Historic Residential Redlining and Present-Day Social Determinants of Health, Home Evictions, and Food Insecurity within US Neighborhoods

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ABSTRACT

OBJECTIVE: Examine the association between historic residential redlining and present-day racial/ethnic composition of neighborhoods, racial/ethnic differences in social determinant of health domains, and risk of home evictions and food insecurity.

RESEARCH DESIGN AND METHODS: We examined data on 12,334 (for eviction sample), and 8996 (for food insecurity sample), census tracts in 213 counties across 37 states in the USA with data on exposure to historic redlining. First, we examined relationships between Home Owners' Loan Corporation (HOLC) redlining grades (A="Best", B="Still Desirable", C="Definitely Declining", D="Hazardous") and present-day racial/ethnic composition and racial/ethnic differences in social determinant of health domains of neighborhoods. Second, we examined whether historic redlining is associated with present-day home eviction rates (measured across eviction filings rates, and eviction judgment rates for 12,334 census tracts in 2018) and food insecurity (measured across low supermarket access, low supermarket access and income, low supermarket access and low car ownership for 8996 census tracts in 2019). Multivariable regression models were adjusted for census tract population, urban/rural designation, and county level fixed effects.

RESULTS: Relative to areas with a historic HOLC grading of "A (Best)", areas with a "D (Hazardous)" grading had a 2.59 (95%CI=1.99–3.19; *p*-value<0.01) higher rate of eviction filings, and a 1.03 (95%CI=0.80–1.27; *p*-value<0.01) higher rate of eviction judgments. Compared to areas with a historic HOLC grading of "A (Best)", areas rated with a "D (Hazardous)" had a 16.20 (95%CI=15.02–17.79; *p*-value<0.01) higher rate of food insecurity based on supermarket access and income, and a 6.15 (95%CI =5.53–6.76; *p*-value<0.01) higher rate of food insecurity based on supermarket access and car ownership.

CONCLUSIONS: Historic residential redlining is significantly associated with present-day home evictions and food insecurity, highlighting persistent associations between structural racism and present-day social determinants of health.

INTRODUCTION

Structural racism, defined as the ways in which societies foster discrimination through mutually reinforcing inequitable systems, is receiving increased attention as an underlying cause of health inequities that disproportionately impact minoritized communities.[5, 10, 20] Structural racism can be conceptualized as antecedent to social determinants of health (SDOH), which affect downstream health outcomes.[31] Historic redlining (or the systematic offering or withholding of low interest home mortgages across different neighborhoods), captures the concept of reinforcement of inequitable systems through overlapping influence on housing availability, banking access, credit, and wealth creation.[10, 26] Additionally, historic redlining captures how structural racism embedded discrimination within laws and policies, which may exert an influence after specific regulations are no longer legal.[26]

Historic redlining was created when the Home Owners' Loan Corporation's (HOLC) grading/coloring of neighborhoods were initiated in the 1930s.[19] Neighborhoods were graded from A, considered "Best" and colored green on maps, to D, considered "Hazardous" and colored red on maps, with implications of grading that included denial of residents within hazardous areas access to credit for home purchases.[19] Redlined neighborhoods were primarily occupied by non-Hispanic Black (NHB) individuals limiting the ability of those living in these neighborhoods to access credit, purchase homes, or build equity to make repairs.[19, 26] While the discriminatory practice of historic redlining is prohibited under the Fair Housing Act of 1968, evidence shows that persistent negative impacts are still present to this day.[19, 26] Residential segregation, economic inequity, and health disparities[12, 21] including increased occurrence of poor mental health, lower life expectancy at birth,[26] greater risk

of experiencing a preterm birth,[17] higher rates of Emergency department visits due to asthma[22], and higher diabetes-related mortality have been linked to historic redlining.[20] However, more remains to be learned about this relationship between upstream factors of structural racism in the form of historic redlining and specific SDOH, known to be linked to poor health outcomes, in particular food insecurity and housing instability.

