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Racial/Ethnic Residential Segregation, Neighborhood Health Care Provision, and Choice of Pediatric Health Care Provider Across the USA

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Abstract
Much research has been conducted that demonstrates a link between racial/ethnic residential segregation and health care outcomes. We suggest that minority segregated neighborhoods may have diminished access to organizations and that this differential access may contribute to differences in health care outcomes across communities. We analyze this specifically using the case of pediatric health care provider choice. To examine this association, we estimate a series of multinomial logistic regression models using restricted data with ZIP code level geoidentifiers from the 2011–2012 National Survey of Children's Health (NSCH). We find that racial/ethnic residential segregation is related to a greater reliance on non-ideal forms of health care, such as clinics, and hospital outpatient departments, instead of pediatric physician's offices. This association is at least partially attenuated by the distribution of health care facilities in the local area, physician's offices, and health care practitioners in particular. Additionally, families express greater dissatisfaction with these other forms of care compared to physician's offices, demonstrating that the lack of adequate health care provision is meaningful for health care outcomes. This study expands the literature by examining how the siting of health organizations has consequences for individuals residing within these areas.

Keywords Access to health care · Residential segregation · Race/ethnicity · Neighborhoods · Pediatric health care

Introduction

The scholarly literature over the past several decades has seen growing interest in understanding the relationship between racial/ethnic residential segregation and how this relates to health outcomes, with particular attention to how it may shape healthy living environments. In particular, the bulk of this literature has focused on the distribution of food and fitness, recreational, and green resources across urban communities [1–3]. However, increasing attention has been paid to the spatial distribution of health care resources across communities and how this may differ by segregation status [4–7]. Such studies demonstrate that minority segregated communities lack a wide variety of health care establishments compared to their White counterparts, though some of this effect can be accounted for with measures for the socio-economic status of such areas [4, 8, 9].

Although this research area has recently seen tremendous growth, there are several important limitations of this literature that this study seeks to address. Primarily, with few exceptions, much of the extant work on the relationship between segregation, the distribution of organizations and health/health care outcomes fails to connect all of these pieces. There is also relatively little attention to teasing out this association to examine how the unequal distribution of resources across communities shapes and constrains choices and outcomes, especially as it relates to individual-level processes. In particular, the bulk of this literature does not examine where specifically individuals are going for their health needs in light of what is physically proximate to them [10]. The assumption is that inadequate resources in communities limit and constrain choices for service provision, but there are few empirical tests of this process in the extant literature.

In this analysis, we examine these processes for one such case: how this relates to the choice of pediatric health care

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provider that families make for their children. Specifically, with this analysis, we have several research questions: Does this organizational context affect where families are able to obtain health care for their children? In particular, how do these patterns relate to racial/ethnic residential segregation? Does having more health care resources in close proximity relate to if and where families are able to seek health care for their children's health care? Finally, we ask, does this relate to outcomes for the child—is it related to family satisfaction with the provider? We posit that racial/ethnic residential segregation and the provision of local health care services will constrain where families are able to obtain care for their children. Moreover, we suggest that ultimately this will relate to the level of satisfaction that parents express about their children's providers. First, we review the extant literature and theorizing on the topic.

Theoretical Framework and Literature Review

Segregation and Health-Related Resources

It has been over two decades since Williams and Collins [11] first theorized racial residential segregation to be the fundamental cause of racial health disparities. In this seminal article on the topic, they proposed mechanisms by which segregation produces racial/ethnic health inequity by limiting educational and employment opportunities; greater exposure to environmental toxins; poorer housing quality; poor health behaviors related to exercise, diet, and tobacco and alcohol use; higher rates of crime; and poor access to medical care [11]. Within the context of health care, these scholars argued that residential segregation has resulted in socially vulnerable neighborhoods with high concentrations of low socioeconomic status and racial/ethnic minority individuals and limited access to quality health care resources including health clinics, primary care physicians, and pharmacies [11]. Since then, a number of empirical studies have demonstrated the disproportionate health consequences of the divisive, institutionalized racism that is residential segregation [5, 12–21]. Despite the comprehensive body of literature identifying the association between residential segregation and a diverse set of health outcomes, the social problem persists. Thus, it is clear that we must focus on the mechanisms identified by Williams and Collins [11] to shift the conversation from identifying segregation as a health-related social problem to combatting the problem.

This study will examine in more detail one of their proposed mechanisms: the distribution of health-related organizations across urban space. In recent years, there has been an increase in studies that explore the spatial distribution of health-related resources; however, limited studies have focused on health care resources specifically. Existing literature is predominantly focused on the spatial distribution of health-related resources with respect to promoting a healthy living environment, including the distribution of food and recreational resources. Research has demonstrated that segregated neighborhoods with a larger presence of racial/ethnic minorities and lower socioeconomic status individuals have less healthy food retail availability and accessibility [22–27], a greater presence of unhealthy food alternatives such as fast food restaurants [28, 29] and fewer fitness and recreational facilities and parks [30–34]. Health-related resources including healthy food retail, recreational resources, and stable, affordable housing conditions are critical to promoting a healthy living environment for residents of segregated neighborhoods. This study will focus on health care specifically, which is a relatively understudied facet of this work on the distribution of resources.

Segregation, Spatial Inequality, and Health Care Utilization

Existing literature has demonstrated that health care utilization and access are unequal between residents of neighborhoods with racial/ethnic composition [35–38]. Past studies have found that residents of minority segregated neighborhoods are more likely than residents of White neighborhoods to utilize emergency departments [9, 35, 37, 38], not have a usual source of care [39], and to use clinics compared to a physician's office [10]. Additionally, Black individuals living in segregated neighborhoods are less likely to have health care visits compared to Whites, while Black individuals living in non-segregated neighborhoods are more likely to have health care visits compared to Whites [36]. Thus, the effect of place on Black-White disparity in health care utilization is clear.

