger theoretical frameworks of racial capitalism (Robinson 2000) and racialized space (Neely and Samura 2011) and environmental justice work by Bullard (1990), Bullard (1993), and Taylor (2000, 2014) examining the characteristics associated with environmental risk. The economic inequality model and environmental racism model reflect a long-standing, ongoing debate in environmental justice research in particular and in research on inequality in general. Each model implies distinct hypotheses regarding the association between race and class inequality and resource scarcity.

The environmental racism model suggests that a neighborhood's lack of resources is twofold. Resource scarcity is directly related to the racialized processes of residential segregation, 'steering' by realtors, and bank redlining, as well as the actions of industry actors and corporate leaders who deliberately avoid siting commercial properties in predominantly Black neighborhoods. This aversion to predominantly Black neighborhoods is often consistent regardless of the socioeconomic status of the neighborhood and potential economic gains (Pellow 2000; Pulido 2000, 2016). In *Dumping in Dixie*, Bullard (1990) describes environmental racism as an ideological and institutional facet of racism that underlies the overrepresentation of toxic hazard sites in Black communities. Bullard posits that this overrepresentation is directly associated with the underrepresentation of Blacks in zoning councils that yield the power to industries to site in certain neighborhoods. This sentiment is underscored by Cedric Robinson's argument that racism permeates societies to such an extent that Black neighborhoods are deemed valueless for economic development and dispensable for toxic industry development (Robinson 2000). The attention to not only the institutional but also the larger structural and historical processes embedded with racism that undergird environmental racism and racial capitalism is what makes these theories more suitable than organizational theories for this study. In sum, this model suggests the following:

H1: Neighborhoods with a higher concentration of Black residents will be more likely to be MDAs relative to those with a lower concentration of Black residents.

The economic inequality model suggests that both industry/commercial actors and residential consumers are rational economic actors (Been 1994). Thus, industry actors weigh potential liability and property costs and choose to site commercial properties such as pharmacies and supermarkets in the most cost-effective neighborhoods. These processes unsurprisingly disadvantage poorer people and neighborhoods (Yandle and Burton 1996). Thus, economic processes lead to neighborhoods with a high concentration of poverty and simultaneously scarce food, pharmacy, and greenspace resources. This model suggests the following:

H2: Neighborhoods with low median household income will be more likely to be MDAs than neighborhoods with higher median household income.

In 2019, a white elected official of Maryland referred to Prince George's County – a predominantly Black and very affluent county – as a '[n-word]' district, suggesting that the overwhelming wealth achieved by Blacks in that county does not overshadow their blackness and the devaluation of their blackness by those in power (Miller 2019). Continuing the race–class debate in EJ research and attempting to further investigate the American race–class correlation that makes it challenging to decipher an independent race or class effect, I set Hypotheses 1 and 2 against each other. The third model suggests the following:

H3: After adjustments for neighborhood median household income, the statistically significant association between the concentration of Black residents and likelihood of being an MDA will remain.

Previous studies that have explored how blackness interacts with class to impact a variety of health, well-being, and life outcomes have shown that Blacks do not reap the benefits of various socioeconomic resources (i.e. education, income, occupational status, wealth) to the same extent that their non-Black counterparts do (Boen 2016; Oliver and Shapiro 1997; Pattillo-mccoy 1999). To explore how race and class may interact to uniquely shape the experiences of both low-income and high-income Blacks, the fourth model suggests the following:

H4: Predominantly Black neighborhoods with higher median household income will be more likely to be an MDA than high income neighborhoods that are not predominantly Black. Similarly, low-income, predominantly Black neighborhoods will be more likely to be an MDA than their low-income, not predominantly Black counterparts.

Data and Methods

Data and sample

This study focuses on the urban South as defined by the specifications of the U.S. Census Bureau. The study sample includes all populated census tracts from one county from each of the 16 southern US states and Washington, DC (*N* = 3011) (see Table A1 in Appendix for the list). Each county included in the sample from each state was chosen based on population density, racial and socioeconomic heterogeneity, and median household income. As much of this *neighborhood-level* data was collected by the sole author, time and resources limited a more comprehensive sample of every urban neighborhood in each of the 17 states/areas.

