Retail Redlining in New York City: Racialized Access to Day-to-Day Retail Resources

Naa Oyo A. Kwate, Ji Meng Loh, Kellee White,
and Nelson Saldana

ABSTRACT *Racial residential segregation is associated with health inequalities in the USA, and one of the primary mechanisms is through influencing features of the neighborhood physical environment. To better understand how Black residential segregation might contribute to health risk, we examined retail redlining; the inequitable distribution of retail resources across racially distinct areas. A combination of visual and analytic methods was used to investigate whether predominantly Black census block groups in New York City had poor access to retail stores important for health. After controlling for retail demand, median household income, population density, and subway ridership, percent Black was associated with longer travel distances to various retail industries. Our findings suggest that Black neighborhoods in New York City face retail redlining. Future research is needed to determine how retail redlining may perpetuate health disparities and socioeconomic disadvantage.*

KEYWORDS *Segregation, African American/Black, Retail, Redlining, Neighborhoods, New York City*

Racial residential segregation is thought to be the foundation on which Black–White disparities in health status have been built.⁴² Three primary mechanisms through which segregation operates include: (1) the concentration of poverty, (2) constrained access to economic and educational opportunity structures, and (3) neighborhood social and physical environments, including housing quality and the distribution of amenities and retail resources.^{16,24,34,35,41,42} These pathways create economic, social, and physical contexts that determine the likelihood of conditions that foster, support, or sustain health.

One of the primary constituents of a healthy neighborhood is the provision of public or private services that support people in their daily lives.²¹ Public or private services include education, transportation, health care, and retail services. These services, along with the reputation of an area, are important neighborhood features. Reputation influences how areas are perceived by residents, service planners and investors, and in turn, availability of services.²¹ Black segregated neighborhoods

Kwate and Saldana are with the Department of Human Ecology, School of Environmental and Biological Sciences, Rutgers, The State University of New Jersey, New Brunswick, NJ, USA; Loh is with the AT&T Labs-Research, Florham Park, NJ, USA; White is with the Department of Epidemiology and Biostatistics, Arnold School of Public Health, University of South Carolina, Columbia, SC, USA; Saldana is now a doctoral student at the Department of Sociology, University of Michigan, Ann Arbor, MI, USA.

Correspondence: Naa Oyo A. Kwate, Department of Human Ecology, School of Environmental and Biological Sciences, Rutgers, The State University of New Jersey, New Brunswick, NJ, USA. (E-mail: nokwate@rci.rutgers.edu)

often face lacking or poor quality goods and services, and these deficits are often characterized as a reflection of poor commercial viability or deficits in resident consumerism. In other words, Black neighborhoods often have poor retail reputations and have difficulty in attracting businesses and employment opportunities. Research and commentary has demonstrated the health impact of the retail environment in Black neighborhoods, both when needed resources (e.g., supermarkets) are scarce,²⁷ and when health damaging products such as alcohol are aggressively marketed.¹⁸

In international settings, poverty has been associated with resources that are deleterious to health opportunity,^{11,33} but this relationship is not consistent. For example, evidence for food deserts in low income areas is equivocal in several countries.⁵ In Scotland, deprivation was not always associated with fewer day-to-day resources; nurseries, pharmacies, and credit unions were actually denser in deprived areas.²² In the USA, the relationship between income and resource access is also equivocal, but proportion Black is consistently negatively associated with access to a variety of day-to-day resources that are directly and indirectly related to health.

RETAIL REDLINING

Black neighborhoods are often characterized by the inequitable distribution (i.e., density and proximity) of amenities and retail resources important for health.^{20,40} In one national study, proportion Black at the zip code level, but not neighborhood poverty, was inversely associated with resources such as hardware stores, pharmacies, savings banks and convenience stores.³⁷ Across Baltimore, New York City (NYC), and Winston-Salem, the spatial distribution of supermarkets, parks, recreational facilities, and retail areas was racially patterned, with Black residents having the lowest access. Additionally, within NYC (815 block groups in Upper Manhattan), proportion Black was related to fewer supermarkets.³⁸ In Atlanta, predominantly Black census tracts had less access than income-matched predominantly White counterparts for a number of resources such as grocery stores, non-fast food restaurants, small banks and movie theaters.¹⁵ In NYC, predominantly Black zip codes (also true for low income zip codes) had smaller, less dense retail stores than White zip codes, with lower diversity in food service, and no (0 %) upscale chain groceries, compared with a value of 8 % in White zip codes.²⁶ Because Black zip codes had the same amount of retail space and more transit rail than White zip codes, observed disparities were not driven solely by those cost-related factors²⁶. Disparities are especially acute for national retailers. Of the bottom 29 zip codes across the five boroughs for the number of national retailers, 12 (41 %) were predominantly Black.⁸ Finally, access to OTC syringes is racially patterned in NYC. After accounting for the need for services, areas with low proportions of White residents had fewer than half of such pharmacies than areas with high proportions of White residents, and this disparity increased over time. Moreover, while racial and ethnic composition accounted for 43 % of spatial variation in access, adding poverty to the model had a negligible effect.¹⁰

Why is the proportion of Black residents consistently inversely related to resources important for promoting and maintain health? Small and McDermott³⁷ contend that business operation is not based solely on customers' pockets—political and economic conditions such as government incentives and entrepreneurship grants play a key role in where and how businesses operate. But if retailers systematically

avoid Black neighborhoods, and mark them as less desirable or tenable as consumer markets, these areas are effectively being redlined for retail. Retail redlining¹² refers to spatial discrimination whereby retailers, particularly chain stores, fail to serve neighborhoods or target them for unfavorable treatment based on the racial composition of the customers and/or the store operators. From a health perspective, retail redlining contributes to racialized risk environments. Cooper et al.¹⁰ articulate a racialized risk environment as one in which health-related features occur in spatial pockets of risk or protection based on the race and ethnicity neighborhood populations.