From Williams and Collins [11] theorizing discussed above, one possible explanation for the disproportionate health care utilization in segregated neighborhoods may be the spatial distribution of health care resources. Findings have demonstrated that health care establishments and resources including physician's offices, health care practitioners, and health care services are sparser in minority segregated residential areas [4–6, 8, 9, 40–44]. Furthermore, research has indicated that travel time to health-related resources decreases the likelihood of utilization [45–49]. One study demonstrated that Black segregation is positively associated with travel times to the doctor and that this relationship is mediated by the density of physicians offices [41]. Therefore, if distance to health-related resources decreases utilization and segregated neighborhoods have disproportionate health care facilities, then it is likely that the unequal distribution of health care resources results in worse health

care outcomes in segregated neighborhoods, by way of low utilization.

Although these studies have focused on segregation and its relationship to the spatial distribution of health-related resources, the literature is missing research that empirically tests the link between segregation, health-related resource deprivation, and health care utilization. Essentially, while we know that there is an unequal distribution of health care resources across space, it is not clear whether or not it actually leads to poorer health care outcomes. Communities require a diverse network of health-related and health care resources that not only address the promotion of a healthy social environment, but moreover, provide health care resources that support residents in minority segregated communities. The current study aims to address the health disparities in health care access and utilization in a nationwide spatial analysis of the mechanistic pathway between racial/ethnic residential segregation and health care utilization in children by way of lack of health care resources. We outline our conceptual approach to this analysis in Fig. 1. In the following analysis, we will test these different pathways to examine whether or not local provision of care accounts for the association between residential segregation and poor health care utilization choices. First, we detail our data and methodological considerations.

Materials and Methods

Data

To examine these relationships, we compiled data from several sources. First, the primary data comes from the restricted use version of the 2011–2012 National Survey of Children's Health (NSCH), a large national random telephone survey conducted from February 2011 to June 2012 by the National Center for Health Statistics (NCHS) of the Centers for Disease Control and Prevention (CDC). The 2011–2012 version of the survey included both landline and cellphone random digit dialing for the first time. The survey is conducted of parents about their children to monitor trends in children's health and to assess the need for and gaps in children's health services. A total of 95,677 NSCH surveys were conducted across the USA, allowing for adequate coverage of patterns across the country by a small geographic unit of analysis. To analyze patterns by area, we submitted a proposal to the NCHS to gain access to the restricted version of the data, which includes the ZIP code as a geographic identifier, and the data was analyzed in the context of a secure federal Research Data Center (RDC). Of the total numbers of surveys conducted across the USA, we limit our analysis to only ZIP codes in urban areas that belong to a Metropolitan Statistical Area (MSA) as defined by the Office of Management and Budget (OMB). This reduces the number of ZIP codes down to 6735 (from 33,130) and the sample size down to 43,723. The theoretical arguments outlined here pertain to urban processes of resource scarcity as it relates to segregation. Other work has shown that rural areas, especially as compared to urban areas, lack a wide variety of resources, but with this analysis, we wanted to examine these associations as a form of urban inequality and not conflate the findings with those for rural areas.

To examine how these child-level outcomes relate to area-level patterns in service provision and demographics, we combined the ZIP code geotagged version of the data with data from 2008 to 2012 American Community Survey (ACS) 5-year estimates, measured at the ZIP code tabulation area (ZCTA) unit of analysis. The data are only released in 5-year aggregates as they are not representative for 1 year at small geographic units of analysis like the ZIP code. This data source provides socio-demographic data to describe the context in which the NSCH respondent is embedded to better understand how local demographics, such as residential segregation and poverty, related to health care utilization and satisfaction. We additionally paired this with the 2012 County Business Patterns (CBP) ZIP Code Industry Detail file. The US Census Bureau uses IRS tax records to provide this data on business establishments. Specifically,

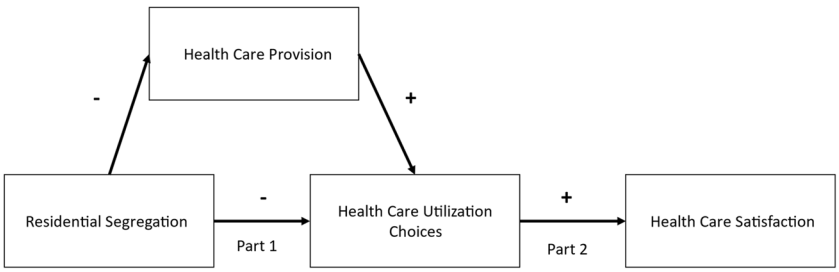

Fig. 1 Conceptual model of hypothesized relationships. Note: Fig. 1 provides a visual depiction of the relationships hypothesized in the analysis. First, we predict that residential segregation will be related to health care provider choices and that this is mediated by the local provision of health care (part 1). Second, we predict that health care provider choice will be related to satisfaction with that provider (part 2)

we use ZIP code level counts of certain kinds of health care establishments to provide an estimate of the local health care context for those families in the NSCH data.

Dependent Variables

In this analysis, we examine two primary dependent variables as noted in the conceptual pathway above. The first is a categorical variable for the type of care that the family usually uses for their child's health care. This item comes from a two-part question, specifically worded as "Is there a place that [your child] usually goes when [he/she] is sick or you need advice about [his/her] health?" with the response options of no, yes, and more than one place. This is followed up by "What kind of place is it?" with the response options of doctor's office, hospital emergency room, hospital outpatient department, clinic or health center, retail store clinic, school, friend/relative, Mexico or some other location outside of USA, or some other place. We combined these response options into six total categories for no usual source of care, doctor's office, hospital emergency room, hospital outpatient department, clinic or health center (including retail store clinic), and other (to include all other categories), with physician's offices as the reference category. These categories were also included as the main independent variables in a set of dummy variables in the second analysis predicting patient satisfaction.

