Determinants of Residential Preferences Related to Built and Social Environments and Concordance between Neighborhood Characteristics and Preferences

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Abstract We explored associations between residential preferences and sociodemographic characteristics, the concordance between current neighborhood characteristics and residential preferences, and heterogeneity in concordance by income and race/ethnicity. Data came from a cross-sectional phone and mail survey of 3668 residents of New York City, Baltimore, Chicago, Los Angeles, St. Paul, and Winston Salem in 2011–12. Scales characterized residential preferences and neighborhood characteristics. Stronger preferences were associated with being older, female, non-White/non-Hispanic, and lower education. There was significant positive but weak concordance between current neighborhood characteristics and residential preferences (after controlling sociodemographic characteristics). Concordance was stronger for persons with higher income and for Whites, suggesting that residential self-selection effects are strongest for populations that are more advantaged.

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Introduction

Understanding relationships between built environment and health-related behaviors/outcomes is critical for policymakers to design effective public health interventions. While a large body of literature found that built environments were associated with health-related behaviors related to physical activity (active travel [1–5], transport mode choice [6]), diet [7], and subsequent risk of obesity [8, 9]) and self-rated health conditions [10, 11], some scholars argued that these relationships may be biased by residential self-selection [12–14]. Residential self-selection refers to a phenomenon that people are inclined to choose where they live based on their predetermined lifestyle and personal preferences [15, 16]. The concept of residential preferences can be thought of in two ways. First, as "hypothetical preferences" or "stated preferences" [17] that represent the qualities of places that people say they would like their residential neighborhood to have if all possibilities are available for them to choose from. Second, as "revealed preferences" [18] that represent the actual "reasons for decisions that people make" that result in them living in their residential neighborhood. For recent movers, this can represent priorities considered when looking for a place to live, and for longer-term residents, this can represent why a person continues to live in their

residential neighborhood. "Hypothetical preferences" are thus aspirational and are unlikely to consider competing priorities or constraints, whereas "reasons" or "decisions" to move to/stay in the current neighborhood are revealed preferences that have been matched to realized opportunities. Nevertheless, we use the term "residential preferences" throughout the paper for simplicity, and also use it to represent participants' revealed preferences: priorities when looking for a new place to move to, or represent why a person continues to live in their current neighborhood.

The problem that residential preferences pose when examining relationships between built environment and health-related behaviors/outcomes is personal preferences have simultaneous impacts on both the choice of neighborhood and health-related behaviors/outcomes of interest (e.g., active travel) [11, 19–25]. For example, people who already engage and enjoy utilitarian walking and/or who do not currently engage but have strong preferences for active travel are likely to select highly walkable neighborhoods to live, when making a choice is possible. This highlights the difficulty with disentangling how built environments shape attitudes/preferences/behaviors and leaves open the possibility that health-related behaviors/outcomes might be attributable more to attitudinal/preference factors than built environment characteristics [16, 26–31].

Among studies that adjusted for residential self-selection effects, some studies employed modeling approaches [32–37] to generate proxy variables to represent residential preferences, which hypothesized residential self-selection as a function of sociodemographic variables. While these studies enriched the understanding of causality, they lacked explicit information about the residential preferences for neighborhood choice due to data availability issues. Other papers directly measured factors related to residential self-selection using surveys that asked about residential preferences (e.g., reasons for moving to or remaining in the current neighborhood, or the importance level of neighborhood attributes for looking at future residential locations) [19, 27, 38–48]. These studies generally had small sample sizes or in a European setting [48], and did not explore the associations of sociodemographic factors with preferences or included only a small number of sociodemographic variables [49]. Sociodemographic determinants of residential preferences are critical because factors such as income, or racial discrimination in housing may severely limit the residential choices

people can make [50–53]. The evidence on associations between a variety of sociodemographic characteristics and residential preferences remains scarce.

More recent studies have begun to examine the level of agreement/discordance between actual and preferred neighborhood types. However, only a small number of neighborhood domains have been examined, such as traditional neighborhood versus suburban neighborhood [19, 28, 50, 54–57], transit oriented development area versus non-transit oriented development area [58], and neighborhood walkability only [49]. In addition, empirical evidence on the associations of the dissonance/concordance with sociodemographic characteristics is limited.

This study extends our understanding of residential self-selection by assessing residential preferences (reasons for moving to or remaining in the current neighborhood) in relation to neighborhood and individual characteristics using detailed survey data in urbanized areas. This study aims to [1] explore associations between residential preferences and sociodemographic characteristics and [2] investigate the concordance between current neighborhood characteristics and residential preferences and examine if the concordance varies by income and race/ethnicity. We chose to explore income and race/ethnicity variations in the concordance due to the importance of these variables in residential self-selection such as the opportunities for choosing where to live and race/ethnic residential segregation.