D'Rozario and Williams¹² argue: "chain stores willingly cede profitable, inner-city locations to independents while they saturate suburban, less-profitable locations with their stores. This cannot be explained by any economic theory that we are aware of" (p. 177). The authors note that retailers typically explain their absence by citing stagnant or low populations, high crime rates and therefore high insurance rates, low numbers of comparable retailers already in the area, insufficient household incomes, and downscale tastes and preferences. Concerns about demand (e.g., income and consumer preferences) are clearly a basic consideration for any business. Retail markets depend on the supply of existing retail and the demand for more.⁴³ Evidence of retail redlining exists when resource disparities persist in the absence of the negative consumer characteristics typically cited by retailers, or when neighborhoods are disproportionately assigned negative attributes, such as being low in consumer savvy and retail demand. In this paper, we empirically investigate the presence of retail redlining in NYC among retailers that are potentially important to health.

RETAIL DEMAND

Macintyre et al.²¹ contend that place-based needs for health rest on Maslow's hierarchy of human needs. Uppermost in the formulation are such needs as air, water, food, shelter, security and hygiene; last is social, cultural and physical recreation (play). Some of these broad human needs can be mapped onto retail goods and services. For example, most people would find it desirable to have stores in their neighborhood where needs for food (e.g., supermarkets), hygiene (e.g., Laundromats), and play (e.g., toy stores) can be met.

Retailers are keenly aware of finely-measured demand for goods and services, though they do not have perfect information about local tastes and buying power.¹⁵ Several metrics are available to measure retail demand; a common one is simply household income. It is thought that at the most basic level, areas with high household incomes should be better able to support retail. However, several have criticized this reasoning, arguing that it does not take into account the latent purchasing power of densely populated urban areas.^{9,43} One Pittsburgh study found that using expenditures per square mile rather than household income revealed greater purchasing power in an underinvested neighborhood than in an affluent counterpart.⁹

Retail demand is also assessed by calculating the market potential index (MPI), which describes the expected number of consumers in a given area compared with the US national average. The information used to derive the MPI index is usually collected through market segmentation cluster analytic techniques. These methods integrate information such as census data and purchasing and consumptive behaviors to describe the lifestyle preferences, spending habits, and favorite brands

and products of neighborhood residents. Although the specific manner in which the classifications are constructed is proprietary, the methodological approach is similar⁷ and is offered by several companies, such as ESRI, Claritas, and Experian. These systems enable businesses to capitalize on possible markets that might be missed when solely relying upon census statistics, and can be useful in identifying locations for new stores, selecting merchandise that matches consumer preferences, and targeting advertising with the right message.¹³

ESRI's¹⁴ retail demand is derived as:

$$\text{Expected number of consumers} = \sum_{n=1}^{n=65} (\text{count}_n \times \text{consumption rate}) \quad (1)$$

where n is a count of community tapestry segments (descriptions of the lifestyle preferences and spending habits of neighborhood residents) and the consumption rate is for the unique segments that characterize a neighborhood;

$$\text{Local consumption} = \text{expected consumers} / \text{base count} \quad (2)$$

$$\text{MPI} = (\text{local consumption} / \text{US consumption}) \times 100 \quad (3)$$

In this formulation, 100 indicates the US national average; values above and below 100 indicate retail demand that is higher, and lower than the national average, respectively. Thus, a value of 85 would indicate that the retail demand was 15 % lower than the national average, and a value of 300 would indicate that the retail demand was three times as high as the national average.

It is often argued that scarce retail in Black neighborhoods reflects low demand. Thus, we used ESRI's¹⁴ measure of demand to examine racialized access to a variety of retail resources after controlling for key covariates. We hypothesized that after controlling for socioeconomic and retail covariates, the proportion of Black residents would be inversely associated with proximity to goods and services that support health, and positively associated with proximity to goods that destabilize health.

METHOD

Geography

We studied the 5,730 census block groups comprising NYC five boroughs: Manhattan, Brooklyn, Queens, The Bronx, and Staten Island. In 2000, NYC had 8,008,278 residents, of whom 24.5 % were Black, 27 % Latino, 35 % White, and 9.8 % Asian or Pacific Islander, and the median household income was \$38,909.²⁸ By 2010, despite an increase in total population, there were declines among White (33.3 %) and Black (22.8 %) residents.²⁹ Although NYC is diverse in its racial/ethnic composition, it remains highly segregated (Figure 1).