Evidence from the past two decades show that NHB and Hispanic households are twice as likely to experience food insecurity (defined as limited or uncertain access to food) as non-Hispanic White (NHW) households [7] Walker 2020,[11] USDA.[27, 28] NHB individuals also have worse food access in that they are more likely to live within areas designated as either food swamps or food deserts,[7, 11, 30] and such areas have further been found to be concentrated within high poverty communities.[9] Similarly, there exist longstanding gaps in housing insecurity (characterized by challenges paying rent/mortgage) across race/ethnicity, with 19% of NHW households having housing insecurity, compared to 25.4% of Hispanic households, and 33.5% of NHB households.[8] Similar disparities have been noted in relation to home evictions, with NHB renters having a higher risk of being subject to eviction filings and eviction judgments.[15] The COVID-19 pandemic has further exacerbated disparities, with NHB and Hispanic communities disproportionately affected by greater job loss,[13] higher rates of food insecurity,[2, 7] and housing insecurity.[8]

Understanding how structural racism underlies current health inequities across populations is critical to effectively reduce health disparities and improve population health. This study will contribute to this understanding, and to prior literature, by examining the association between historic redlining and present-day racial/ethnic differences in SDOH domains, risk of home eviction and food insecurity. First, this study will examine relationships between HOLC ratings and the racial/ethnic composition and SDOH domains of neighborhoods today. Second, this study will examine whether historic redlining is associated with food insecurity rates and present-day eviction rates. These analyses are particularly critical as the COVID-19 eviction moratoria and policies implemented to address food insecurity during the pandemic are being removed, potentially resulting in a disproportionate harm for those with exposure to historic redlining practices.

RESEARCH DESIGN AND METHODS

Study Sample

We combined data from several sources in this study. First, we sourced HOLC area ratings to create a complete set of digitized historic redlining maps from the Mapping Inequalities project.[23] Second, we sourced recent eviction data for 2018 from the Princeton University Eviction Lab, sourced from LexisNexis Risk Solutions.[14] Third, we sourced 2019 food insecurity data from the United States Department of Agriculture (USDA) Food Access Research Atlas data.[29] Finally, we sourced demographic, socio-economic, neighborhood, and healthcare data from the Opportunity Insight and CDC Places databases.[24, 25] All data were matched based on census tract information to create two analytic samples, home eviction and food insecurity. Resulting study variables are mainly based on the US adult (age≥18) population; however, deviations from this are noted below.

Study Variables

Outcome Measures. Eviction measures included eviction filings and eviction judgments. The eviction filing rate represents the rate of civil lawsuit filings per 100 renter occupied households within a given calendar year. This is the first action in the formal eviction process and represents a civil lawsuit filed by landlords to evict tenants and/or collect past-due rents.[14] Additionally, we also use a measure of eviction judgment rates. This measure captures the rate of cases that result in an eviction judgment against the defendant, forcing them to vacate a premise by a specific date.

Food insecurity measures included access to supermarkets and income, access to supermarkets and a vehicle, and geographic access to supermarkets. As food insecurity generally involves both economic and physical access to food, the first of these measures approximates the food-insecure population using information on the share of the census tract population that are low-income individuals that live beyond ½ mile from the closest supermarket. Low-income census tracts are here identified based on the USDA definition of a tracts that have: (i) a poverty rate of 20% or greater; or (ii) a median family income less than or equal to 80% of the State-wide median family income; or (iii) if the tract is in a metropolitan area, has a median family income less than 80% of the metropolitan area's median family income.[29] Low access census tracts are identified as those with at least 500 people, or at least 33%, of the population residing outside of ½ mile from the closest supermarket.[29] The second measure captures food insecurity using the share of tract housing units that are without a vehicle and that are beyond ½ mile from the closest supermarket. Lastly, we also capture food insecurity using a tract level measure purely based on geographic access — this is measured as the share of the tract population that are beyond ½ mile from the closest supermarket. While these measures differ from measures of food insecurity used within prior studies that often capture food insecurity at a more aggregate geographic unit (e.g., county, MSA or state) (see, e.g.,[4, 6]), the data used for this study has the important benefit of being available at the granularity of census tracts.

Exposure Measure. Our primary exposure measure is historic redlining based on a categorical HOLC rating of a given census tract. These ratings are based on historic static maps, and do not vary over time within the data. Given that the historic HOLC grading areas do not always perfectly overlap with present-day census tracts, we assign each area's HOLC rating based on its HOLC Grade score.[20] First, the share of a census tract contained within a given HOLC area was established. Second, HOLC neighborhood ratings were given a numeric classification with "A" designated the "best" areas=1, "B" the "still desirable" areas=2, "C" the "definitely declining" areas=3, and "D" the "hazardous" or redlined areas=4. Third, for census tracts that overlap multiple HOLC areas, a weighted average historic redlining Grade score was constructed based on the census tract overlaps. The resulting *HOLC Grade* score is thus a continuous measure between 1 (best) and 4 (fully redlined), and this measure is used to assign a grading to each census tract. This grading is defined as an "A" when the *HOLC Grade* score is less than 1.5; a "B" for a *HOLC Grade* score between 1.5 and 2.5; a "C" for a *HOLC Grade* score between 2.5 and 3.5; and a "D" designation for a *HOLC Grade* score greater than 3.5.