Population/population density mattered because it has been a key facet of urbanity as defined in the literature (Carnahan, Gove, and Galle 1974). Racial heterogeneity was also an important factor in sampling because of how inequality in urban metro areas occurs in racialized patterns in the deserts and neighborhood effect literature (Turley 2003; Wilson 1987). Moreover, racial minorities and immigrant populations are usually aggregated in urban centers throughout the country (Caldeira 2012). For similar reasons, the percentage of population at or below the poverty level and median household income also shaped the selection of counties from each state as the literature suggests that among urban metro areas, income inequality is at its highest and poverty is concentrated, particularly in the southeast USA (Sharma 2017). Thus, counties in the final sample most exemplified 'urban' in southern US contexts (Lloyd 2012; Robinson 2014).[2]

Census tracts are routinely used as proxies for neighborhoods as they are a good approximation of a neighborhood environment with reliable social and economic data available from the U.S. Bureau of the Census and are designed to be relatively permanent over time (n.d.). Census tracts include approximately 4000 people, and boundaries are delineated to encompass a relatively demographically and economically homogeneous population. In addition, census tracts adhere to visible geographic boundaries (Foster and Aaron Hipp 2011; U.S. Census Bureau 2018).

Dependent measure

The paper examines MDAs by focusing on spatial access to three resource types. Research on spatial inequality wavers between the ½ mile and 1-mile limit when examining access in urban areas (Ploeg, Michele, and Breneman 2015). I use a l-mile buffer as this research centers on urban cities in the southern USA, which are often less compact than their northeastern and western counterparts; and a ½ mile buffer would result in an overly sensitive measure of access.[3]

Three desert types were used to construct the MDA measure. Food desert measures were taken directly from the U.S. Department of Agriculture (USDA) Food Access Research Atlas (Economic Research Service (ERS) Economic Research Service (ERS), U.S. Department of Agriculture (USDA) 2015), which offers census-tract level data on food access. These data were dichotomously coded based on whether at least 33% of the population lived 1+ miles from the nearest supermarket, supercenter, or large grocery store.[4] Food access was limited to these food destinations as research has shown that superstores are an important source of produce year-round (Chung and Myers 1999). The green desert measure assesses access to a park, sports field, trail, or botanical garden within each census tract. The pharmacy desert measure assesses access to a pharmacy within a census tract. Address data for each green space and pharmacy were collected from city and county parks and recreation websites for every county in the sample as well as the National Plan and Provider Enumeration System (NPPES) National Provider Identifier (NPI) registry, and these data were geocoded using ArcGIS software. Spatial analyses were conducted using ArcGIS tools and census tracts were dichotomously coded based on whether there were one or more green spaces or pharmacies within a 1-mile, straight-line distance of the population centers of each census tract.[5]

The MDA measure represents a census tract with the absence of one or more resource types. Census tracts are dichotomously categorized as an MDA (1) or not (0) based on being a food, pharmacy, and green-space desert concurrently or any combination of two of these types of deserts (i.e. food-green, food-pharmacy, pharmacy-green).

I also constructed a nuanced, ordinal measure of co-occurring resource scarcity. Census tracts were coded according to whether they were multiple deserts, single resource deserts (i.e. food only, green only, pharmacy only), or no deserts (0–2).

Independent measure

Race and class measures were obtained from 2013 to 2017 five-year estimates of the American Community Survey census data for each census tract in each county. The race/ethnicity measure was constructed using the percent Black alone variable (*M* = 36.77, SD = 31.91). Neighborhoods were coded based on whether they were predominantly Black, moderately Black, or marginally Black (1–3). I categorize the measure of predominance as greater than or equal to one standard deviation above the mean percent Black residents (i.e. 68.7), while moderately Black represents having a Black population that is above the mean but less than 1 standard deviation above the mean (i.e. 36.78–68.6% Black). The marginal Black measure represents having a Black population below the mean (i.e. less than 36.7% Black). The class measure is the median household income within a census tract.