Defining Retail Resources

As in other research²² we tried to operationalize retail resources that corresponded to key human needs. Additionally, to address our research questions we required stores with: (a) a strong retail presence in NYC, (b) a geographic scale that could be expected to result in relatively high prevalence across the city (e.g., we would not expect a large department store such as Saks Fifth Avenue in every census block

FIGURE 1. Heat map of percent Black across the five boroughs of NYC.

group), and (c) nationally available MPI data either for that particular brand or for the same category of stores. We focused on (multi)national and local NYC retail chains to meet these criteria. Wherever possible, we examined more than one retail chain for each need, in order to observe variability among brands and store types within the same category, as shown in Table 1.

We extracted retail location from internet-based reference service ReferenceUSA, which contains data on businesses in North America. We searched the US Business/Employers USA database using the custom search in February 2010. Retail chains

TABLE 1 Store sample by human need, retail category, and type of store chain

Need	Category	Store chain	Total stores (N)
Hygiene	Apparel	Clothing store	72
		Athletic shoe store	58
		Athletic shoe and sporting goods store	35
		Shoe store (2) ^b	137
Healing	Pharmacies	Pharmacy and household sundries no. 1	64
		Pharmacy and household sundries no. 2	119
		Pharmacy and household sundries no. 3	205
	Health supplements	Vitamin supplements store no. 1	34
		Vitamin supplements store no. 2	84
	Nutrition ^a	Fast food restaurant no. 1	47
		Fast food restaurant no. 2	72
		Fast food restaurant no. 3	38
		Fast food restaurant no. 4	74
		Fast food restaurant no. 5	248
		Fast food restaurant no. 6	50
Information	Information and technology	Electronics goods and supplies	118
		Bookstore	17
	Educational and professional supplies	Office supply store	65
Play	Physical activity	Fitness club (3) ^b	109
	Recreation	Video game store	70

^aWe used fast food to represent nutritional resources that are deleterious to health
^bNumbers in parentheses refer to the number of brands combined to represent stores in this category

were searched by name and the county that corresponds with each borough of NYC (Manhattan=New York, Brooklyn=Kings, Bronx=Bronx, Queens=Queens, and Staten Island=Richmond). Using county rather than borough names made for more accurate retrieval of store locations, particularly for the borough of Queens, which uses multiple names for mail delivery (e.g., Flushing, Jamaica). The results of the query were downloaded in Excel format. Stores that were different divisions of the same company were merged to represent one retail brand. All businesses (N=1,731) were then plotted using the latitude/longitude XY-coordinates in the database.

We purchased market potential data for the year 2008 from ESRI. For each of the retail stores, we selected market potential variables that were exact or comparable matches for the store name or retail type. As an example, if we were interested in locations for Home Depot, we would search the ESRI database for MPI values for Home Depot. If present, we used those data; if not, we used a proxy variable that approximated the store category (e.g., hardware and building supplies). For all stores, we used retail demand data for purchases in the last 3, 6, or 12 months (the data varied for different retail categories).

Analytic Plan We used a combination of visual and analytic methods to study retail redlining. Constructing maps of the city displaying MPI values and measures of access together allowed us to visually detect spatial variations in MPI, retail access, and relationships between the two that may not be easily modeled statistically. Correlation coefficients were computed to identify possible dependence and marginal relationships between variables of interest. To measure access, we considered Euclidean, rather than network distances to the nearest store because we were interested in the overall access to stores, rather than immediate walkable

proximity. And, as noted earlier, though we examined stores with relatively high frequency throughout the city, we would not expect most people to be able or inclined to walk to all of them. It is likely that shopping trips to these stores would comprise a mix of walking, public transportation, or driving. Additionally, variations in land use and automobile use in the boroughs made Euclidean distance a more comparable measure across the city.

Besides percent Black from 2000 census data (PctBlk), we included as covariates select population characteristics at the block group level that could be expected to be associated with retail location. These included MPI values, because stores locate where demand is high; population density (PopDens), because stores locate where a dense consumer base is present; median household income (MHI), because stores locate where consumers have incomes to support purchases at the outlet in question; and average weekday subway ridership for the year 2000 (Subway), because store locations near transit hubs are desirable.

We first employed generalized linear models (GLMs) to model access in terms of the predictor variables. We did so separately for each type of store, using nearest distance as the response variable.

Specifically, with nearest distance to block group i denoted by Y_i , we have:

$$Y_i \sim N(\mu_i, \sigma^2)$$

$$\mu_i = \alpha + \beta_1 \text{MPI} + \beta_2 \text{PopDens} + \beta_3 \text{PctBlk} + \beta_4 \text{MHI} + \beta_5 \text{Subway}$$

Where the observed nearest distance Y_i is equal to μ_i plus normal error with variance σ^2 , and where μ_i depends on the indicated covariates. The model is fit to the data using the R statistical package, specifically the *glm* function, yielding estimates for α and the β . These models are independent error models and do not incorporate spatial information except through spatial correlations within the predictor variables. When there is significant spatial correlation in the data, such models can still provide accurate estimates of the coefficients but may be over optimistic in terms of the uncertainty. We examined the residuals from the fitted models for spatial correlations using variograms.