For reference, in the context of the USA, a physician's office refers to a regular outpatient medical practice with typically one physician or a group of physicians and that is often physician owned. For children, this is typically a pediatrician or family physician's office. Hospital emergency departments provide unscheduled care in a triaged fashion to patients who require immediate care, though these can vary in size and in the array of services offered depending on the level of center. Hospital outpatient departments typically provide specialty clinical or diagnostic services, but for patients who do not require overnight hospitalization. Clinics are also outpatient medical settings and are typically larger than a physician's office and provide a wider array of medical and laboratory services but may not be the same provider with each visit. These are typically owned and operated by health care companies, either for profit (especially for retail clinics) or non-profit, rather than a practitioner. We focus on these different types of providers as research has shown important distinctions in the type of provider and the quality of care given, especially for pediatric patients. This work has demonstrated that a regular physician's office is the standard of care for routine, non-specialty care as these types of practices generally provide more comprehensive care with greater continuity over time [50–52]. Other types of care, such as acute or walk-in care, like a hospital emergency room or a retail clinic, often provide more fragmented care, which is usually given without access to patient medical charts and treatment history [50, 53, 54]. Oftentimes, the regular physician's office, with knowledge of the patient over time and access to the complete medical history, also allows for the discussion of other issues or medical needs other than the named reason for the visit [51, 55]. For children, who have delineated well-child checkups and immunization schedules, these distinctions may be especially important [56].

Next, we include a dependent variable for the level of satisfaction that the parent expresses over their choice of care to see if it relates to the type of care used. For this, we created an index of five variables aimed at understanding how satisfied the parent is with their child's provider across several dimensions. These survey items include "[During the past 12 months / Since [his/her] birth], how often did [S.C.]'s doctors and other health care providers spend enough time with [him/her]?" "[During the past 12 months / Since [his/her] birth], how often did [S.C.]'s doctors and other health care providers listen carefully to you?" "When [S.C.] is seen by doctors or other health care providers, how often are they sensitive to your family's values and customs?" "[During the past 12 months / Since [his/her] birth], how often did you get the specific information you needed from [S.C.]'s doctors and other health care providers?" "[During the past 12 months / Since [his/her] birth], how often did [S.C.]'s doctors or other health care providers help you feel like a partner in [his/her] care?" Each of these items had the response options of never, sometimes, usually, and always. Using confirmatory factor analysis, which produced a one factor solution, these were combined into one factor measuring patient satisfaction, where higher values indicate a more positive evaluation of their child's provider across these five areas.

Independent Variables

For the first analysis, addressing the type of care used, we have two key sets of independent variables. The first is a set of ZIP code level measures for racial/ethnic residential segregation. Typically, segregation scores are measured at a large geographic unit of analysis, such as the county or metropolitan area to provide a summary score of how groups are dispersed or clustered throughout that area [57]. However, in this case, we aim to examine how segregated an area is at the neighborhood level, or a small geographic unit of analysis, to measure the extent of segregation in neighborhoods within a metropolitan area, as opposed to between metropolitan areas. Moreover, many segregation scores are aspatial in nature even if they use geographic units of analysis [58, 59]. In this analysis, we use a set of clustering scores that take into account the percentage of the different racial/ethnic groups in an area, as well as their geographic/spatial neighbors, measured at the level of the ZIP code using the following formula:

$$C_i = x_i \sum_{j=1,j\neq i}^{n} w_{ij}x_j$$

where x_i is the variable for feature i (the focal ZIP code), x_j is the variable for feature j (the other ZIP codes), and w_{ij} is the spatial weight between features i and j (as defined by a queen spatial weight matrix) [4]. Essentially, the score reflects the product of the percent of a group in a ZIP code and the average percent in its neighbors (row standardized), with neighbors defined by a first-order queen contiguity spatial weight matrix. These scores were calculated in GeoDa 1.18.0. The calculation is similar to the formula for local Moran's I, a commonly used spatial clustering metric, except that it only pinpoints high clustering as opposed to high and low clustering combinations [60, 61]. Theoretically, the measure could range from 0 to 10,000. A score of 10,000 would be possible for a ZIP code that was composed of 100% of a certain group, and all neighboring ZIP codes also had 100% of the same group. Also, to account for differences in the relative sizes of groups across the USA, these scores are all group mean centered per ZIP code to the mean of the metropolitan area, which is an approach used by similar research [62, 63]. Due to large differences in the relative size of racial/ethnic groups across regions of the USA, centering allows us to highlight differences within metropolitan areas, as opposed to between metropolitan areas, i.e., where groups are most highly concentrated and clustered within a metro area, regardless of their relative group size across the USA. We calculated these scores for each of the three largest racial/ethnic groups in the USA. In this analysis, we include three scores: *clustering measure for percent Black* (non-Latino), *for percent Latino* (of any race), and *for percent Asian* (non-Latino). We exclude an analysis of White clustering due to problems with multicollinearity with the inclusion of all four groups in a single model and focus instead on the clustering of minority groups in neighborhoods.

Moreover, to assess how the local provision of health care services relates to the link between the racial/ethnic clustering scores and health care provider choice, we also include a set of four types of health-related services from the County Business Patterns (CBP) ZIP Code Industry Detail file, which are coded by industry using North American Industry Classification System (NAICS) codes. Here, we use four such codes: 621111 Offices of Physicians (except Mental Health Specialists), 6213// Offices of Other Health Practitioners, 622110 General Medical and Surgical Hospitals, and 6241// Individual and Family Services. These are included as counts of the four different types of establishments in a ZIP code: *doctor's offices*, *other health care practitioners*, *hospitals*, and *social services*.