SDOH Domains. SDOH domains as defined by the Kaiser Family Foundation were constructed based on available measures within the datasets, including: (i) economic stability; (ii) neighborhood physical environment; (iii) education; (iv) food; (v) community and social context; and (vi) health care system.[3] Economic stability is captured by the share of individuals living in poverty (based on 2006–2010 American Community Survey (ACS)); the median household income (based on 2012–2016 ACS); the fraction of the adult population with positive W-2 earnings in 2015; and the employment rate (based on 2000 Decennial Census). Neighborhood physical environment is captured using our eviction filings rates (defined previously above); the average rent for two-bedrooms (based on 2011–2015 ACS); the share of tract residents with a commute time below 15 min to work (based on 2006-2010); and the average resident commute time to work (based on 2000 Decennial Census). Education is assessed using the share of tract residents with a college degree or higher (based on 2006-2010 ACS), and based on the average math performance of third grade students on standardized test scores in 2013 (as such, we note that this latter measure is not based on an adult population). The food domain is assessed using our three food insecurity measures (defined above). Community and social context is assessed using the probability that a resident reaches the top 20% of the national income distribution in 2014–2015 based on having parents with an income within the 10th percentile of the income distribution; the probability of residents being incarcerated in 2010 given their parents were in the 10th percentile of the income distribution; and the average annual area job growth rate (based on the average annualized job-growth rate between 2004 and 2013). Lastly, the health care system domain is assessed using measures on the share of uninsured patients; the share of residents with an annual checkup; the share of individuals with a dental visit, and the share of residents that receive an appropriate cholesterol screening, colon screening (for adults aged 50–75), and a mammography screening (for women aged 50–74).

Population Size, Urban/Rural, Race/Ethnicity. We also utilize census tract level measures for the population size, area urban/rural designation (defined as rural if the population-weighted centroid of a census tracts is in an area with population less than 2500; otherwise, the tract is defined as urban),[29] and the share of non-Hispanic Black (NHB), non-Hispanic White (NHW), Hispanic, and Asian residents. Based on the racial/ethnic compositions of each tract, we define its majority racial/ethnic group as the racial/ethnic population that makes up the largest share of residents out of our measured groups of NHB, NHW, Hispanic, and Asian residents (data are based on the 2010 US Decennial Census). Racial/ethnic groups was chosen to ensure sufficient sample size.

Statistical Analysis

Several ecological level analyses were performed. First, we investigated how the racial/ethnic makeup of different areas varies across their historic HOLC ratings, and second how SDOH domains differ in levels across areas with different majority race/ethnicity populations. Two-sided *t*-tests were performed to assess mean differences. Next, we conducted a set of analyses to assess the relationship between an areas' historic HOLC rating and present-day home eviction and food insecurity measures. These analyses adjust for census tract population, urban/rural designation, and county-level fixed effects. The adjustment for county-level fixed effects means that our main effects are identified based on within-county variation (across census tracts) within the HOLC rating exposure and the resulting eviction or food insecurity outcome. As such, our approach adjusts for potential confounding that may stem from differences in policies/initiatives addressing eviction and food insecurity risk across different counties/states in the USA.

RESULTS

For our home eviction sample, we have 12,334 census tracts with historic exposure to structural racism in the form of redlining, and for our food insecurity sample we have 8996 census tracts with historic redlining exposure. Figure 1 provides a visual overview of the 213 counties across 37 states within our HOLC redlining and eviction data sample, and HOLC redlining and food insecurity data sample. The color