Methods

Data

The primary data source was the Community Survey (CS), a cross-sectional phone and mail survey conducted during August 2011–May 2012, of residents living in select areas of New York, Baltimore, Chicago, Los Angeles, St. Paul MN, and Winston Salem NC. The primary purpose of the survey was to obtain information on the characteristics of neighborhoods which would subsequently be linked to a different cohort study [59, 60]. Census tracts were first selected in the cities/neighborhoods where the cohort participants lived, and then a random list of residents was generated. The sampling goal was set as 16 participants per tract for the tracts where the cohort participants from exam 1–5 resided, and as 10 participants per tract for the tracts

where the cohort participants from exam 6+ resided. The inclusion criteria were participants were at least 18 years old and lived in the selected tracts. To encourage participation, residents in the selected tracts received advance letters about the research project; participants received $2 incentives for mail questionnaires and $10 incentives for completed telephone interviews. A total of 4212 participants completed the survey either by mail or telephone, representing a 33.7% overall response rate. The distribution of participants per tract is median 14 participants (Q1: 12, Q4: 25). The CS survey asked participants about their neighborhood characteristics (physical and social environment), reasons for moving to/remaining in their neighborhoods, and sociodemographic information.

Variables

Residential Preferences

In the present study, the term "residential preference" refers to reasons for moving to or remaining in the current neighborhoods. To assess residential preferences, the CS contained 15 items regarding reasons to move to or stay in their neighborhoods (see rows in Table 1). Participants were asked to indicate the degree of importance for each item on a 5-point scale ranging from "not at all important" to "very important." We employed principal component analysis (PCA) to identify which items to group into preference scales. Items were retained if their loadings were at least 0.5 on only one scale and after examination of eigenvalues and scree plots. Three scales were identified. Scale 1 roughly represented a preference for "walkable & accessible neighborhoods" (7 items, easy to walk to places and easy access to urban amenities and shopping places, eigenvalue 6.25, Cronbach alpha coefficient [CAC] 0.88, 51% of the total variance). Scale 2 roughly represented a preference for "safe, car-inviting, & attractive neighborhoods" (4 items, attractiveness, low crime, and easy access to highway and convenient parking, eigenvalue 2.01, CAC 0.75, 30% of the total variance). Scale 3 only included a preference for "housing affordability & quality" (2 items, low housing cost, and high housing quality, eigenvalue 1.16, CAC 0.52, 19% of the total variance). PCA was only used to identify which items comprised a scale. Subsequently, each participant's scale was derived by averaging items that were grouped together based on the PCA. The substantive direction

for the residential preference scales was that higher value indicated higher level of importance.

Sociodemographic Characteristics

Sociodemographic variables included age, gender, race/ethnicity, education, annual household income, and length of time living in current neighborhood. For annual household income, participants were asked to choose from 8 categories with lowest category less than $8,000 and highest category $100,000 or more. Income was further classified into four categories such that each had approximately 25% of the sample. Missing values for income were retained as a dummy category for analysis. Race/ethnicity was reported in multiple questions: Hispanic status was asked first, followed by a separate question to identify race. If participants reported multiple races, they were asked an additional question about which race category they most identified with. We formed indicator variables to identify Hispanics regardless of ethnicity, and non-Hispanic African Americans, Asians, Whites, and Other. For length of time living in current neighborhood, participants were asked to choose from 6 categories: less than 1 year, 1–4 years, 5–10 years, 11–15 years, 16–20 years, more than 20 years.

Neighborhood Characteristics

The CS contained 20 statements about neighborhood characteristics. For each statement, participants were asked to indicate the degree of agreement on a 5-point Likert style scale ranging from strongly disagree to strongly agree. Some of the statements were reverse coded (as indicated in Table 1) to ensure all the statements followed the same direction. Principal component analysis identified 4 scales that represented neighborhood walkability, healthy food, aesthetic quality, and safety (as described in [60]). We calculated each participant's value for each neighborhood scale by two steps [59]. First, we averaged scores of items that were grouped together based on PCA for each scale for each participant. Second, we averaged all the participants' scores within a 1-mile buffer around each participant's residence. This 1-mile neighborhood crude means represent the community's perception of the neighborhood environment rather than one individual's perception of their environment. There was a high density of CS respondents within a 1-mile buffer around each

Table 1 Alignment of retained items for residential preferences and neighborhood characteristics

Perceived neighborhood characteristics	Residential preferences (reasons for moving to or staying in the current neighborhood)												
	Walkable & accessible neighborhoods							Safe, car-inviting, & attractive neighborhoods				Housing affordability & quality	
	Family and friends within walking distance	Amenities (parks, playgrounds, & rec centers) within walking distance	Food stores within walking distance	Other shopping within walking distance	Access to public transportation options	Easy to walk to places	Lots of people out and about in the neighborhood	A low crime rate	Attractive appearance	Easy access to the freeway or other major roads	Convenient parking	Quality of housing	Cost of housing
Walkability													
It is pleasant to walk in my neighborhood	×								×			+	
In my neighborhood it is easy to walk to places		×	×	×	×								
I often see other people walking in my neighborhood							×						
I often see other people exercise in my neighborhood							×						
My neighborhood offers many opportunities to be physically active		×											
Local sports clubs and other facilities in my neighborhood offer many opportunities to get exercise		×											
Healthy food													
A large selection of fresh fruit and vegetables is available in my neighborhood			+			+							+
A large selection of low fat foods is available in my neighborhood			+			+							
The fresh fruits and vegetables in my neighborhood are of high quality			+			+							
Food stores in my neighborhood sell whole-grain foods such as whole-wheat bread			+			+							
Aesthetic quality													
There is a lot of trash and litter on the street in my neighborhood-Reverse coded									×				
There is a lot of noise in my neighborhood-Reverse coded													
My neighborhood is attractive									×				+
In my neighborhood, the buildings and homes are well-maintained									+			×	
Safety													
I feel safe walking in my neighborhood day or night								×				+	
Violence is a problem in my neighborhood-Reverse coded								×					
My neighborhood is safe from crime								×					