We include several sets of covariates in each of the models, measured at three different levels of analysis. The first is child level characteristics as reported by parent/guardian. These include sex, age, race, health insurance status, and general parent-rated health. *Age* is measured continuously, while *sex* (1 = female, 0 = male), *insured* (1 = has any kind of health insurance, 0 = else), and *Medicaid* (1 = Medicaid recipient, 0 = else) are dichotomized into dummy variables. Race is coded as a set of dummy variables for *White*, *Black*, *Latino*, and *Other* racial groups, with White serving as a the reference group. We use an "other" racial category instead of including a separate category for Asian, even though we include an Asian clustering score, because of what is available in the NSCH dataset. The Asian racial category at the individual-level is only provided in certain states where the Asian population is sufficiently large, which would limit the sample to only about 20% of its original size. Thus, in order to keep as large of a sample size as possible, we opted to use the "other" racial category, instead of the more refined coding scheme that includes an Asian category. However, since we do not face this same problem at the area level, we still include a measure for Asian clustering as noted above as some literature exists on the case of Asian segregation and health [64, 65]. We also include a measure for the general physical health status of the child to control for health need. This is measured ordinally with the response options of excellent, very good, good, fair, and poor, and thus, higher values on this measure indicate *poor health*.

We also include variables from the individual-level survey that reflect the household and family circumstances of the child. These include the highest level of education of either parent/guardian, whether or not the parents are married, whether or not at least one parent/guardian is employed, whether or not the parents/guardians own their home, the percent of the federal poverty line of the household income, whether or not the household receives government cash assistance or Supplemental Nutrition Assistance Program (SNAP) benefits, and whether or not the household is primarily English speaking. *Percent of the FPL* is treated continuously. *Married parents* (1 = married, 0 = else), *employed* (1 = employed, 0 = else), *own home* (1 = own home, 0 = else), *cash assistance* (1 = household received government cash assistance), *SNAP recipients* (1 = household receives SNAP benefits), and *no English* (1 = language other than English spoken primarily at home, 0 = else) are all re-coded as dichotomous variables. Parent/guardian education level is recoded into a set of dummy variables to indicate the highest level of education of any parent or guardian in the household with the categories of *less than high school*, *high school*, or *more than high school*, with less than high school serving as the reference category.

In addition to the clustering scores, we also include a number of ZIP code level controls to account for the social and economic situation of the neighborhood. These include *percent foreign born*, *percent in poverty*, *percent of the*

population with a bachelor's degree or higher, *percent uninsured*, and *percent with no vehicle*. These are each measured continuously as percentages. We also tested for multicollinearity using the variance inflation factor (VIF), and it was not found to be a problem with any of the included variables. Descriptive statistics for all variables used can be found in Table 1. Note that these only include the means (or proportions) and standard deviations (where applicable) as NCHS restricted data use does not allow for the disclosure of variable ranges.

Methods

To examine these associations, we estimate models for the two parts of this analysis. First, to examine the type of care used, we estimate a series of multinomial logistic regression models for the multi-category outcome. We also set physician's offices as the baseline comparison category as previous research has established that regular care with a consistent primary care provider to be optimal health care provider, especially for routine and regular (non-specialty) care [50]. This is especially the case for children who have routine well-child visits and immunizations at set intervals throughout childhood. Because data are measured at two different units of analysis, the individual level survey data paired with data on the ZIP code context, we also correct the standard errors using the clustering by ZIP code.

In terms of the modeling strategy, we first estimate a model with all of our child, household, and ZIP code level variables included to get a baseline model how segregation is related to health. These results can be found in Table 2. Then, we add the health care organization variables to the model to see whether or not the inclusion of the health care counts alters the relationship between the clustering scores and the choice of provider. We add these in one-by-one, as they are too colinear with each other to include in a single model. Because of the multinomial specification of the dependent variable and the continuous coding of the main independent variables, a formal significance test of their mediation was not possible. Instead, we examine percentage changes in the size of the coefficients to see if the inclusion of the health care provision counts changes the relationship between clustering and the choice of provider. A truncated version of these results can be found in Table 3. For these results in Table 3, we provide the raw coefficients from the models, as well as x-standardized odds ratios, due to the large differences in the scales for both the clustering scores and the health care resource variables. While the health care resource variables reflect counts, which are integers and therefore not appropriate for using a non-integer standard deviation change, this approach seems to provide a more easily interpretable version of the results, as a one-unit change would be quite small, and it also allows for an easier comparison across the different variables and health care types (with the common metric of a standard deviation change).

For the second part of the analysis, we estimate a series of two OLS models of the patient satisfaction index to see if the choice of provider relates to opinions about that provider. We present two models here, one without and one with the area-level variables included. These were also corrected with robust standard errors that account for the ZIP code level clustering at the ZIP code-level. These results can be found in Table 4.

Results

Part 1: Choice of Health Care Provider

The first part of this analysis focuses on the parent's usual choice of health care provider for their children and whether or not that is related to the constrained set of choices available in minority segregated areas. For this, we turn to Table 2. For the clustering scores, we see that Black clustering is significantly related to the choice of a hospital outpatient department and a clinic or health center, as compared to a doctor's office. These are both significant and positive, meaning that as Black clustering increases, the use of a hospital outpatient department and clinic, instead of a doctor's office, also increases. These are not negligible effect sizes either. For use of an outpatient department, a one standard deviation increase in Black clustering is related to an increase in the use of an outpatient department, as compared to doctor's office, by a factor of 1.12 or 12%. For clinic use, a one standard deviation increase in Black clustering is related to an increase in the choice of clinic or health center, as compared to a doctor's office, by a factor of 1.072 or 7.2%. There is also a significant and positive relationship for Latino clustering for clinic use where a one standard deviation in Latino clustering is related to an increase in the use of a clinic or health center, instead of doctor's office, by a factor of 1.057 or 5.7%. Thus, for Black and Latino clustering, in these two cases, we see that clustering is related to the use of non-ideal provider types as compared to physician's offices. Asian clustering is not significant for any of the categories, though.