HOLC & Eviction Sample: Number of Tracts Per County
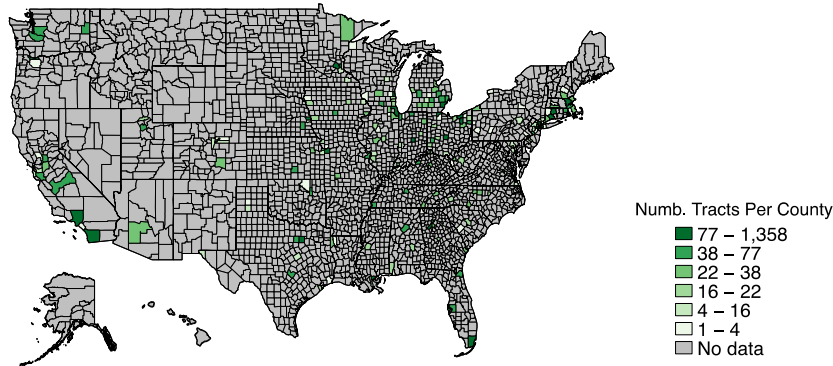
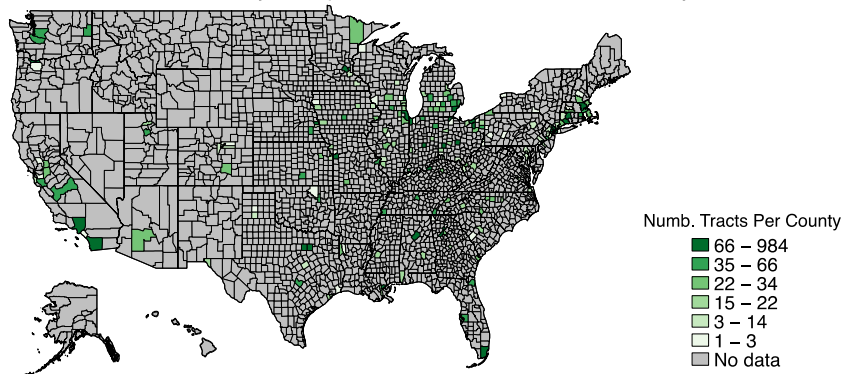HOLC & Food Security Sample: Number of Tracts Per County

Figure 1 Visual overview of 213 counties included in eviction and food insecurity data samples.

coding of counties captures the number of individual census tracts within each county used in the analysis.

Differences in Racial/Ethnic Makeup of Historically HOLC Graded Areas

Table 1 breaks down the racial/ethnic resident shares across each of the HOLC grades (A=best, through to D=hazardous or redlined). Two-way *t*-tests comparing the racial/ethnic share for census tracts with an "A" grade to those with an

"D" grade indicate that historically redlined areas to this day are disproportionately inhabited by racial/ethnic minorities.

Differences in SDOH Domains

Table 2 provides summary statistics describing SDOH characteristics by majority race/ethnicity of historically HOLC graded census tracts. Bold mean entries across the NHB, Hispanic, and Asian majority columns indicate a statistically significant mean difference based on two-sided *t*-tests

Table 1 Summary Statistics for Race/Ethnicity Share Across Historic HOLC Grading A through D

	Share NHW Mean (SD)	Share NHB Mean (SD)	Share Hispanic Mean(SD)	Share Asian Mean(SD)
HOLC Grade = A ("Best") (*n*=588)	70.8(25.1)	14.2(22.4)	8.4(11.3)	4.3(7.1)
HOLC Grade = B ("Still Desirable") (*n*=2371)	55.9(31.2)	21.6(29.4)	15.1(20.2)	4.8(8.0)
HOLC Grade = C ("Definitely Declining") (*n*=5911)	42.9(31.8)	24.8(29.5)	23.1(25.2)	6.21(11.0)
HOLC Grade = D ("Hazardous") (*n*=3464)	33.6(30.5)	32.8(33.2)	25.9(27.6)	5.25(10.1)
Two-way t-test (Grade A Vs. D)	*p*-value < 0.0001	*p*-value < 0.0001	*p*-value < 0.0001	*p*-value = 0.0288

"*n*" designates the row sample size. Race/Ethnicity data is based on 2010 census data

Table 2 Summary Statistics Describing Social Determinants of Health Characteristics by Majority Race/Ethnicity of Census Tracts