Other covariates and controls

Nativity status is assessed by the percent foreign born within a census tract. I include this measure as nativity is routinely used in studies of access to neighborhood resources (see Small and McDermott 2006). This is particularly interesting as urban cities in the south continue to be common immigrant destinations (Johnson–Webb 2002; Winders 2006). A *mobility* measure indicates the percentage of employed individuals who walk to work: this is an indirect measure of access to public or personal transportation on a regular basis, as research has shown that transportation access can be a barrier to access to food stores even when residents have spatial access (Dai and Wang 2011). However, because walking to work might also be a convenience and marker of privilege in some neighborhoods, I also included the *percentage of households with no vehicle*, which more directly measures access to personal transportation. Housing measures included percentage of housing units that are *owner-occupied*. This variable is included as an indirect measure of neighborhood socioeconomic status. *Population density* and *area* were also controlled for at the census-tract level as these variables are consequential for examinations of spatial inequality. Each of these controls was obtained from American Community Survey (ACS) census-tract data. Lastly, I control for neighborhood economic potential via federal designation as an *opportunity zone*, which encourages development and investment through various financial and tax incentives (Eastman and Keading 2019).

Analysis

I provide descriptive statistics for key dependent and independent variables (Tables 1 and 2). Next, I use binary logistic regressions to test the main hypotheses using the binary MDA measure (Table 3). Results are reported as odds ratios (OR). Odds ratios *greater* than 1 indicate that the event (a neighborhood being an MDA) is *more* likely to occur with a 1-unit increase in the predictor, and vice versa.

I use ordinal logistic regression to analyze the co-occurrence of resource scarcity (Table 4). Ordinal logistic regression is appropriate for ordinal dependent variables and provides proportional odds ratios (POR) that are similar in interpretation to odds ratios. Because these regression models fail to account for spatial dependence across census tracts (i.e. that resource-scarce neighborhoods may cluster together in a nonrandom way), the analysis also includes a test of spatial autocorrelation using Global Moran's *i*. Results of this test indicate minimal spatial autocorrelation across the sample ($p < 0$, Moran's $i = .004$). Geocoding and spatial analysis are conducted in ArcGISPro, and all other statistical analyses are conducted in R.

Table 1. Descriptive Sample Characteristics ($N = 3011$).

	Proportion
Dependent Measures	
Resource Scarcity	
MDA	.31
Three-resource desert	.10
Food, Pharmacy, and Green	.10
Two-resource desert	.21
Food & Green	.06
Food & Pharmacy	.08
Pharmacy & Green	.07
Single-resource desert	.27
Food only	.14
Pharmacy Only	.03
Green Only	.10
Non-Desert	.42

Source: USDA Food Access Research Atlas (Economic Research Service (ERS) Economic Research Service (ERS), U.S. Department of Agriculture (USDA) 2015); National Plan and Provider Enumeration System (NPPES); Various US parks and recreations websites.

Results

Descriptive statistics

Table 1 and 2 provide descriptive statistics for the dependent and independent measures, respectively. Nearly one-third (.31) of the neighborhoods in the sample are MDAs ($n = 934$), while more than half (.58) are at least one kind of resource desert ($n = 1760$). Low resource scarcity neighborhoods are the most frequent (.27), followed by medium (.21) and high (.10) resource scarcity neighborhoods. Additionally, neighborhoods that are food deserts only are the most common (.14) among resource scarce neighborhoods, followed by neighborhoods that are green deserts only (.10) or food-pharmacy-green deserts (.10). Neighborhoods that are food-pharmacy deserts (.08), pharmacy-green deserts

Table 2. Descriptive Sample Characteristics ($N = 3011$).