Interestingly, the clustering scores do not seem to be related to the provider category for not having any care at all and for the use of an emergency room, as compared to the doctor's office. Instead, these seem to be a function of the socio-economic circumstances of the child and household. In particular, the effect of insurance status here is quite large and more pronounced than in the other models. For having no care, being insured relates to an 85% decrease in having no usual source of care versus a doctor's office, and it related to an 81% decrease using an emergency room versus a doctor's office for the usual source of care.

Table 1 Descriptive statistics, including means and standard deviations for continuous variables and proportions for categorical variables, used in all models

Variable name	Mean/Proportion	St. dev	Description
Dependent variables			
Type of care			
No usual source	0.04	–	Provider choice (1 = no usual source, 0 = else)
ER	0.02	–	Provider choice (1 = ER, 0 = else)
Outpatient department	0.02	–	Provider choice (1 = outpatient department, 0 = else)
Clinic	0.12	–	Provider choice (1 = clinic, 0 = else)
Physician's office	0.79	–	Provider choice (1 = physician's office, 0 = else)
Other	0.01	–	Provider choice (1 = other, 0 = else)
Provider satisfaction index	0.00	1.00	Factor score for patient satisfaction index
Child-level variables			
Female	0.49	–	Child sex (1 = female, 0 = else)
Age	8.70	5.22	Child age in years
Race (White = ref.)			
White	0.60	–	Child race (1 = non-Latino White, 0 = else)
Black	0.13	–	Child race (1 = non-Latino Black, 0 = else)
Latino	0.16	–	Child race (1 = Latino, 0 = else)
Other	0.11	–	Child race (1 = non-Latino other race, 0 = else)
Insured	0.96	–	Insurance status (1 = insured, 0 = else)
Medicaid	0.24	–	Insured through Medicaid (1 = Medicaid, 0 = else)
Poor health	1.48	0.77	Parent-rated health (1 = excellent, 5 = poor)
Household-level variables			
Parent education			
High school	0.30	–	Parents' highest level of education (1 = high school diploma, 0 = else)
More than high school	0.56	–	Parents' highest level of education (1 = more than high school diploma, 0 = else) school diploma, 0 = else)
Married parents	0.67	–	Parents' marital status (1 = married, 0 = else)
Employed	0.89	–	Parents' employment status (1 = employed, 0 = else)
Own home	0.73	–	Housing status (1 = own home, 0 = else)
% FPL	5.97	2.54	Household percent of the federal poverty line
Cash sssistance	0.05	–	Household receives any cash assistance (1 = yes, 0 = no)
SNAP	0.15	–	Household receives SNAP assistance (1 = yes, 0 = no)
No English	0.09	–	Household does not speak English (1 = yes, 0 = no)
ZIP code-level variables			
Black clustering	30.06	1180.31	Clustering measure of percent Black
Latino clustering	5.59	673.59	Clustering measure of percent Latino
Asian clustering	0.06	129.73	Clustering measure of percent Asian
% foreign born	12.36	10.35	Percent of ZIP code that is foreign born
% in poverty	12.83	9.12	Percent of ZIP code below federal poverty line
% bachelor's	35.84	17.68	Percent of ZIP code with a bachelor's degree
% uninsured	12.52	7.45	Percent of ZIP code that is uninsured
% no car	8.85	10.31	Percent of ZIP code with no personal vehicle
Health care variables			
Physician's offices	23.73	28.23	Number of physician's offices in ZIP code
Health care practitioners	16.92	14.30	Number of health care practitioners in ZIP code
Hospitals	0.37	0.66	Number of hospitals in ZIP code
Social services	7.04	7.23	Number of social service agencies in ZIP code

N = 43,723. Data come from the 2011–2012 National Survey of Children's Health, the 2008–2012 American Community Survey, and the 2012 County Business Patterns

Table 2 Coefficients, ZIP code clustered robust standard errors, and odds ratios from multinomial regression models of usual place of care (reference group = physician's office)