Next, we fit spatial GLMs to include spatially correlated errors (ε_i) to the right-hand side of each linear equation. This was done using the *geoRglm* function in the R package *geoR*. Smiley et al.³⁸ investigated retail density with spatial lag models and spatial error models. The former explicitly treats autocorrelation as a feature of interest, wherein resource density is a function of neighboring area characteristics. The latter treats autocorrelation as a confounder; this was our approach. Smiley et al.³⁸ found that in NYC, where autocorrelation was highest among the study cities, including neighboring block group information did not strengthen observed relationships. Additionally, spatial lag and error models produced similar findings. Thus, we modeled autocorrelation with a spatial error approach. We expected the direction of the relationship between the response and the predictors in the spatial error model to be similar to the independent GLMs, but with perhaps reduced significance.

We chose the exponential form for the correlation structure of the errors. In general, parameters for the correlation structure consist of the nugget, variance and range. We set the nugget, representing micro-scale variability, to be zero. The range is estimated by fitting the exponential correlation model to the variograms of the independent GLM residuals. We set an upper limit for the range to 5 km. The

variance parameter is estimated together with the coefficients of the predictors in the spatial regression.

RESULTS

Descriptive Analyses

General Trends Figure 2 shows boxplots of distance in kilometers to nearest store across all store categories. Several things are evident. First, the median distance (black lines in each box) to nearest store was quite similar, at approximately 1 km or 12 city blocks or less for most store chains. Thus, residents in the middle 50 % of block groups traveled a similar distance to the nearest store, regardless of type. The stores with the shortest distances were fast food restaurant no. 5, pharmacy no. 3, and the general shoes stores. These were the top 3 stores for number of locations, comprising over a third of all the stores in our sample. A few stores had higher median distances. The median distance to bookstores was about 3 km, and the median for the clothing store was about 3.5 km.

Second, variability in distance to nearest (height of the boxes) was also quite similar for most stores. The stores with the relatively high median distances showed greater variability than most other stores (e.g., bookstores, vitamin/supplement store no. 2, and clothing stores). Third, store chains within the same category (vitamin/supplements, fast food, and pharmacy household sundries) were not consistent in median distance or variability. As can be seen, the two vitamin stores and the two

FIGURE 2. Boxplots of distance to nearest for all retail stores. Store abbreviations are: Vit SS= Vitamin & Supplement store; FFR=Fast food restaurant; P&HS=Pharmacy & household supplies; Ath shoe=Athletic shoes; Reg shoes=General shoe stores.

shoe stores presented quite different profiles, fast food varied across the six chains, and pharmacy no. 1 was more similar to office supplies than to the other pharmacies.

Bivariate correlations (Table 2) show that predominantly Black areas faced greater distances to retail outlets; percent Black was positively associated with distance to nearest store for 65 % (13 out of 20) stores. Percent Black was also inversely related to MPI for 40 % of stores, indicating that as the proportion of Black residents increased, industry perceptions of retail demand declined. Of the 12 stores for which percent Black was positively associated with retail demand, six were fast food restaurants.

Spatial Mapping: Retail Demand and Distance to Nearest Store Figures 3, 4, 5, and 6 map represent each of the four human needs. In the interest of space, we show only selected stores (clothing, one pharmacy, electronics stores, and fitness clubs). In each map, shading indicates distance (kilometers) to nearest store, with darker shading for higher distances. The contour lines in each map represent retail demand, such that areas that with the same market potential index are connected by the same contour lines. On these maps, MPI is smoothed so that we obtain values over a continuous surface rather than only at block group centroids. As with an actual landscape, the contour lines show the peaks and valleys in the market potential index as well as the gradient (closely packed lines suggest a sharp increase/decrease in market potential index). Each map has 16 contour levels from the minimum to maximum of the smoothed market potential index.

Clothing stores (Figure 3), have low distances in most of Manhattan, and high distances in Upper Manhattan, The Bronx, Central Brooklyn, North and Southeastern Queens and the Rockaways. Most of these latter areas have high

	MPI	Nearest distance
Clothing store	−0.03	0.44
Athletic shoe store	−0.21	0.08
Athletic shoes and sporting goods	−0.21	0.09
Shoe stores	−0.29	0.01
Pharmacy and household sundries no. 1	0.15	0.09
Pharmacy and household sundries no. 2	0.22	0.36
Pharmacy and household sundries no. 3	0.02	0.06
Vitamin supplements store no. 1	−0.22	0.28
Vitamin supplements store no. 2	0.14	0.46
Fast food restaurant no. 1	0.69	−0.42
Fast food restaurant no. 2	0.15	−0.25
Fast food restaurant no. 3	0.59	−0.20
Fast food restaurant no. 4	0.06	−0.04
Fast food restaurant no. 5	0.11	−0.02
Fast food restaurant no. 6	0.25	−0.04
Electronics goods and supplies	0.23	0.06
Bookstore	−0.51	−0.08
Office supply store	−0.23	0.36
Fitness club	−0.44	0.17
Video game store	0.23	0.17

FIGURE 3. Heat and contour maps for MPI and distance to nearest store for clothing stores.