The darker shading with the symbol of "×" indicates strong alignment between survey questions in the residential preference scales and survey questions in the neighborhood rating scales; the lighter shading with the symbol of "+" indicates moderate alignment between survey questions in the neighborhood rating scales and survey questions in the residential preference scales

participant: median 45 persons (IQR 75 persons (Q1, 21; Q3, 96); minimum 1, maximum 217). Higher values on the neighborhood scales indicate better neighborhood characteristics. Population density within each participant's 1-mile buffer neighborhood was created based on census block population data from Census 2010. For blocks that were partially contained within the buffer of each participant, the population was apportioned within and outside of the buffer based on area in and out of the buffer.

Analytic Sample

Among the 4212 participants in the CS, 544 were excluded due to missing key variables: sociodemographic covariates (age, gender, race, length of time living in the current neighborhood, and education) ($n = 428$), residential preference scales ($n = 109$), and neighborhood characteristics scales ($n = 7$). The final sample for analysis consisted of 3668 participants. The demographic characteristics of the participants in the final sample were similar to those in the excluded subset, except that excluded participants were slightly older, less likely to be White, and had lower education and lower income. Nevertheless, participants who were retained were diverse in age, race/ethnicity, education, and income, and roughly approximated the census areas from which they came.

Statistical Methods

Descriptive statistics were used to describe the sample characteristics (including unadjusted Spearman's rank correlations between residential preferences and neighborhood characteristics). To address aim 1, we employed *multiple linear regression* models to examine the associations between participants' sociodemographic characteristics (independent variables) and their preferences for [1] walkable and accessible neighborhoods and [2] safe, car-inviting, and attractive neighborhoods. (We verified the preference scores were normally distributed thus suitable for linear regression.) We used *logistic regression* to examine associations between participants' sociodemographics and preference for housing affordability & quality. The majority of participants indicated that housing affordability & quality were important which is why low preference for housing affordability & quality was used. Low preference was defined as leaning towards "not

very" or "not at all important" (which was the lowest 15th percentile). For aim 2, we used *multiple linear regression* models to investigate the concordance between residential preferences (independent variables) and current neighborhood characteristics (normally distributed dependent variables: walkability, healthy foods, aesthetic quality, safety) adjusted for sociodemographic characteristics and population density. For aim 2, the main tables displayed coefficients showing concordance between (i) preference for walkable and accessible neighborhoods and neighborhood/community ratings for walkability and healthy foods; (ii) preference for safe, car-inviting, and attractive neighborhoods and neighborhood/community ratings for aesthetic quality and safety; and (iii) preferences for housing affordability & quality for all neighborhood/community outcomes. This was done to focus our attention on the residential preferences and neighborhood ratings that had reasonable alignment of survey questions (see Table 1). Table 1 darker shading with the symbol of "×" indicates strong alignment between neighborhood rating questions and residential preference questions; and lighter shading with the symbol of "+" indicates moderate alignment (see Table 1). As the residential preference scales may be correlated with each other, we also tested the relationships by adjusting other residential preference scales for each residential preference (Table 5, part 2). In order to examine heterogeneity by income and race, we tested a limited set of interactions and then presented *stratified analysis* by income and race/ethnicity separately (Fig. 1). For the regression analyses, we used dummy assignment for missing values of annual household income. Complete case analysis generated similar results although confidence intervals were wider. To retain larger sample size and gain more statistical power, we presented the models with the dummy assignment for income. Additionally, we explored regression models adjusting for site dummy variables in sensitivity analyses. The results were similar, but were not presented as the site dummy variables were collinear with population density. Further, the multi-level models for aim 1 were tested; results did not change, so the simpler models are presented. We did not test the multi-level models for aim 2 because the outcome variables (neighborhood characteristics in a 1-mile area) already accounted for clustering since they were an aggregation of participant responses for a 1-mile area.

Results

Descriptive Statistics

Table 2 shows the descriptive statistics for sociodemographic characteristics, residential preferences, and neighborhood characteristics. The sample was 61% female and mean of characteristics were age 50.80 years old (SD 17.23), 14 years of education (SD 3 using midpoint), and $53,318 annual income (SD $36310, using midpoint). For residential preferences, the mean values for preference of walkable & accessible neighborhoods, preference of safe, car-inviting, and attractive neighborhoods, and preference of housing affordability & quality were 3.36 (SD 0.98), 3.86 (SD 0.85), and 4.20 (SD 0.73), respectively. Mean for neighborhood characteristics were 3.67 for walkability (SD 0.42), 3.72 for healthy food (SD 0.44), 3.56 for aesthetic quality (SD 0.55), and 3.24 for safety (SD 0.55). The median population density was 9,697 persons/mile [2] (interquartile range 12505/mile [2], density represents within 1-mile buffer neighborhood).