	Mean	SD	Range
Independent Measures			
Race			
Percent Black NH	36.77	31.91	0–100
Marginally Black NH	.59	–	–
Moderately Black NH	.18	–	–
Predominantly Black NH	.23	–	–
Class			
Median Household Income (in $10,000s)	6.11	3.34	.92–25
Controls			
Percent Foreign Born	14.65	13.33	0–68.44
Percent Owner-Occupied	55.64	23.89	0–100
Percent Walking Commuters	2.64	6.09	0–100
Percent HH w/ No Vehicle	10.68	11.65	0–84.6
Area (sq. miles)	3.08	9.40	.03–183.04
Population Density	5018.3	5652.2	3.3–66,344.4
Opportunity Zone	.11	–	–

Source: American Community Survey (ACS) (2013–2017 5-year estimates)
NH = Non-Hispanic
HH = Households
Marginal = 0–36.6% Black
Moderate = 36.7–66.6% Black

Table 3. Binary Logistic Regression of Multiple Resource Scarcity (N = 3011).

	Model 1	Model 2	Model 3	Model 4
Independent Measures				
Race				
Moderately Black NH	1.207		1.249	.505*
Predominantly Black NH	2.786***		2.913***	1.424
Class				
Median Household Income (in $10,000s)		1.008	1.031	1.009
*Race * Class*				
Moderately Black NH				1.165**
Predominantly Black NH				1.132**
Controls				
Percent Foreign Born	1.013**	1.003	1.014**	1.011*
Percent Owner-Occupied	1.006*	1.006	1.004	1.003
Percent Walking Commuters	.984	.966*	.981	.978
Percent HH w/ No Vehicle	.959***	.982*	.962***	.970***
Area	1.156***	1.151***	1.158***	1.154***
Population Density	1.000***	1.000***	1.000***	1.000***
Is an Opportunity Zone	.635*	.799	.634*	.646*

Odds ratios
a. The base *Race* category for Models 1, 3, and 4 is Marginally Black Non-Hispanic (<36.77% Black)
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 4. Ordinal Logistic Regression of Compounded Resource Scarcity (N = 3011).

	Model 1	Model 2	Model 3	Model 4
Independent Measures				
Race				
Moderately Black NH	1.254*		1.305*	.754
Predominantly Black NH	2.549***		2.698***	1.450
Class				
Median Household Income (in $10,000s)		1.012	1.037*	1.020
*Race * Class*				
Moderately Black NH				1.099*
Predominantly Black NH				1.126**
Controls				
Percent Foreign Born	1.000	.991**	1.000	.999
Percent Owner-Occupied	1.001	1.000	.998	.998
Percent Walking Commuters	.996	.982	.996	.994
Percent HH w/ no Vehicle	.960***	.978***	.962***	.967***
Area	1.249***	1.243***	1.248***	1.244***
Population Density	1.000***	1.000***	1.000***	1.000***
Is an Opportunity Zone	.665**	.809	.665**	.682*

Proportional odds ratios
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

(.07), and food-green deserts (.06) each accounted for less than 10% of the sample, while neighborhoods that are pharmacy deserts only were the least common (.03).

Black non-Hispanics make up 36.77% of residents in neighborhoods in the sample (SD = 31.91), nearly a quarter (.23) of the neighborhoods in the sample are predominantly Black (i.e. 68.7% Black or more), 18% (.18) of neighborhoods in the sample are moderately Black (i.e. between 36.8% and 68.6% Black), and over half (.59) of the sample are marginally Black neighborhoods (less than 36.8% Black). The average median household income is $61,078 (SD = $33,411).

Resource scarcity

Table 3 provides results of binary logistic regression of the dichotomous MDA measure. Model 1 of Table 3 shows the odds ratio for the individual effects of the presence of Black residents in neighborhoods. Predominantly, Black neighborhoods are more than two and a half times as likely to be an MDA compared to marginally Black neighborhoods (OR = 2.786, $p < .001$). Model 2 shows the odds ratio for the individual effect of median household income. This association is non-significant. To assess collective effects of both race and class, Model 3 includes both independent variables in the same model. Predominantly Black neighborhoods are nearly three times more likely to be an MDA compared to marginally Black neighborhoods (OR = 2.913, $p < .001$). Median household income remains statistically non-significant. Model 4 includes the full model with interaction terms between both moderately and predominantly Black and median household income. The statistical interactions for both moderately Black (OR = 1.165, p < .01) and predominantly Black (OR = 1.132, $p < .01$) are significant. For ease of interpretation, Figure 1 provides a graphical representation of the race–class interaction. The figure shows a steep increase in the probability that a neighborhood will be an MDA as the median household increases for both moderately and predominantly Black neighborhoods relative to marginally Black neighborhoods.