percentages of Black and Latino residents. Tracing contour lines, however, shows that areas with quite different actual exposures to clothing stores in fact have similar retail demand. Electronics stores (Figure 4) are more widely dispersed across the city, as shown by the relatively uniform low shading of distance to nearest. Similarly, large swaths of the city share the same contours for retail demand, and there are fewer areas of closely packed lines. Fitness clubs (Figure 5) show more diverse patterning of distance to nearest. Some of the same areas that faced relatively high

FIGURE 4. Heat and contour maps for MPI and distance to nearest store for electronics stores.

distances to clothing stores showed the same pattern for fitness clubs, but the magnitude of distance is not as great (lighter shading). Retail demand for fitness clubs is also defined more finely than clothing and electronics stores, as shown by the dense tangles of contour lines throughout the city. Finally, the map for one pharmacy and household supply store (Figure 6) shows that large areas of the city have similar retail demand, but areas of Queens without large percentages of Black

FIGURE 5. Heat and contour maps for MPI and distance to nearest store for fitness clubs.

residents have dense contour lines. The contours suggest that those areas are seen as having fine distinctions in demand for pharmacies.

Overall, Figures 3, 4, 5, and 6 suggest that areas with high concentrations of Black residents (as per Figure 1) have longer distances to travel to a variety of stores. Additionally, MPI contours suggest that stores are not equally distributed as a function of retail demand. We employed regression models to investigate whether areas with higher concentrations of Black residents have stores at greater distances

FIGURE 6. Heat and contour maps for MPI and distance to nearest store for pharmacies.

even after accounting for area income, retail demand, and other population characteristics thought to influence store locations.

Regression Analyses

We focus our discussion on the spatial, rather than the independent regressions. As predicted, estimates in the spatial models (Table 3) were generally in the same direction as those in the independent regression (not shown), but were reduced in

TABLE 3 Predictors of distance to nearest store

	Intercept	MN	MPI	PctBlk	PopDens	Income	Subway
Bookstores							
Estimates	7.0700*	-0.0590*	-0.0001*	-0.0031	0.0000	-6.69E-08*	0.0000
SD	0.0380	0.0139	0.0000	0.0042	0.0000	0.0000	0.0000
p value	0.0000	0.0000	0.0151	0.4630	0.4680	0.0174	0.2310
Vitamin supplements store no. 1							
Estimates	6.7000*	-0.2190*	-0.0001*	0.0128*	-6.20E-08*	0.0000	-1.44E-07*
SD	0.0330	0.0155	0.0000	0.0047	0.0000	0.0000	0.0000
p value	0.0000	0.0000	0.0013	0.0067	0.0000	0.0645	0.0005
Vitamin supplements store no. 2							
Estimates	3.4900*	-0.5400*	-0.0001*	0.0645*	-1.33E-07*	0.0000	-2.73E-07*
SD	0.0196	0.0269	0.0000	0.0091	0.0000	0.0000	0.0000
p value	0.0000	0.0000	0.0012	0.0000	0.0000	0.4610	0.0007
Fast food restaurant no. 1							
Estimates	4.8100*	-0.1160*	-	-0.0183*	0.0000	0.0000	0.0000
SD	0.0504	0.0184	0.0000	0.0057	0.0000	0.0000	0.0000
p value	0.0000	0.0000	0.0386	0.0014	0.0586	0.2100	0.2620
Fast food restaurant no. 2							
Estimates	2.6100*	-0.2270*	-0.0001*	-0.0389*	-5.47E-08*	1.16E-07*	-1.04E-07*
SD	0.0150	0.0182	0.0000	0.0060	0.0000	0.0000	0.0000
p value	0.0000	0.0000	0.0000	0.0000	0.0023	0.0026	0.0480
Fast food restaurant no. 3							
Estimates	3.9300*	0.0510*	0.0000	-0.0233*	0.0000	7.08E-08*	0.0000
SD	0.0270	0.0182	0.0000	0.0058	0.0000	0.0000	0.0000
p value	0.0000	0.0052	0.0790	0.0001	0.7250	0.0483	0.1550
Fast food restaurant no. 4							
Estimates	3.8000*	-0.0997*	-0.0001*	0.0056	0.0000	0.0000	-2.17E-07*
SD	0.0534	0.0195	0.0000	0.0059	0.0000	0.0000	0.0000
p value	0.0000	0.0000	0.0376	0.3410	0.3910	0.3390	0.0000
Fast food restaurant no. 5							
Estimates	1.9400*	-0.0799*	-0.0004*	0.0412*	-7.55E-08*	0.0000	-1.88E-07*
SD	0.0629	0.0230	0.0001	0.0070	0.0000	0.0000	0.0000
p value	0.0000	0.0005	0.0000	0.0000	0.0003	0.0648	0.0020
Fast food restaurant no. 6							
Estimates	2.7700*	-0.1730*	-	0.0065	-4.62E-08*	-6.05E-08*	0.0000
SD	0.0134	0.0137	2.30E-05	0.0044	0.0000	0.0000	0.0000
p value	0.0000	0.0000	0.0481	0.1390	0.0004	0.0329	0.3240
Electronic goods and supplies							
Estimates	2.6400*	-0.2120*	-0.0001*	0.0164*	-1.05E-07*	0.0000	-1.11E-07*
SD	0.0229	0.0181	0.0000	0.0057	0.0000	0.0000	0.0000
p value	0.0000	0.0000	0.0000	0.0041	0.0000	0.8500	0.0240
Office supply store							
Estimates	3.2600*	-0.2830*	-0.0001*	0.0286*	-7.48E-08*	0.0000	-1.92E-07*
SD	0.0174	0.0193	0.0000	0.0062	0.0000	0.0000	0.0000
p value	0.0000	0.0000	0.0000	0.0000	0.0001	0.0975	0.0005
Clothing store							
Estimates	4.8400*	-0.1730*	-	0.0150*	-3.89E-08*	0.0000	-8.46E-08*
SD	0.0238	0.0139	0.0000	0.0043	0.0000	0.0000	0.0000
p value	0.0000	0.0000	0.0042	0.0005	0.0023	0.7630	0.0235
General shoe store							
Estimates	3.0400*	-0.1550*	-0.0001	0.0179*	-6.04E-08*	0.0000	-3.50E-07*
SD	0.0534	0.0195	0.0000	0.0059	0.0000	0.0000	0.0000
p value	0.0000	0.0000	0.0584	0.0025	0.0006	0.6930	0.0000
Athletic shoe and sporting goods store							
Estimates	2.8000*	-0.2690*	-0.0001*	0.0222*	-8.36E-08*	0.0000*	0.0000
SD	0.0136	0.0151	0.0000	0.0049	0.0000	0.0000	0.0000
p value	0.0000	0.0000	0.0169	0.0000	0.0000	0.0316	0.1030