Associations Between Residential Preferences and Sociodemographic Characteristics

Adjusted associations between residential preferences (dependent variables) and sociodemographic characteristics (independent variables) are shown in Table 3. In general, stronger preferences were associated with being older, female, non-White/non-Hispanic, and lower education (all $p < 0.05$). For example, there was a positive linear trend between age and preference for safe, car-inviting, and attractive neighborhoods (p for trend $p < 0.01$ across age groups). Participants at the age group > 60 had a higher mean score for preference of walkable & accessible neighborhoods compared to the age group 18–30 (mean difference 0.12). Persons with lower income had stronger preference for walkable & accessible environment ($p < = 0.001$) whereas persons with higher income had stronger preference for safe, car-inviting, and attractive neighborhoods ($p < = 0.04$). Sociodemographic patterns were weaker regarding preferences for housing affordability & quality. The odds of lower preference for housing affordability & quality were higher in males and White non-Hispanics, but lower in higher education and higher income ($p < 0.05$). Results suggest that persons with stronger preferences for safe, car-inviting, and attractive neighborhoods lived in areas with lower population density (test for trend $p < 0.0001$), but there was no clear pattern between population density and preference for walkable & accessible neighborhoods. In general, living longer in one's current neighborhood was associated with stronger preferences for preferences of walkable and accessible neighborhoods and safe, car-inviting, and attractive neighborhoods, but weaker preference for housing affordability & quality (although associations were mostly not statistically significant).

Concordance Between Neighborhood Characteristics and Residential Preferences

Table 4 shows the bivariate concordance between residential preferences and neighborhood characteristics. Preference for walkable & accessible neighborhoods was weakly negatively correlated with neighborhood aesthetic quality, and safety (rho approximately − 0.3). Population density within 1-mile neighborhood was positively correlated with preference for walkable & accessible neighborhoods (rho = 0.36) and very weakly negatively correlated with preference for safe, car-inviting, and attractive neighborhoods (rho = − 0.14). There were no meaningful correlations between other variables (rho magnitude < 0.12). Table 4 also shows the pairwise correlations among the three residential preference scales. The preference for safe, car-inviting, & attractive neighborhoods was moderately correlated with the preference for walkable & accessible neighborhoods (rho = 0.41) and the preference for housing affordability & quality (rho = 0.40). The correlation between preference for walkable & accessible neighborhoods and preference for housing affordability & quality was relatively weak (rho = 0.26).

Table 5 shows the regression results for the concordance between neighborhood characteristics (dependent variables) and residential preferences (independent variables) adjusted by sociodemographic characteristics (age, gender, race/ethnicity, education, annual household income, length of time living in the current neighborhood in model 1), and with additional adjustment for population density in the 1-mile neighborhood (model 2). In model 1, neighborhood walkability had a significantly positive relationship with preference of walkable & accessible neighborhoods ($\beta = 0.05$, $p < 0.0001$) and preference of housing affordability & quality ($\beta = 0.03$, $p < 0.05$). However, the magnitude was small: for example, for one unit increase in the preference of

Table 2 Descriptive statistics for sample characteristics

$N = 3668$	Number	Percent (%)
Person sociodemographic characteristics		
Age		
18–30	534	14.56
30–45	945	25.76
45–60	1104	30.10
> 60	1085	29.58
Gender		
Male	1447	39.45
Female	2221	60.55
Race/Ethnicity		
White	1227	33.45
African American/black	856	23.34
Asian	594	16.19
Hispanic-Latino	882	24.05
Other	109	2.97
Education		
12th grade or lower without diploma	423	11.53
High school graduates	1631	44.47
Bachelor's degree or higher	1614	44.00
Income		
1st quartile: Less than $25,000	873	23.80
2nd quartile: $25,000–$50,000	828	22.57
3rd quartile: $50,000–$75,000	529	14.42
4th quartile: $75,000 or above	871	23.75
Missing	567	15.46
Length of time living in the current neighborhood		
< 1 year	219	5.97
1–4 years	726	19.79
5–10 years	782	21.32
11–15 years	458	12.49
16–20 years	378	10.31
> 20 years	1105	30.13
	Mean	Std.
Residential preferences		
Walkable & accessible neighborhoods	3.36	0.98
Safe, car-inviting, & attractive neighborhoods	3.86	0.85
Housing affordability & quality	4.20	0.73
Neighborhood characteristics		
Walkability	3.67	0.42
Healthy food	3.72	0.44
Aesthetic quality	3.56	0.55
Safety	3.24	0.55
Other neighborhood characteristics	Median	Interquartile range
Population density in 1-mile neighborhood	9697.44	12505

Table 3 Adjusted associations between sociodemographic characteristics and residential preferences