	NHW Majority			NHB Majority			Hispanic Majority			Asian Majority		
	Mean	**SD**	*N*	**Mean**	**SD**	*N*	**Mean**	**SD**	*N*	**Mean**	**SD**	*N*
Economic stability												
Share living in poverty	.2	.1	6604	**.3**	.2	2956	**.3**	.1	2447	.2	.1	324
Median HH income	63932.8	32334.5	6600	**34916.4**	17035.6	2955	**41015.5**	14956.5	2447	**57815.9**	21968.6	323
Share with positive W-2 Earnings	.8	.1	6596	**.7**	.0	2955	**.7**	.0	2448	.8	.0	323
Employment rate	.6	.1	6605	**.5**	.1	2955	**.5**	.1	2448	**.5**	.1	324
Neighborhood physical environment												
Eviction filing rate	4.4	6.8	6605	**12.0**	10.4	2957	4.8	6.4	2448	**2.0**	2.9	324
Eviction judgment rate	2.0	3.1	6605	**4.5**	4.0	2957	**1.7**	1.8	2448	**.8**	1.6	324
Avg. rent two-bedrooms	1173.6	500.3	5587	**896.5**	282.5	2405	**1091.4**	265.2	2130	**1410.8**	362.2	276
Share with travel-time less than 15 min to work	.3	.1	6605	**.2**	.1	2956	**.2**	.1	2447	**.1**	.1	324
Avg. commute time to work	26.4	7.8	6604	**32.8**	9.9	2955	**33.3**	7.6	2448	**36.6**	7.8	324
Education												
Share with college degree or more	.4	.2	6604	**.2**	.1	2956	**.1**	.1	2448	**.3**	.1	324
Avg. Std. math test scores in grade=3	3.0	.9	6605	**2.3**	.9	2957	**2.6**	.6	2447	**3.2**	.6	324
Food												
Share low access and income	18.5	17.2	5331	**34.1**	23.5	2194	**20.6**	19.8	1315	**9.7**	11.2	156
Share low access and no car	5.2	6.4	5331	**13.6**	11.8	2194	5.2	7.1	1315	**3.0**	5.6	156
Share low access (1/2 mile)	57.4	32.9	5331	60.0	34.7	2194	**40.3**	33.8	1315	**33.8**	33.1	156
Community and social context												
Probability of reaching top 20% of national income distribution, given parents in 10th percentile of income dist.	14.6	10.1	6596	**7.4**	4.9	2955	**11.2**	5.0	2448	**25.0**	7.4	323
Probability incarcerated, given parents in 10th percentile of income dist.	2.8	3.7	6577	**6.2**	3.8	2953	2.7	3.0	2448	**0.7**	1.7	323
Average annual job growth rate	0.8	6.4	6233	0.7	9.1	2886	**2.0**	8.0	2415	**2.9**	7.2	321
Health care system												
Share uninsured	11.9	4.8	4680	**19.3**	5.8	2633	**26.3**	7.5	2143	**15.4**	4.1	257
Share with annual checkup	68.7	5.0	4680	**76.9**	3.9	2633	67.4	5.1	2143	**71.2**	3.7	257
Share with dental visit	67.2	10.5	4680	**50.2**	10.2	2633	**50.6**	9.1	2143	**59.1**	8.8	257
Share with cholesterol screening	78.8	6.6	4680	**80.0**	5.0	2633	**76.8**	4.4	2143	**81.0**	3.4	257
Share with colon screening	65.2	7.3	4680	**57.9**	7.0	2633	**52.4**	6.6	2143	**55.9**	6.8	257
Share with mammography screening	79.1	3.1	4680	**82.5**	2.4	2633	**78.7**	2.7	2143	**76.6**	2.2	257

Race/Ethnicity data is based on 2010 census data. Bold entries denote means that are significantly different at *p*<0.01 level from that of the reference group (NHW)

relative to the NHW majority column mean values. Results indicate that there exist significant differences across census tracts with different racial/ethnic majority populations related to all six SDOH domains. Additionally, apart from medical checkups, results for NHB and Hispanic majority census tracts have consistently worse outcomes than do NHW majority census tracts when it comes to the domains of economic stability, neighborhood physical environment, education, food, community and social context, and the health care system as it pertains to the share of uninsured residents.

Association Between Historic Redlining and Present-Day Home Evictions and Food Insecurity

Table 3 presents summary statistics across home eviction and food insecurity measures stratified by each census tracts' historic HOLC rating. Present-day eviction filings and eviction judgment rates are significantly higher within historically redlined areas when compared to areas with a historic

grade of "A." Proportion of residents with low access to a supermarket and low income is significantly higher in historically redlined areas. Similarly, those with low access to a supermarket and low vehicle access are also significantly more prevalent within historically redlined areas. However, food insecurity assessed purely on a geographic distance basis (i.e., as the distance to a supermarket) is lower within historically redlined areas.