TABLE 3 (Continued)

	Intercept	MN	MPI	PctBlk	PopDens	Income	Subway
Athletic shoe store							
Estimates	4.8400*	-0.2320*	-0.0001	0.0148*	-6.66E-08*	0.0000	0.0000
SD	0.0285	0.0163	0.0000	0.0050	0.0000	0.0000	0.0000
p value	0.0000	0.0000	0.0903	0.0030	0.0000	0.4510	0.2230
Pharmacy and household sundries no. 1							
Estimates	3.6300*	-0.0054	0.0000*	0.0106*	-7.09E-08*	0.0000	-1.54E-07
SD	0.0325	0.0168	0.0000	0.0051	0.0000	0.0000	0.0000
p value	0.0000	0.7480	0.0487	0.0392	0.0000	0.9830	0.0006
Pharmacy and household sundries no. 2							
Estimates	1.8200*	-0.1030*	-0.0001*	0.0377*	-1.03E-07*	0.0000*	0.0000
SD	0.0110	0.0135	0.0000	0.0045	0.0000	0.0000	0.0000
p value	0.0000	0.0000	0.0000	0.0000	0.0000	0.0067	0.0561
Pharmacy and household sundries no. 3							
Estimates	2.3400*	-0.0551*	-0.0001*	0.0228*	-1.44E-07*	0.0000	0.0000
SD	0.0629	0.0230	0.0000	0.0070	0.0000	0.0000	0.0000
p value	0.0000	0.0167	0.0000	0.0011	0.0000	0.1990	0.4770
Fitness clubs							
Estimates	2.7500*	-0.1000*	-0.0001*	0.0050	-8.26E-08*	0.0000	-1.37E-07*
SD	0.0206	0.0165	0.0000	0.0052	0.0000	0.0000	0.0000
p value	0.0000	0.0000	0.0021	0.3360	0.0000	0.8860	0.0025
Video game store							
Estimates	3.8300*	-0.1580*	-0.0001*	0.0194*	-4.00E-08*	-1.11E-07*	0.0000
SD	0.0507	0.0186	0.0000	0.0057	0.0000	0.0000	0.0000
p value	0.0000	0.0000	0.0317	0.0006	0.0178	0.0017	0.7670

* $p < 0.05$, level of significance

size. Including spatial correlation in the errors caused more of the variation in the response to be taken up there. In comparison to the independent models, when percent Black was significant, the direct effect was lessened because some of the effect is due to what occurs in neighboring areas. In one instance (fast food restaurant no. 5), the direction changed from negative to positive, but remained statistically significant.

In all models, we examined the effect of the percentage of Black residents on distance to nearest store, controlling for median household income, population density, retail demand, subway ridership, and location in the borough of Manhattan. Decreasing/negative distance to stores that are beneficial for health is a positive outcome, because it indicates that residents do not have to travel as far to the nearest store. Decreasing/negative distance to stores that are deleterious to health is a negative outcome, because it indicates that residents in those areas face greater risk environments. All stores except fast food were considered beneficial for health.

Overall, distance to nearest store tended to decrease as subway ridership, population density, and retail demand (MPI) increased. Income tended not to be associated with store distance. Location in Manhattan, the commercial and business center of the five boroughs, was always negatively associated with distance to nearest stores (though not statistically significant for two stores). Below we discuss the association between percent Black and store access by human need and category. For clarity, we use “nearby stores” to indicate decreasing distances to nearest store; “distant stores” refers to increasing distances to nearest store.

Human Need: Hygiene The store category here was apparel (clothing and shoes). For clothing, but not general shoes or athletic shoes, increases in retail demand were

associated with nearby stores. After controlling for MPI and other variables, we found that each increase in percent Black was associated with a 0.015-km increase in distance to the nearest clothing store. Percent Black was also associated with distant athletic shoe stores, athletic shoe and sporting good stores, and general shoes.