Table 4 provides results of ordinal logistic regression of compounded resource scarcity. Model 1 shows the independent effect of a neighborhood being predominantly Black on its likelihood of being an MDA. A neighborhood that is predominantly Black has more than two and a half times the odds of more compounded resource scarcity (POR = 2.549, $p < .001$) relative to marginally Black neighborhoods. Similarly, moderately Black neighborhoods have 25% higher odds of more compounded resource scarcity relative to marginally Black neighborhoods (POR = 1.254, $p < .05$). Model 2 shows no association between median household income and compounded resource scarcity. Model 3 includes both independent variables, and the results show that predominantly Black neighborhoods have more than twice the odds of compounded resource scarcity (POR = 2.698, $p < .001$), while moderately Black neighborhoods have 30% higher odds of compounded resource scarcity (POR = 1.305, $p < .05$) relative to marginally Black neighborhoods. A neighborhood with a higher median household income also has 3% higher odds of compounded resource scarcity (POR = 1.037, $p < .05$). Model 4 includes the race–class interactions for moderately Black (POR = 1.099, $p < .05$) and predominantly

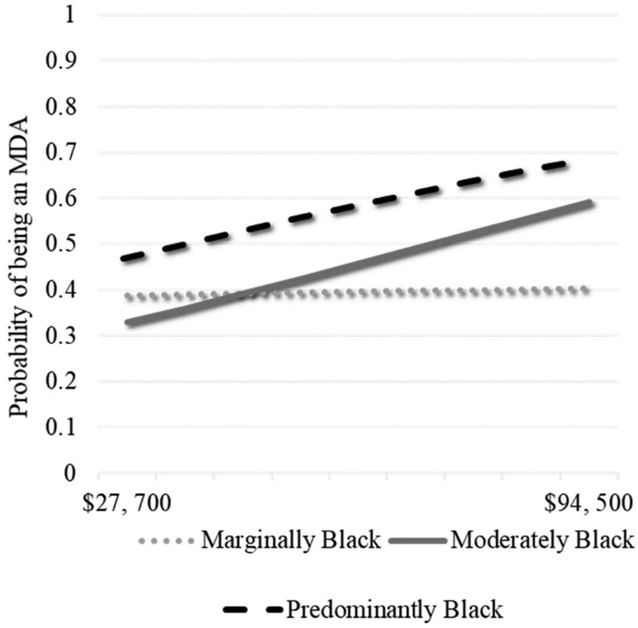

Figure 1. Interaction Effects of Race and Class on Multiple Resource Scarcity.

Black (POR = 1.126, $p < .01$) neighborhoods; results suggest that both moderately and predominantly Black neighborhoods with high median household income are more likely to be MDAs relative to neighborhoods with high median household income that are marginally Black as well as low-income moderately or predominantly Black neighborhoods.

In sum, I find support for Hypotheses 1, 3, and 4. Predominantly Black neighborhoods are more than twice as likely to be MDAs than marginally Black neighborhoods (Hypothesis 1). These findings hold even after adjustment for median household income, thereby providing strong evidence in support of Hypothesis 3.

While binary logistic regression analyses provide no support for Hypothesis 2, ordinal logistic regression analyses show that increases in median household income are associated with a *greater* likelihood of experiencing compounded resource scarcity. The race–class interaction analyses offer a better understanding of these findings – results demonstrate that higher median household income is associated with greater likelihood that a neighborhood is an MDA for *moderately Black and predominantly Black neighborhoods*. The null effect of higher income is only apparent for neighborhoods that are marginally Black. Thus, I find overwhelming support for Hypothesis 4.