Table 4 provides results of adjusted regression models. Compared to areas with a historic HOLC grading of "A," areas with a "D" grading had a 2.59 (95%CI=1.99–3.19; *p*-value<0.01) higher rate of eviction filings, and a 1.03 (95%CI=0.80–1.27; *p*-value<0.01) higher rate of eviction judgments. We also find that relative to areas with a historic HOLC grading of "A," those rated with a "D" had a 16.20 (95%CI=15.02–17.79; *p*-value<0.01) higher rate of food insecurity based on supermarket access and income, and a 6.15 (95%CI =5.53–6.76; *p*-value<0.01) higher rate of food insecurity based on supermarket access and car ownership. The reverse relationship was observed when food insecurity

Table 3 Summary Statistics for Eviction Measures and Food Insecurity Measures, Across Historic HOLC Grading A Through D

	(A) Eviction measures		(B) Food insecurity measures		
	Eviction filing rate Mean(SD)	Eviction judgment rate Mean(SD)	Low access low income Mean(SD)	Low access low car ownership Mean(SD)	Low access Mean(SD)
HOLC Grade = A ("Best") (nA=588; nB=553)	4.7(7.5)	2.0(3.0)	12.5(11.9)	3.6(4.5)	61.6(30.4)
HOLC Grade = B ("Still Desirable") (nA=2371; nB=1912)	5.6(7.1)	2.2(2.6)	17.1(16.6)	5.1(6.4)	55.6(32.9)
HOLC Grade = C ("Definitely Declining") (nA=5911; nB=4229)	6.3(8.5)	2.6(3.5)	23.1(20.2)	7.1(8.4)	54.2(34.1)
HOLC Grade = D ("Hazardous") (nA=3464;nB=2302)	6.8(8.9)	2.7(3.4)	28.1(23.1)	9.9(11.3)	54.96(36.1)
Two-way t-test (Grade A Vs. D)	*p*-value < 0.0001	*p*-value < 0.0001	*p*-value < 0.0001	*p*-value < 0.0001	*p*-value = 0.0001

"nA" designates the row sample size for the Eviction Measures; "nB" designates the row sample size for the Food Insecurity Measures

Table 4 Regression Model Estimates of Eviction Rates and Food Insecurity

	(A) Eviction measures		(B) Food insecurity measures		
	(1)	(2)	(3)	(4)	(5)
	Eviction filing rate	Eviction judgment rate	Low access low income	Low access low car ownership	Low access
HOLC Grade = A (REF) ("Best")					
HOLC Grade = B ("Still Desirable")	1.17***	0.48***	6.23***	1.67***	−5.44***
	(0.58–1.76)	(0.26–0.71)	(4.95–7.50)	(1.16–2.18)	(−8.34 to −2.55)
HOLC Grade = C ("Definitely Declining")	2.09***	0.94***	12.45***	3.90***	−7.37***
	(1.51–2.67)	(0.71–1.17)	(11.22–13.68)	(3.40–4.41)	(−10.10 to −4.63)
HOLC Grade = D ("Hazardous")	2.59***	1.03***	16.40***	6.15***	−6.70***
	(1.99–3.19)	(0.80–1.27)	(15.02–17.79)	(5.53–6.76)	(−9.62 to −3.78)
Observations	12,334	12,334	8996	8996	8996
R-squared	0.41	0.39	0.30	0.19	0.17
Controls	X	X	X	X	X
County FEs	X	X	X	X	X

Beta coefficient estimates, along with robust 95% confidence intervals (within parentheses) are reported. Statistical significance is denoted as ***p<0.01. Controls include tract population and urban/rural status

was assessed solely based on supermarket access. Across the three different food insecurity measures, we also note that the coefficient of variation is the highest for the measure based on supermarket access and income.

Supplementary Appendix Table S1 shows the summary statistics for the full pooled sample while Supplementary Appendix Table S2 shows the census tracts per state for eviction and food insecurity samples.