Human Need: Healing The first category was pharmacies, comprising three separate chains. For all pharmacies, increasing retail demand was associated with nearby stores. After controlling for MPI and other variables, percent Black was associated with distant stores for all three chains. These chains had many stores throughout the city; chain no. 3 had the second highest number of outlets of any store. Despite the high prevalence, residents in predominantly Black areas have to travel further distances to reach them. The estimate was largest for chain no. 2, at 0.038 km (0.4 city blocks) increase for each increase in percent Black. The second category, health supplements, had fewer stores than pharmacies and household sundries. Percent Black was again associated with distant supplement stores. Taken together, access is compromised in predominantly Black areas to medicines, medical supplies, health supplements, and household supplies.

Conversely, distance to health-deleterious nutrition in the form of fast food generally decreased as percent Black increased. Retail demand was not significantly associated with one chain (no. 3), but otherwise, as demand increased, distance to fast food decreased. After controlling for MPI and other variables, percent Black was variably associated with three chains. For the remaining three, percent Black was associated with nearby stores. The largest estimate for nearby fast food (chain no. 2) was the same magnitude (0.038 km) as distant pharmacies (chain no. 2).

Human Need: Information We examined the category information and technology with electronics stores and bookstores. Increasing retail demand was associated with nearby stores. And, as with most other stores, after controlling for MPI and other variables, percent Black was associated distant electronics stores. This was one of the more prevalent store chains in our sample. Percent Black was also related to distant bookstores, but this association was not statistically significant. Finally, we investigated educational and professional supplies in the form of office supply stores. Here again, percent Black was associated with distant stores.

Human Need: Play We used fitness clubs and video game stores to operationalize play. For both categories, increasing retail demand was associated with nearby facilities. After controlling for MPI and other variables, percent Black was not significantly associated with distance to the nearest fitness club. Like most other stores, distance to video game stores increased as a function of percent Black.

Secondary Analyses

Although our primary focus was on percent Black as a predictor of retail access, we also examined the effects of percent White using the same models. Given the high levels of residential segregation in NYC, we might expect a neatly opposite set of findings for the proportion of White residents. This was only partially true. Of the seven stores for which percent Black was associated with distant stores (clothing, pharmacies, health supplements, and office supplies), we did indeed observe nearby stores for percent White. Additionally, three of the four fast food restaurants with a significant association with percent Black showed an opposite, and significant

relationship with percent White (distance to nearest increased). Stores that were non-significant for percent Black (fitness clubs and two fast food restaurants) were also non-significant for percent White. Finally, 7 stores (35 %) showed no association with percent White after controlling for covariates. These stores showed a statistically significant relationship with percent Black, but when modeled with percent White, area characteristics such as MPI, median household income, and subway ridership better explained distance to the nearest store. Race appears to come more into the fore in predicting store location when residents are Black.

DISCUSSION

We investigated retail redlining in NYC by asking whether predominantly Black areas had restricted access to retail resources after accounting for area characteristics that would be central in business siting: median household income, population density, subway ridership, and retail demand. We hypothesized that after these controls, as percent Black increased, so too would distance to the nearest health-promoting store (across several retail categories); conversely, we hypothesized that percent Black would be inversely related to the distance to the nearest health-deleterious store (fast food). Almost across the board, the results supported our hypotheses. Spatial mapping showed that retail demand was often similar across areas with varied racial and socioeconomic characteristics. Yet, spatial regressions revealed that as percent Black increased, the distance to the nearest clothing store, shoe store (general and athletic), pharmacy, health supplement store, electronics store, office supply store, and video game store increased. Cooper et al.¹⁰ surmised that perhaps chain pharmacies have less coverage of urban communities with low percentages of White residents. Our data support this assertion for several pharmacy chains. Distance to fast food decreased with more Black residents, concordant with other studies.¹⁹

Retail demand was inversely associated with percent Black. That is, predominantly Black areas were described as having low demand for a variety of goods and services. Even after accounting for this low demand, inequalities in retail access persisted. Indeed, the measure of retail demand we used—the market potential index—likely underestimates demand in Black neighborhoods. The index is based in part on surveys (e.g.,²⁵) that ask respondents not necessarily to report affinities towards particular brands, but to discuss the frequency of patronizing shops in their area. Given that Black neighborhoods are unlikely to have the stores about which the survey inquires, residents will perforce give responses that indicate minimal shopping at these outlets, spuriously suggesting lack of demand. If the best available measures artificially reduce demand in Black neighborhoods, our results would underestimate the magnitude of retail redlining.