Discussion

The present study examined resource scarcity across urban neighborhoods in the South. More than half of neighborhoods in urban cities in the southern USA have resource scarcity of at least one of the three types examined in the study (food, pharmacy, greenspace). More importantly, nearly one-third of neighborhoods in urban cities in the southern USA are multiply-deserted areas, which signals that compounded, co-occurring resource scarcity is not an anomaly for the urban South. Guided by an environmental justice (EJ) framework, this multi-state study sought to determine the race and class patterns of resource scarcity across neighborhoods. Results suggest that neighborhoods where Black residents are an overwhelming majority are more likely to be resource scarce neighborhoods.

Guided by an environmental justice framework, I test both the economic inequality and environmental racism models. While I found support for the environmental racism model, support for the economic inequality model was not readily apparent. Results suggest that resource scarcity (measured as having no access to grocery stores, pharmacies, and/or greenspaces within 1 mile) in neighborhoods is not shaped by class alone. More poignantly, the interaction between race and class in the study suggests that even in neighborhoods with high economic appeal (i.e. higher median household income) that these neighborhoods are predominantly Black renders them valueless. That moderately Black neighborhoods were consistently not associated with co-occurrent resource scarcity further emphasizes how the predominance of Black people in neighborhoods (and the consequential 'marking' of the neighborhood as a 'Black neighborhood') shapes processes of disinvestment and resource scarcity. Further, the interaction analyses findings that show that higher income moderately and predominantly Black neighborhoods are also more likely to be MDAs than their low-income, moderately and predominantly Black counterparts are provocative. That somehow, collective upward mobility for Blacks in the form of racially homogenous, high-income communities results in even more neighborhood resource deprivation speaks to the enduring effects of racial residential segregation (Massey and Tannen 2016). This is so much more poignant when recognizing that moderately Black neighborhoods had no association with multiple resource scarcity until the mediation of median household income. Figure 1 shows that lower income, moderately Black neighborhoods are less likely to be an MDA than neighborhoods with even less Black people – until the median household income increases. At higher income levels, the benefits for moderately Black neighborhoods disappear. Along with racial residential segregation, the likelihood that these higher income, predominantly Black communities are likely historically Black areas where middle-class Black residents have maintained their foothold might also explain the counterintuitive findings. Likewise, low-income Black neighborhoods might possibly be prime areas for urban renewal processes that bring in resources imbued with *symbolic* boundaries that, for long-time, low-income Black residents, seem 'off limits' (Sullivan 2014).

Limitations

Because food desert measures were limited to access to large grocers and supermarkets despite empirical evidence of the use of alternative food destinations by residents as well as saturation of fast-food restaurants in neighborhoods, resource scarcity in terms of food might be overestimated (Bukenya 2018; Ruelas et al. 2012; Kwate 2008; Hager et al. 2017; Sharkey, Dean, and Nalty 2012). Moreover, the green desert measure excludes private parks as well as zoological parks and other green spaces not designated for public use. Thus, the measure may also underestimate individual access to green space in a more general sense. Additionally, greenspace has been measured in various ways, including a more comprehensive measure of green infrastructure outlined by the National Recreation and Park Association (NRPA, n.d).

Taken together, limitations in the desert measures may overestimate resource scarcity measures in general and the MDA measure specifically. Moreover, because the study explores absolute access to resources rather than resource density, there is more to uncover about how the number of resources in a neighborhood relates to neighborhood characteristics. However, the lack of access may be apparent even in neighborhoods not objectively designated as deserted. Research suggests that, even in formerly low-income, gentrifying neighborhoods with newly sited supermarkets, older, poorer residents continue to lack access to food via these 'food mirages' that imbue symbolic boundaries that alienate them (Sullivan 2014). Furthermore, although the existence and implications of multiply-deserted areas are important in understanding resource access among marginalized groups, it is important to note that the study does not explicate the nuanced, subjective nature of access, resiliency, and coping that is better highlighted through more qualitative methods (e.g. Reese (2018)). Lastly, as the study focuses on neighborhoods within older, single counties across each southern state, the sample excludes Black neighborhoods in other counties within larger metropolitan statistical areas (MSA) and thus does not completely reflect the diversity of Black experience in metro areas.