N = 3668	Outcome variables*								
	Preference for walkable & accessible neighborhoods			Preference for safe, car-inviting, & attractive neighborhoods			Low preference (< 3.5) for housing affordability & quality		
Variables	Coef.	SE	p value	Coef.	SE	p value	OR	95% C.I.		p value
Age										
18–30 (Ref.)										
30–45	*0.10*	0.05	0.05	*0.19*	0.04	< .0001	1.22	0.81	1.82	0.34
45–60	0.09	0.05	0.08	*0.21*	0.05	< .0001	1.29	0.86	1.92	0.22
> 60	*0.12*	0.05	0.02	*0.27*	0.05	< .0001	1.03	0.67	1.58	0.89
Gender										
Female (Ref.)										
Male	*− 0.13*	0.03	< .0001	*− 0.14*	0.03	< .0001	*1.95*	1.56	2.43	< .0001
Race/ethnicity										
White (Ref.)										
African American /black	*0.23*	0.04	< .0001	*0.40*	0.04	< .0001	*0.65*	0.47	0.92	0.01
Asian	*0.13*	0.05	0.01	*0.36*	0.04	< .0001	0.85	0.59	1.22	0.38
Hispanic-Latino	*0.18*	0.05	< .0001	*0.35*	0.04	< .0001	0.75	0.53	1.05	0.09
Other	*0.27*	0.09	0.00	*0.22*	0.08	0.01	0.66	0.32	1.36	0.26
Education										
12th grade or lower without diploma (Ref.)										
High school graduate	*− 0.16*	0.05	0.00	0.00	0.05	0.92	*0.52*	0.38	0.72	< .0001
Bachelor's degree or higher	*− 0.41*	0.06	< .0001	*− 0.19*	0.05	0.00	*0.52*	0.36	0.75	0.00
Annual household income**										
Less than $25,000 (Ref.)										
$25,000–$50,000	*− 0.15*	0.04	0.001	*0.09*	0.04	0.02	0.77	0.56	1.04	0.09
$50,000–$75,000	*− 0.27*	0.05	< .0001	*0.12*	0.05	0.01	*0.49*	0.32	0.75	0.00
$75,000 or above	*− 0.26*	0.05	< .0001	*0.16*	0.04	0.00	*0.62*	0.43	0.89	0.01
Length of time living in current neighborhood										
< 1 year (Ref.)										
1–4 years	0.06	0.07	0.41	*0.12*	0.06	0.05	0.95	0.53	1.72	0.86
5–10 years	0.05	0.07	0.49	0.11	0.06	0.09	1.48	0.83	2.63	0.19
11–15 years	0.13	0.07	0.09	*0.19*	0.07	0.00	1.49	0.81	2.75	0.20
16–20 years	0.07	0.08	0.33	0.10	0.07	0.15	1.40	0.74	2.63	0.30
> 20 years	0.11	0.07	0.10	*0.18*	0.06	0.00	1.69	0.94	3.02	0.08
Population density in 1-mile neighborhood										
1st quantile	*− 0.80*	0.05	< .0001	*0.54*	0.04	< .0001	0.74	0.52	1.05	0.09
2nd quantile	*− 0.50*	0.04	< .0001	*0.45*	0.04	< .0001	0.80	0.57	1.11	0.18
3rd quantile	*− 0.36*	0.04	< .0001	*0.33*	0.04	< .0001	1.21	0.89	1.65	0.22
4th quantile (Ref.)										

*Preferences for walkable & accessible neighborhoods and safe, car-inviting, & attractive neighborhoods; the dependent variables are the original scores without transformation, Housing cost, and quality; dependent variable is modeling whether the value is low (< 3.5)

**In order to retain those missing income (15.5%), missing income is coded as a dummy category and coefficient not shown

Italic fonts are estimates where $p < 0.05$

Table 4 Unadjusted (bivariate) Spearman's rank correlations between neighborhood characteristics and residential preferences

N = 3668	Preference for walkable & accessible neighborhoods	Preference for safe, car-inviting, & attractive neighborhoods	Preference for housing affordability & quality
Neighborhood characteristics			
A. Walkability	− 0.09	− 0.04	− 0.02
B. Healthy Food	− 0.11	0.02	− 0.02
C. Aesthetic quality	− 0.30	0.11	0.02
D. Safety	− 0.27	0.08	− 0.01
Other neighborhood characteristics			
Population density in 1-mile neighborhood	0.36	− 0.14	− 0.01
Residential preferences			
Preference for walkable & accessible neighborhoods	1	0.41	0.26
Preference for safe, car-inviting, and attractive neighborhoods	0.41	1	0.40
Preference for housing affordability & quality	0.26	0.40	1

walkable & accessible neighborhoods, we can expect the score of neighborhood walkability to increase by an average of 0.05 units. Neighborhood aesthetic quality was significantly related with preference of safe, car-inviting, and attractive neighborhoods ($\beta = 0.13$, $p < 0.0001$) and preference of housing affordability & quality ($\beta = 0.04$, $p < 0.05$). Neighborhood safety was significantly related with preference of safe, car-inviting, and attractive neighborhoods ($\beta = 0.11$, $p < 0.0001$) and preference of housing affordability & quality ($\beta = 0.05$, $p < 0.0001$). Neighborhood healthy food was significantly related with preference of walkable & accessible neighborhoods ($\beta = 0.03$, $p < 0.0001$). After controlling for population density, the coefficients for preference of walkable & accessible neighborhoods and neighborhood walkability and neighborhood healthy foods were similar; the coefficients for preference of safe, car-inviting, and attractive neighborhoods and neighborhood aesthetic quality and safety decreased. In general, inference remained the same after further adjustment for the other preference scores (Table 5, part 2).