Some study limitations should be noted. First, we focused on large national and multinational retail chains, given literature on retail redlining, the necessity of studying multiple store locations across the city, and the availability of data on retail demand for these establishments. Thus, our analysis precluded the inclusion of small independent retailers. Research is needed to investigate the number and trajectory of small stores over time in Black neighborhoods. If they also cede these areas as markets, our findings would again underestimate the lack of retail accessibility for Black residents. A second limitation related to our data is the fact that we retrieved our data from a private vendor database, and although we cleaned the data to be free of obvious errors, some aspects of data integrity are unclear and are not easily checked. For example, stores listed in the database may have closed, and new stores

may have opened, but were not yet included in the database at the time we compiled our sample. Some stores may simply be missing altogether. If inaccuracies were not distributed at random, our analyses could be biased. However, research has shown good concordance between commercial databases and direct observation. For one of the store types we studied (drugstores), 95.8 % agreement was observed between vendor and street-collected data. When disagreement occurred, it was not associated with population characteristics.²

Our operationalizations of retail access also have some limitations. Macintyre, Macdonald, and Ellaway²² argue that researchers should carefully theorize the direction of effects for given resources. For example, bus stops may give access to transportation and increase walking and access to jobs, but they may also produce more diesel fumes, pedestrian and bicycle accidents and traffic noise. In our study, we categorized pharmacies as health supportive because they provide day-to-day health related goods, first aid supplies, and access to prescription medicines. However, pharmacies increasingly resemble convenience stores, with more and more aisles dedicated to processed and energy dense foods and beverages. Proximity to convenience stores is related to overweight/obesity/poor diet.⁶ Also, we measured access by distance alone. In fact, material and social attributes other than proximity affect retail access and healthy behaviors.³⁸ Indeed, research has shown that crime shrinks effective resource availability, while public transit increases it in Black neighborhoods.³

Finally, we did not control for every possible factor that could influence where stores locate. Returning to D'Rozario and Williams'¹² formulation, retailers typically cite low populations, insufficient household incomes, and downscale tastes and preferences. Our results showed that inequities in access persisted after controlling for these variables. Retailers also cite high crime rates and high insurance rates. We did not control for crime rates, as we did not have access to detailed, temporally and spatially appropriate data (see³⁰ for basic precinct-level data). Still, it is difficult to articulate a coherent logic about why crime might drive the racial patterning of six retail categories across NYC, after accounting for area income, population density, retail demand and numbers of subway riders. Crime levels are not constant across areas varying in these attributes. It also remains unclear why fast food retailers (which had shorter distances to Black areas) would be inured to high crime rates, if we expect crime to be uniformly high across all Black neighborhoods. Thus, it is unlikely that spatial areas with high concentrations of Black residents have greater distances to retail due to high crime levels.

Taken together, our findings suggest retail redlining of predominantly Black areas in NYC. Research is needed to investigate the processes by which these patterns come to pass, and to investigate the complex relationships residents have with stores, particularly independents vs. national chains. Meltzer and Schuetz²⁶ found that economically upgrading zip codes saw more retail presence between 1998 and 2007. However, in Central Harlem, despite years of gentrification and the introduction of empowerment zones, retail declined markedly between 1995 and 2006, in part due to building demolition. Where retail increases in Harlem did occur, gains took place among large chains and entrepreneurial "boutiques," while older, local retail declined.⁴⁴ In gentrifying neighborhoods, residents may appreciate more resources, but face disruptions in social bonds forged with small business owners, and resent the linkage of new stores to White newcomers.⁴⁴ It is not our contention that the proliferation of large retail chains is always unequivocally to the benefit of Black neighborhoods. But redlining by large chains broadly categorizes Black communities as unwanted markets, which has implications for future

disinvestment. Retail redlining reflects and perpetuates inequalities that have important social and health consequences.

One such consequence is likely to be health status. More research is needed to investigate how retail affects health. As with studies of segregation more generally, research should investigate how health effects operate cross-sectionally and cumulatively.⁴¹ It will be important to investigate health effects beyond constrained access to protective resources (e.g., pharmacies) or over-exposure to unhealthy resources (e.g., fast food). Retail redlining could also act as a stressor, initiating poor health outcomes and exacerbating extant ones. Poor health status results from constricted participation in the social and economic life of the country¹⁷ and neighborhood problems in segregated neighborhoods are likely to lead to negative health outcomes as a result of high allostatic load.²³ A dearth of available retail can be counted among these kinds of exposures. A lack of entertainment venues and places to shop are associated with impaired health³⁹ and lengthy travel to needed resources often at higher prices, is a significant stressor for many residents in Black neighborhoods.⁴ Moreover, to the extent that deficits in community resources are perceived as the result of racism, residents again are at risk of negative health outcomes.^{31,32}

Longitudinal research is also needed to investigate whether retail redlining perpetuates disadvantage. As noted earlier, measures of retail demand may derive in part from reported behaviors, rather than expressed shopping preferences. In Black neighborhoods, particular consumer behaviors may not occur simply because residents do not have the access to facilities to do so. The end result is the initiation of a vicious cycle. Low purported retail demand leads to a paucity of organizational resources; this paucity leads to decrements in consumer behavior and in the retail reputation of Black neighborhoods, which further mark these areas as untenable for stores. Black neighborhoods are misperceived with regard to market size, buying power, and market risk and stability,¹ and White, suburban and exurban spaces are construed as the most savvy and eligible consumer markets. Retail reputation also affects asset accumulation vis-à-vis homeownership, the primary means through which Americans build wealth.³⁶ Retail and other organizational amenities are important determinants of neighborhood desirability, making the under-resourced context in Black neighborhoods a factor in lower home values. Together, retail redlining could harm African American health and well being through effects on resource access, stress, and opportunity structures.

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