	No usual care			Emergency room			Outpatient department			Clinic		
Variable name	*B*	SE	OR	*B*	SE	OR	*B*	SE	OR	*B*	SE	OR
Child-level variables												
Female	−0.015	0.051	0.985	−0.096	0.077	0.909	−0.120	0.067	0.887	0.039	0.031	1.040
Age	0.045***	0.005	1.046	0.008	0.008	1.008	−0.000	0.007	1.000	0.022***	0.003	1.022
Race (White = ref.)												
Black	0.548***	0.086	1.729	0.944***	0.122	2.571	0.738***	0.112	2.092	0.109	0.064	1.115
Latino	0.492***	0.081	1.636	0.716***	0.137	2.046	0.313*	0.129	1.367	0.531***	0.051	1.701
Other	0.476***	0.082	1.609	0.488**	0.151	1.629	0.648***	0.109	1.911	0.225***	0.056	1.252
Insured	−1.877***	0.090	0.153	−1.660***	0.156	0.190	−0.552***	0.163	0.576	−0.780***	0.074	0.459
Medicaid	0.193*	0.081	1.213	0.562***	0.134	1.755	0.231*	0.104	1.260	0.206***	0.048	1.229
Poor health	0.012	0.031	1.012	0.251***	0.044	1.285	0.315***	0.041	1.370	0.090***	0.019	1.094
Household-level variables												
Parent education												
High school	−0.219**	0.075	0.803	−0.304**	0.106	0.738	−0.007	0.110	0.993	−0.368***	0.047	0.692
High school	−0.371***	0.072	0.690	−0.432***	0.109	0.649	−0.071	0.107	0.931	−0.420***	0.047	0.657
Married parents	−0.167**	0.058	0.846	−0.457***	0.099	0.633	−0.225**	0.084	0.799	−0.032	0.038	0.969
Employed	−0.192**	0.067	0.825	−0.118	0.096	0.889	−0.039	0.103	0.962	0.014	0.045	1.014
Own home	−0.474***	0.066	0.622	−0.380***	0.096	0.684	−0.514***	0.092	0.598	−0.302***	0.040	0.739
% FPL	−0.094***	0.015	0.911	−0.122***	0.024	0.885	−0.070***	0.020	0.932	−0.098***	0.009	0.907
Cash assistance	0.071	0.103	1.074	0.145	0.116	1.156	−0.023	0.139	0.977	0.030	0.065	1.031
SNAP	−0.142	0.079	0.868	0.062	0.112	1.064	−0.496***	0.113	0.609	−0.094	0.052	0.910
No English	1.290***	0.086	3.633	0.656***	0.135	1.927	0.615***	0.126	1.850	0.856***	0.055	2.353
ZIP code-level variables												
Black clustering[a]	0.010	0.027	1.011	−0.007	0.030	0.991	0.096**	0.031	1.120	0.059***	0.016	1.072
Latino clustering[a]	0.020	0.037	0.987	−0.022	0.052	0.985	0.095	0.056	1.066	0.082**	0.030	1.057
Asian clustering[a]	0.043	0.174	1.006	0.418	0.267	1.056	−0.013	0.258	0.998	−0.132	0.162	0.988
% foreign Born	−0.002	0.004	0.998	−0.017**	0.006	0.983	0.005	0.005	1.005	−0.012***	0.003	0.886
% in poverty	0.004	0.005	1.004	0.004	0.007	1.004	0.025***	0.006	1.025	0.018***	0.004	1.018
% bachelor's	−0.001	0.002	0.999	−0.006	0.004	0.994	0.001	0.003	1.001	−0.003	0.002	0.997
% uninsured	0.015*	0.006	1.016	0.020*	0.009	1.020	−0.026**	0.009	0.974	−0.000	0.005	1.000
% no car	−0.009*	0.004	0.991	0.014**	0.004	1.014	0.002	0.004	1.002	0.001	0.003	1.001
Pseudo R^2	0.118											

Individual-level $N = 43{,}721$. ZIP code-level $N = 6735$. B = coefficient

Odds ratios for these variables also reflect x-standardized odds ratios

The models also include an "other" category for place of usual care, but these results are not shown for the sake of parsimony

SE standard error, *OR* odds ratio, *FPL* federal poverty line

[a]Coefficient and standard error multiplied by 1000 for the ease of presentation

*** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$

Of note, several other individual-level variables play an important role here as well. In particular, child race is significantly related to each of the provider categories, such that being Black, Latino, or in another racial category, as compared to White, is related to not having a usual source of care, using an emergency room, using a hospital outpatient department, and a clinic or health center (with the exception of Black for clinics). That is, racial/ethnic minority children are more likely to use each one of these types of health care providers instead of physician's offices as compared to their White counterparts, net of their socioeconomic circumstances and insurance status. Similarly, not speaking English in the household is related to a greater likelihood of not having a usual source of care and using a clinic. For example, being in a non-English speaking home relates to an increase in not having a usual source of care, as compared to doctor's office use, by a factor of 3.63 or 263%. This is the single largest effect for this variable (speaking English at home),

Table 3 Coefficients, ZIP code clustered robust standard errors, and odds ratios from multinomial regression models of usual place of care (reference group = physician's office)

	No usual care			Emergency room			Outpatient department			Clinic		
Variable name	*B*	SE	OR	*B*	SE	OR	*B*	SE	OR	*B*	SE	OR
Model with physician's offices included												
Black clustering[a]	0.007	0.027	1.009	−0.010	0.030	0.988	0.086**	0.031	1.107	0.047**	0.016	1.057
Latino clustering[a]	0.026	0.037	0.983	−0.029	0.052	0.981	0.072	0.057	1.050	0.060*	0.030	1.041
Asian clustering[a]	0.043	0.174	1.006	0.417	0.268	1.056	0.024	0.271	1.003	−0.101	0.163	0.987
Physician's offices	−0.001	0.001	0.978	−0.001	0.002	0.973	−0.005**	0.002	0.867	−0.006***	0.001	0.850
Pseudo R^2	0.119											
Models with other health care practitioners included												
Black clustering[a]	0.012	0.027	1.014	−0.006	0.030	0.993	0.079*	0.031	1.098	0.061***	0.016	1.074
Latino clustering[a]	−0.017	0.037	0.989	−0.020	0.052	0.987	0.074	0.058	1.051	0.084**	0.031	1.058
Asian clustering[a]	0.039	0.174	1.005	0.410	0.269	1.055	0.034	0.253	1.004	−0.140	0.161	0.982
Practitioners	0.002	0.002	1.026	0.002	0.003	1.024	−0.014***	0.004	0.820	0.002	0.003	1.024
Pseudo R^2	0.118											
Models with hospitals included												
Black clustering[a]	0.011	0.027	1.013	−0.005	0.030	0.994	0.099**	0.031	1.124	0.061***	0.016	1.074
Latino clustering[a]	0.019	0.037	0.987	−0.021	0.052	0.986	0.096	0.056	1.067	0.082**	0.030	1.057
Asian clustering[a]	0.039	0.174	1.005	0.411	0.268	1.055	−0.020	0.256	0.997	−0.137	0.162	0.982
Hospitals	0.031	0.039	1.020	0.044	0.051	1.029	0.060	0.063	1.040	0.040	0.042	1.027
Pseudo R^2	0.118											
Models with individual and family services included												
Black clustering[a]	0.009	0.026	1.011	−0.006	0.030	0.993	0.097**	0.031	1.121	0.062***	0.016	1.076
Latino clustering[a]	0.020	0.037	0.987	−0.021	0.052	0.986	0.097	0.056	1.067	0.091**	0.030	1.063
Asian clustering[a]	0.038	0.174	1.005	0.415	0.266	1.055	−0.015	0.258	0.998	−0.136	0.159	0.983
Services	0.001	0.004	1.009	0.005	0 .005	1.035	0.004	0.005	1.031	0.014***	0.004	1.109
Pseudo R^2	0.119											

Individual-level $N = 43{,}721$. ZIP code-level $N = 6735$. B = coefficient

All odds ratios reflect x-standardized odds ratios

The models also include an "other" category for place of usual care, but these results are not shown for the sake of parsimony

SE standard error, *OR* odds ratio

[a]Coefficient and standard error multiplied by 1000 for the ease of presentation

*** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$

but there are substantively large effects for all types of care as compared to use of a physician's office.