We also tested a limited set of interactions of residential preferences with income and race/ethnicity separately (focused on the preference and neighborhood scales that were expected to align, shown in Tables 1 and 5). Specifically, we focused on the pairs of neighborhood walkability and preference of walkable & accessible neighborhoods, neighborhood healthy food and

preference of walkable & accessible neighborhoods, neighborhood aesthetic quality and preference of safe, car-inviting, and attractive neighborhoods, neighborhood safety and preference of safe, car-inviting, and attractive neighborhoods. Results stratified by income and race/ethnicity are shown in Fig. 1 (panels (a), (b), (c), (d)). Residential preferences had significant interactions with annual household income (all $p < = 0.02$ except income interaction $p = 0.13$ for panel (b)) and race/ethnicity ($p < = 0.01$), separately. The concordance between neighborhood characteristics and residential preferences focused on was stronger among those with higher annual household income. The concordance between neighborhood characteristics and residential preferences was also stronger for White participants than other racial/ethical groups.

Discussion

This study had two research aims: [1] Exploring the associations between residential preferences and sociodemographic characteristics; [2] Investigating the concordance between current neighborhood characteristics and residential preferences and examining if the concordance varies by income and racial/ethnic groups. First, we found that residential preferences differed significantly by almost all sociodemographic variables. Persons with lower income had stronger preference for

Table 5 Adjusted concordance between neighborhood characteristics and residential preferences ($N = 3668$)

Outcome variables: neighborhood characteristics (1-mile around the residence)

	A. Walkability						B. Healthy food						C. Aesthetic quality						D. Safety					
	Model 1 *			Model 2 *			Model 1 *			Model 2 *			Model 1 *			Model 2 *			Model 1 *			Model 2 *		
	β	SE	p value	β	SE	p value	β	SE	p value	β	SE	p value	β	SE	p value	β	SE	p value	β	SE	p value	β	SE	p value
Part 1. Residential preferences - separate (entered one-by-one)																								
Walkable & accessible neighborhoods	0.05	0.01	<.0001	0.05	0.01	<.0001	0.03	0.01	<.0001	0.05	0.01	<.0001	−0.09	0.01	<.0001	0.01	0.01	0.11	−0.08	0.01	<.0001	−0.01	0.01	0.20
Safe, car-inviting, and attractive neighborhoods	0.03	0.01	0.00	0.03	0.01	0.00	0.05	0.01	<.0001	0.04	0.01	0.00	0.13	0.01	<.0001	0.04	0.01	<.0001	0.11	0.01	<.0001	0.05	0.01	<.0001
Housing affordability & quality	0.03	0.01	0.00	0.02	0.01	0.00	0.02	0.01	0.05	0.02	0.01	0.01	0.04	0.01	<.0001	0.03	0.01	<.0001	0.05	0.01	<.0001	0.04	0.01	0.00
Part 2. Residential preferences adjusted for each other (independent of each other)																								
Walkable & accessible neighborhoods (independent of other scales)	0.05	0.01	<.0001	0.05	0.01	<.0001	0.02	0.01	0.03	0.04	0.01	<.0001	−0.15	0.01	<.0001	−0.01	0.01	0.09	−0.14	0.01	<.0001	−0.04	0.01	<.0001
Safe, car-inviting, and attractive neighborhoods (independent of other scales)	0.00	0.01	0.62	0.00	0.01	0.70	0.05	0.01	<.0001	0.02	0.01	<.0001	0.19	0.01	<.0001	0.05	0.01	<.0001	0.17	0.01	<.0001	0.07	0.01	<.0001
Housing affordability & quality (independent of other scales)	0.01	0.01	0.30	−0.01	0.01	0.35	−0.01	0.01	0.42	0.00	0.01	0.65	0.01	0.01	0.46	0.02	0.01	0.04	0.02	0.01	0.09	0.02	0.01	0.04

*Model 1 adjusted for age, sex, race/ethnicity, education, income, number of years living in the neighborhood;

Model 2 adjusted for model 1 variables + population density in 1-mile;

β represents adjusted mean difference in outcome (neighborhood ratings within 1 mile of residence), per one unit increase in preference score;