Conclusion

Despite these limitations, the current study contributes knowledge about the relationship between inequality and the physical and built environment and further demonstrates that race and racism shape disadvantage for marginalized individuals in more complex and insidious ways than demonstrated thus far. The findings have implications for policy-level and community interventions to remedy disparities in access to material resources. While there have been efforts to increase food access *or* greenspace for low-income, minority neighborhoods via farmer's markets and community gardens, understanding that these neighborhoods are experiencing compounded, co-occurring resource scarcity calls for a more comprehensive policy intervention or community initiative that seeks to increase access to healthy foods, greenspace, and prescription medicines. Additionally, the study findings that suggest that higher income Black residents lack access to three important health-related resources provide further insights on why wealthier Blacks do not receive the same benefits of the health-wealth gradient as their non-Black counterparts (Williams and Collins 2016; Wilson, Thorpe, and LaVeist 2017). Further, the study findings demonstrate race-blind, socioeconomic policy interventions might miss the need for intervention across higher income Black neighborhoods.

Notably, inequality in spatial access to resources disadvantages other racial minorities, including Latinx populations (Ortega et al. 2016), and resource scarcity is pervasive across rural America (Morton and Blanchard 2007). Future research should examine the complex and unique patterns of resource scarcity across various marginalized social locations as well as over time. Lastly, making direct, empirical connections between this resource scarcity and health outcomes at the neighborhood-level should be the next step in this area of scholarship.

Notes

1. This association is consistent when food deserts are measured in terms of access to healthy food and supermarkets, but when measuring food deserts

based on access to fast food restaurants and unconventional 'healthy' food destinations such as convenience stores and dollar stores, the findings are mixed (Zenk and Powell 2008).
2. These factors are commonly used in designating urban/rural status by the U.S. Census. Nearly all (96%) of the census tracts in the sample are federally designated 'urban' census tracts.
3. Supplemental analysis using the ½ mile buffer supports this assertion; nearly all (96%) of neighborhoods were a desert of some kind using this measure and approximately 75% of neighborhoods were multiply-deserted areas.
4. Defined as food stores with at least $2 million in annual sales and containing all the major food departments (Economic Research Service (ERS) Economic Research Service (ERS), U.S. Department of Agriculture (USDA) 2015)
5. Neighborhood spatial inequality has been measured many ways, including place-based measures using straight-line/Euclidean distance or street-network distance (Sparks, Bania, and Leete 2011; Leete, Bania, and Sparks-Ibanga 2012), travel time-based measures, and transportation-option measures (McKenzie 2014). In line with the food desert measure, which uses straight-line /Euclidean distance, I follow suit using Euclidean distance for the green and pharmacy desert measures. Moreover, in a study comparing Euclidean and street network-based measures of access, Sparks, Bania, and Leete (2011) show that Euclidean distances generate the same relative pattern of food access as do network distances.

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No potential conflict of interest was reported by the author(s).

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Appendix

Table A1. List of counties (*N* = 17).

County	Largest City
Berkeley County, WV	Martinsburg
Broward County, FL	Ft. Lauderdale
Dallas County, TX	Dallas
East Baton Rouge Parish, LA	Baton Rouge
Fulton County, GA	Atlanta
Hinds County, MS	Jackson
Jefferson County, AL	Birmingham
Jefferson County, KY	Louisville
Mecklenburg County, NC	Charlotte
New Castle County, DE	Wilmington
Prince George's County, MD	Upper Marlboro
Pulaski County, AR	Little Rock
Richland County, SC	Columbia
Richmond, VA*	Richmond
Shelby County, TN	Memphis
Tulsa County, OK	Tulsa
Washington, DC*	Washington

*Independent City