DISCUSSION

This study highlights the lasting influence of historic redlining on present-day public health. Using a nationally constructed dataset of 213 counties across 37 states, we found that areas historically marked as "hazardous" (or redlined) are disproportionately inhabited by racial/ethnic minorities. These same historically redlined neighborhoods rank

consistently worse all across SDOH domains. These findings are in line with prior work that has documented associations between historic redlining and present day socioeconomic and health outcomes.[1, 12, 20, 21] Our results additionally present new evidence linking historic redlining to present-day housing insecurity and food insecurity. Historically redlined census tracts have significantly higher present-day rates of eviction filings and judgments. This is an important novel finding that contributes to prior literature that has documented racial/ethnic disparities across both housing insecurity and evictions.[8, 15] Our results also show that the prevalence of food insecurity remains significantly higher within historically redlined tracts whether using supermarket access and income, or supermarket access and vehicle access.

While our food insecurity results do not appear to be driven by geographic proximity to supermarkets, but rather by a lack of economic resources in terms of income and vehicle ownership, we caution against drawing strong conclusions based on this observation. The reason for this is multifaceted. First, it is possible that residents within historically redlined areas (on average) live closer to a supermarket, but that the actual travel time (based on the urban environment of many of these locations) is still longer, or that these supermarkets are not generally accessible on foot. Second, proximity to a supermarket is not the same as proximity to a supermarket with affordable food prices. As such, measures of food insecurity based on distance alone may mask important nuances related to travel time, travel accessibility, and food price affordability, which may render certain outlets non-viable shopping options for poor populations. A closer examination of these possibilities appears to represent important avenues for future work; however, our results still provide an important contribution to the literature on food insecurity, and recent work seeking to examine associations between state-level food insecurity and structural racism using alternative operationalization measures.[6]

In summary, our findings contribute to research on the long-standing adverse effects of historic structural racism upon present-day housing and food insecurity. In so doing, our findings hold important implications for present day housing and food insecurity policies. Given the relationship between historic redlining and evictions, we may expect the lifting of COVID-19-related housing moratoria to disproportionately affect residents within historically redlined areas, and therethrough to disproportionately affect communities of color.[18] Thus, in the absence of additional safety nets/supports for renters, the removal of housing moratoria may act to further perpetuate structural inequalities within the housing/renters' markets. Second, our findings indicate that policies that seek to reduce food insecurity by targeting poverty and/or transportation barriers may benefit individuals residing within historically redlined communities. Such programs may act to reduce food insecurity broadly via food/income supplementation and provision of accessible public transportation options,[4, 16] while

also decreasing disparities from historic redlining. Finally, the importance of poverty and access to transportation (as opposed to only the geographic proximity of supermarkets) supports development and testing of new interventions to decrease food insecurity. Future work is needed to examine how access by neighborhoods varies once public transportation options/times are assessed, and furthermore, how interventions such as subsidized grocery delivery services may help ameliorate access barriers.

Study Limitations

First, this study utilized an observational study design, and as such, results should be interpreted as indicative of associations rather than as causal effects. Second, our study was performed at an ecological level of analysis (at the census tract level), and as such, results may not necessarily generalize to specific individuals who reside within these areas. Third, while all our present-day census tract measures are based on data that is considerably more recent than our HOLC data, these measures are not all based on data from the same calendar year. While year-to-year variation within these measures is likely to be modest, and therefore unlikely to bias results, we note this feature of our data. Fourth, mapping of historic HOLC maps into present-day census tracts is imperfect; however, we tested several alternative Grade rating scores to ensure robustness of our findings. Within this study we used a categorical HOLC rating that was constructed based on each census tract's intersections with historic HOLC areas. Using an alternative continuous Grade score measure based on these intersections yields similar results, as does the use of broader HOLC categories that group A and B, and C and D, regions together. Fifth, we acknowledge that the long temporal lag between our HOLC Grade ratings and our other measures requires caution in attributing reported associations in full to the event of historic redlining. However, recent work has reported great persistency (and consistency) within the association of historic HOLC Grade ratings and health outcomes when assessed across a longer time period of 25 years (between 1990 and 2014).[20] Finally, measures are based on currently agreed upon definitions and results could differ if changed. For example, our access measure is based on standard proximity measure of living within ½ mile of a supermarket. This definition may overstate true accessibility in communities where public transportation, for example, makes it problematic to access even geographically proximate locations for the purpose of food consumption.

CONCLUSION

This study highlights the long-lasting associations between structural racism defined as historic redlining and present-day SDOH, including home evictions and food insecurity. Additionally, these finding suggests that those with

long-lasting exposure to structural inequities may be at greatest risk of evictions as COVID-19-related moratoria are lifted, and that future work to address disparities in food insecurity should focus on interventions that address underlying poverty and transportation barriers.

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