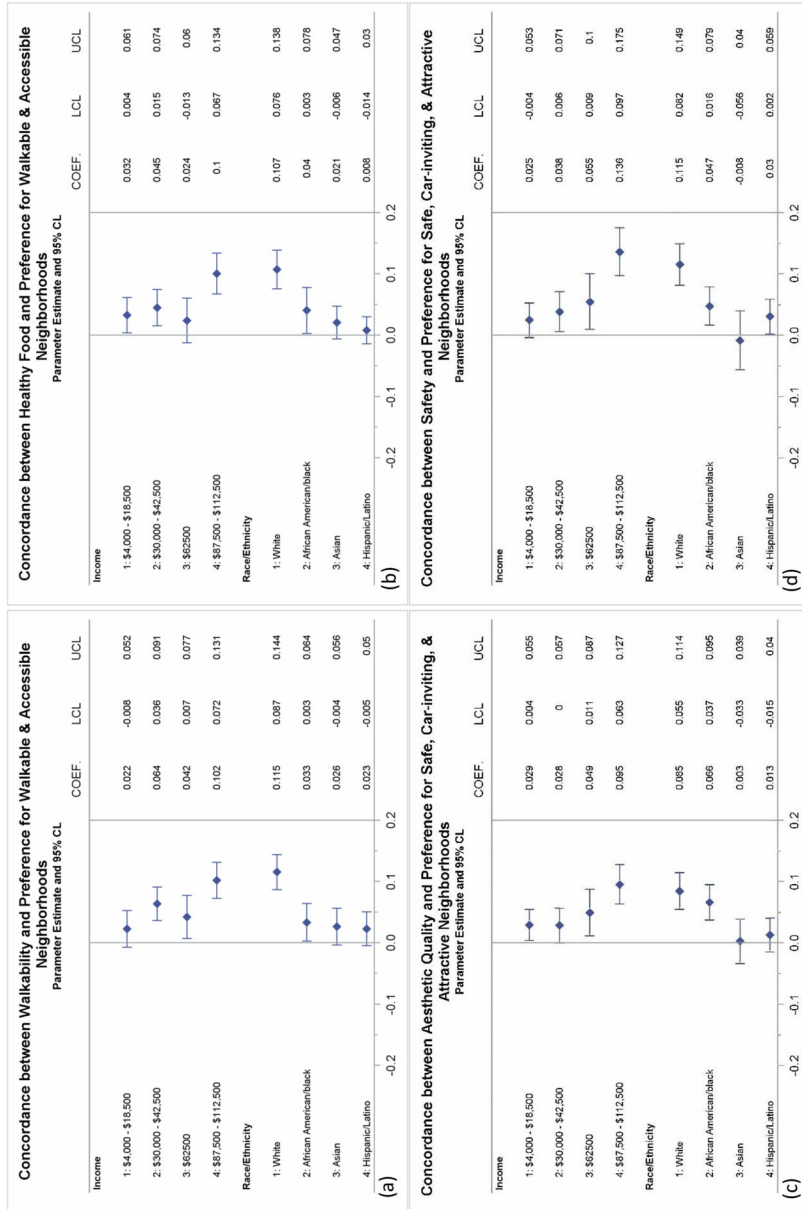Italic fonts are estimates where $p < 0.05$ for the aligned pairs

Fig. 1 Concordance between neighborhood characteristics and residential preferences stratified by income and race. **a** Walkability and preference of walkable & accessible neighborhoods; **b** Healthy food and preference of walkable & accessible neighborhoods; **c** Aesthetic quality and preference of safe, car-inviting, and attractive neighborhoods; **d** Safety and preference of safe, car-inviting, and attractive neighborhoods

walkable and accessible neighborhoods, whereas persons with higher income had stronger preferences for safe, car-inviting, and attractive neighborhoods and housing affordability & quality. Non-White/non-Hispanic had stronger preferences for all three domains. Older, female, and those with lower education reported stronger preferences for both walkable & accessible neighborhoods and safe, car-inviting, & attractive neighborhoods. Participants with higher education had stronger preference for housing affordability & quality. Second, there was significant positive concordance between current neighborhood characteristics and residential preferences, after controlling sociodemographic characteristics. Further, the concordance between neighborhood characteristics and residential preferences was stronger for persons with higher income compared to those with lower income and for White participants compared to non-White racial/ethnic groups.

One notable finding is that residential preferences differed significantly by annual household income. First, participants with higher annual household income had weaker preference for walkable & accessible neighborhoods. This is in line with empirical results that low-income individuals had stronger preferences for compact, walkable, and transit-friendly neighborhoods [61]. Second, higher income groups had stronger preference for safe, car-inviting, and attractive neighborhoods. This result aligns with findings in previous studies that higher income groups are more likely to own cars [46, 62] and use cars for daily travelling [46, 58, 63] and are less likely to consider access to shopping and other urban services in deciding where to live [45]. In addition, other work has found higher income individuals prioritize safety when choosing where to live [19, 64]. Third, participants with higher income also considered housing affordability & quality as an important factor for decisions of moving to/staying in the current neighborhood. It echoes the finding that high-income groups have greater concern for the housing attributes in the process of housing choice [65]. Stratified analysis showed that the concordance between neighborhood characteristics and residential preferences were stronger at higher incomes. A potential reason for this result is that participants with higher income have fewer financial constraints and have more opportunities to choose to live in neighborhoods with their preferred characteristics. This result is consistent with the findings in previous literature that the concordance is lower for households with lower income [19, 50, 66].