Table 3 presents reduced tables of the models presented in Table 2 but with the addition of different types of health care and service organizations to see if the local provision of care is related to the association between residential segregation and the type of care. The first model includes the results for the clustering scores with the inclusion of the number of physician's offices in a ZIP code. A few findings are notable here. First, we see that the coefficient for the number of physician's offices is significant and negative, meaning that the greater the number of physician's offices in an area, the greater likelihood that a family uses that choice of provider (as physician's offices serve as the reference category). The effect of this is substantively large as well. Every one standard deviation (28.23) increase in the number of physician's offices in a ZIP code is related to a decrease in the use of an outpatient department by a factor of 0.867 (or 13.3%) and a decrease in the use of a clinic by a factor of 0.850 (or 15%) as compared to the use of physician's office.

Moreover, when this variable is included, the significant effects of Black and Latino clustering are reduced in their size. For outpatient department use, the Black clustering coefficient is reduced by 10.42% from the previous model presented in Table 2. We find an even larger reduction in the size of the coefficient for use of a clinic versus physician's office. In this case, the Black clustering score is reduced by 20.33%, and the Latino clustering score by 26.83%.

The provision of other types of care providers also produced some results, albeit not as strong as the result for physician's offices. We also included a measure for the number of other types of non-physician health care practitioners.

Table 4 Coefficients and ZIP code clustered robust standard errors from OLS models of patient satisfaction index

	Unadjusted model		Adjusted model	
Variable name	β	SE	β	SE
Type of care				
No usual care	−0.575***	0.037	−0.573***	0.037
ER	−0.501***	0.053	−0.505***	0.053
Outpatient Department	−0.170***	0.039	−0.175***	0.040
Clinic	−0.148***	0.017	−0.155***	0.017
Other	−0.462***	0.087	−0.465***	0.087
Child-level variables				
Female	0.015	0.009	0.015	0.009
Age	−0.012***	0.001	−0.012***	0.001
Race (ref. = White)				
Black	−0.111***	0.017	−0.110***	0.018
Other	−0.215***	0.017	−0.202***	0.017
Latino	−0.065***	0.016	−0.052**	0.017
Insured	0.515***	0.039	0.511***	0.039
Medicaid	0.019	0.018	0.017	0.018
Poor health	−0.168***	0.007	−0.168***	0.007
Household-level variables				
Parent education				
High school	0.064**	0.019	0.062**	0.019
High school	0.067***	0.018	0.069***	0.019
Married parents	0.016	0.012	0.019	0.012
Employed	0.079***	0.019	0.078***	0.019
Own home	0.054***	0.014	0.050***	0.014
% FPL	0.024***	0.003	0.025***	0.003
Cash assistance	−0.036	0.028	−0.042	0.028
SNAP	0.081***	0.023	0.079***	0.023
No English	−0.379***	0.026	−0.358***	0.026
Area-level variables				
Black clustering[a]			−0.007	0.005
Latino clustering[a]			0.027**	0.009
Asian clustering[a]			−0.082	0.047
% foreign born			−0.002***	0.001
% in poverty			0.002	0.001
% bachelor's			0.000	0.000
% uninsured			−0.003*	0.001
% no car			0.001	0.001

Individual-level $N = 42{,}046$. ZIP code-level $N = 6672$. β = coefficient

SE ZIP code clustered robust standard errors, *FPL* federal poverty line

[a]Coefficient and standard error multiplied by 1000 for the ease of presentation

*** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$

This variable was significant in only one comparison, the use of an outpatient department versus physician's offices. The coefficient for the number of health care practitioners was significant and negative, meaning that as the number of other health care practitioners in an area increases, the use of hospital outpatient departments decreases relative to physician's offices. This also reduced the size of the coefficient for Black clustering by 17.71%. In the case of the clinics versus physician's offices, the variable is not significant and does not substantially change the size of the clustering scores.

For the number of hospitals in an area, these do not seem to relate to the choice of provider across areas. The coefficient for the number of hospitals is not significant across the models, and it does not reduce the size of the clustering scores that were significant in the original models. For the number of individual and family services, we see a slightly different pattern. First, for the use of a clinic versus physician's office, the coefficient for the number of services in an area is significant and positive, meaning that the greater provision of social services in an area, the more likely the respondent is to use a clinic or health center for their child's usual provider. Moreover, for both Black and Latino clustering, we see a suppression effect where the effect sizes of both of these are not reduced but are actually increased slightly.

Part II: Health Care Provider Satisfaction

In the second part of the study, we aim to examine whether or not the choice of provider actually matters for how parents evaluate their choice of provider for their children. For these models, we use the index of provider satisfaction as the dependent variable. These models can be found in Table 4. What we can readily see here is that across the board, parents/guardians are less satisfied with all of the other provider choices as compared to the physician's office. These include no usual source of care, emergency rooms, hospital outpatient departments, clinics, and other. These coefficients are each significant and negative, but the magnitude of the effect is different across the different types of care. For instance, having no usual source of care or using the ER leads to the highest dissatisfaction as compared to physician's offices. However, even the effect for clinics is still large. Specifically, from the full adjusted model, using a clinic versus physician's office leads to a 0.155 decrease in the level of satisfaction with the provider.