Despite non-White persons overall having stronger residential preferences for all the three domains, their residential preferences were less aligned with the characteristics of the neighborhood where they lived. While lower average incomes could impede non-White minority groups from moving to neighborhoods with their preferred characteristics, our results were even stronger after adjustment for participants' socioeconomic characteristics. Thus, independent of income, racial/ethnic residential segregation and housing discrimination may contribute to the dissonance between residential preferences and neighborhood characteristics for non-White groups [53, 67–70]. This is consistent with the result that non-White people have stronger mismatch between where they want to live and where they actually live [70].

Residential preferences also varied by age, gender, and education. In general, preferences for both walkable & accessible neighborhoods and safe, car-inviting, & attractive neighborhoods were stronger among older participants. Females had stronger residential preferences than male counterparts, which is supported by other work [71]. Participants with bachelor's degree or higher (vs. 12th grade or lower without diploma) had weaker preferences for walkable & accessible neighborhoods and safe, car-inviting, & attractive neighborhoods but stronger preferences for housing affordability & quality. These findings resonate with the results of a previous study about the variations for neighborhood self-selection factors depending on age, gender, and education [49].

After controlling for sociodemographic characteristics, the regression models demonstrated that neighborhood characteristics were significantly related to residential preferences with which concordance might be expected. Specifically, higher neighborhood walkability was significantly related with stronger preference for walkable & accessible neighborhoods and with stronger preference for housing affordability & quality. Neighborhood aesthetic quality was significantly associated with stronger preferences for safe, car-inviting, & attractive neighborhoods and stronger preference for housing affordability & quality. Neighborhood safety had significant relationship with preferences of safe, car-inviting, & attractive neighborhoods and housing affordability & quality. Neighborhood healthy food was related with stronger preference for walkable & accessible neighborhoods. In general, these results agree with work that found people's attitudinal residential preferences,

lifestyle factors, and reasons to choose a neighborhood are related with their actual residential neighborhood characteristics [28, 39, 44, 54, 72], but results from this study indicate that the concordance exists fairly weak. This may be explained by structural housing discrimination and financial constraints that result in an imperfect match between where people prefer to live and where they actually live (although the concordance is higher for higher income groups and White people). On the other hand, weak concordance may be partly attributable to the incomplete constructs used in this study; for example, the questions did not include preferences regarding proximity to employment, school quality, house size, etc. Besides, some items in the preference scales did not have strong alignment with the items in the neighborhood scales.

Strengths and Limitations

Strengths of this study are the rich dataset with large sample size recruited from multiple cities in the USA. This study enriches the literature on residential self-selection in three aspects. First, it examined the sociodemographic variations in residential preferences based on explicit information of residential neighborhood selection items and a wide range of sociodemographic characteristics. Second, it was able to pair participant preferences to complex dimensions of the neighborhoods where they lived. This work extends prior work that reduced neighborhood characteristics to a dichotomous set of indictors: traditional vs. suburban neighborhood [44, 73]. Third, it provided empirical evidence on the concordance between neighborhood characteristics and residential preferences and estimated how the concordance varies by income and race/ethnicity.

This study also has some limitations. First, survey questions for the reasons to move to or stay in a neighborhood only partially aligned with survey questions for actual neighborhood characteristics. For example, residential preference questions did not specifically ask about healthy food availability and quality. Second, the term residential preference in this study only included one piece of the residential preference construct: reasons or decisions for moving to or staying in the current neighborhood. We did not have data on "hypothetical or even actual preferences." Using reasons or decisions for moving to/remaining in the current neighborhood presents the realistic trade off about the decisions of choosing a neighborhood to live as not everyone has a high degree of freedom to choose where they live [55, 74]. However, those tradeoffs are constrained by the options available in the market and may not fully capture what individuals desire or prefer. Furthermore, the reasons for moving to or staying in the current neighborhood are likely to have endogenous associations with current neighborhood characteristics because neighborhood preferences/attitudes are likely shaped by experiences in one's own neighborhood [28, 39, 72] and the desire to reduce the cognitive dissonance associated with living in a neighborhood that does not match one's intentions. Further, we did not test the effect of racial/ethnic residential segregation and housing discrimination on the concordance between neighborhood characteristics and residential preferences due to limit of data.

Conclusions

This work provides empirical evidence on the sociodemographic determinants of residential preferences and the concordance between residential preferences and neighborhood environment. Despite non-White persons overall having stronger residential preferences, their residential preferences were less aligned with the characteristics of the neighborhood where they lived. Higher level of concordance between preferences and neighborhood characteristics was among people with higher income. These findings provide further evidence on racial and economic disparities in residential decision-making and highlight the need for neighborhood health effects research to carefully consider the role of residential preferences relative to sociodemographic characteristics. Our results suggest that the problems that residential selection creates for causal inference are not uniform across sociodemographic groups and residential self-selection issues are most problematic when drawing inference from datasets with a significant proportion of advantaged persons (higher income, White).

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