Discussion

The goal of this study is to examine how the local provision of health care resources relates to racial/ethnic residential segregation. We examine these relationships in terms of the type of care that people receive, both in terms of where they go for that care and how satisfied they are with that care when they access it. We find that racial/ethnic residential segregation is related to the types of care that people use for their children. Specifically, Black clustering is related to greater use of hospital outpatient departments and clinics,

as compared to physician's offices, and we find that Latino clustering is related to greater use of clinics. We do not find any significant results for Asian segregation. Moreover, we do not find any significant results for not having a usual source of care and using emergency rooms. None of the clustering scores was related to these two types of care. However, a number of the individual-level variables were related to the use of these types of care, especially the insurance status of the child, household English proficiency, and the socio-economic considerations of the family.

Furthermore, when we examine these patterns in light of what is available to people in their neighborhoods, we find that the provision of certain types of care is related to greater use of ideal care by use of physician's offices. Specifically, a greater number of both physician's offices and other health care practitioners are both related to greater use of physician's offices as compared to hospital outpatient departments and clinics. Furthermore, the local provision of both of these sources of care appears to partially attenuate or mediate the relationship between Black and Latino clustering and the care type. This suggests that the local provision of care at least partially explains some of the racial/ethnic gap in access to ideal forms of care, at both the individual and neighborhood levels. We also find that the type of care matters for health care outcomes, with lower reporting of satisfaction with care with the use of these non-ideal types of care as compared to the regular physician's office.

These results are in keeping with much of the previous literature, which has demonstrated that neighborhood segregation is related to a lack of a wide variety of health care organizations [4, 5, 8, 36, 40, 44]. Moreover, some limited work to date has also shown that the provision of that care is related to health care outcomes for communities, especially that the lack of such facilities limits and constrains access to care [5, 6, 43, 66]. However, this work adds to this previous literature by showing that the choice of provider is related to residential segregation specifically and that that the lack of local provision of care relates to a reliance on less ideal forms of care compared to the physician's office. Longstanding research in the health care service literature has demonstrated the physician's office to be the optimal form of routine, preventive care, typically providing more comprehensive care with greater continuity over time [50–52, 55]. This has been shown to be especially important for pediatric care [51, 54, 56]. Thus, this gap in provision and use may be consequential for the communities that lack adequate care options. Indeed, our results also suggest that people using these non-ideal forms of care express more dissatisfaction with their child's provider. One previous study in particular found a similar finding to what is presented here for Latino segregated neighborhoods but only in the Phoenix area [10]. This study expands that finding to the entirety of the USA, through the use of a restricted national data source and accounts for Black and Asian clustering as well.

Despite these findings, this study is not without limitations. First, the analysis only examines pediatric health care, which may be a conservative version of these associations. Children are more likely to be insured than their adult counterparts through various public programs, which are more sympathetic to children. Second, the study is only cross-sectional in nature; therefore, we are unable to make any causal claims about how the local provision of care relates to health care provider choice. Another major limitation is that the study is unable to account for the race of the provider, only whether or not the family had a provider for their child and the type. Previous work has shown that minority physicians are more likely to locate in racial/ethnic minority neighborhoods, and furthermore, that patients report higher levels of satisfaction with those providers [67–69]. For example, one study on pediatric providers found that when Black children see a Black primary care provider, the children and families are more likely to laugh during the encounter [70]. Similarly, other work has shown that ethnic density is related to greater trust in health care and lower rates of reported discrimination in the health care system, suggesting that the physicians in these neighborhoods, who are more likely to be of the same race, instill greater feelings of medical trust [71, 72]. And other work has shown that people will travel further to see a physician of the same race [73, 74]. All of this would suggest that the race of the provider may also play an important role in provider choice as it relates to local provision of care. However, given the constraints of the survey data and our secondary data on the distribution of health care establishments, we cannot account for this in our analysis.

Another limitation is that this analysis only examines urban ZIP codes across the USA, which is only a limited number of the areas across the USA. First, ZIP codes may not be the optimal unit of analysis given that people are not constrained by their ZIP code boundaries when they move about an urban area or make decisions about which providers to use for their various daily needs. Moreover, this ignores large swaths of the USA outside of metropolitan areas, and there may be important other considerations at play for rural or lower density communities, which are not examined here. These could all be important considerations for future work.

Although these limitations need further exploration, this analysis provides some important contributions to the literature on the distribution of health care resources and access to care. Using a large national dataset, we demonstrate that the local availability of health care resources in neighborhoods appears to shape or constrain the type of care that families receive for their children. Moreover, this is related to racial/ethnic residential segregation in that families in Black and Latino communities are more likely to use non-ideal forms of health care provision for their children and that this seems

to be partially explained away by the availability of resources within their neighborhoods. However, when it comes to not receiving care at all or using an emergency room, these are much more influenced by socio-economic considerations and the insurance status of the child. This has important implications for public health policy. Much of the political impetus to improve access to care for children is centered on the expansion of medical insurance programs. While this would appear to provide access to some type of care, it does not necessarily mean that they will gain access to ideal forms of care through physician's offices. Previous work has indicated that pediatric care through a regular pediatrician's office provides better health outcomes and better continuity of care [50, 55]. That is reflected in our data as well, where parents express higher satisfaction with these providers across a number of different indicators. These results suggest that we need to consider not just access to care through health insurance, but rather also providing local primary care options in neighborhoods in a more equitable fashion.

Author Contribution All authors contributed to the study conception and design. Material preparation and data analysis were performed by Anderson. Literature review was performed by Wolski. The first draft of the manuscript was written by Anderson, and all authors commented on previous versions of the manuscript. All authors read and approved the final manuscript.

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Declarations

Ethics Approval This is an observational study using restricted secondary data. The Institutional Review Board at the authors' institution has confirmed that no ethical approval is required.

Competing Interests The authors declare no competing interests.

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