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Brief Report

Shifting US Patterns of COVID-19 Mortality by Race and Ethnicity From June–December 2020

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ABSTRACT

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Objectives: The COVID-19 pandemic has disproportionately affected racial and ethnic minorities in the United States and has been devastating for residents of nursing homes (NHs). However, evidence on racial and ethnic disparities in COVID-19–related mortality rates within NHs and how that has changed over time has been limited. This study examines the impact of a high proportion of minority residents in NHs on COVID-19–related mortality rates over a 30-week period.

Design: Longitudinal study.

Setting and Participants: Centers for Medicare & Medicaid Services Nursing Home COVID-19 Public Use File data from 50 states from June 1, 2020, to December 27, 2020.

Methods: We linked data from 11,718 NHs to (1) Nursing Home Compare data, (2) the Long-Term Care: Facts on Care in the U.S., and (3) US county-level data on COVID cases and deaths. Our primary independent variable was proportion of minority residents (blacks and Hispanics) in NHs and its association with mortality rate over time.

Results: During the first 6 weeks from June 1, 2020, NHs with a higher proportion of black residents reported more COVID-19 deaths per 1000 followed by NHs with a higher proportion of Hispanic residents. Between 7 and 12 weeks, NHs with a higher proportion of Hispanic residents reported more deaths per 1000, followed by NHs with a higher proportion of black residents. However, after 23 weeks (mid-November 2020), NHs serving a higher proportion of white residents reported more deaths per 1000 than NHs serving a high proportion of black and Hispanic residents.

Conclusions and Implications: The disparities in COVID-19–related mortality for nursing homes serving minority residents is evident for the first 12 weeks of our study period. Policy interventions and the equitable distribution of vaccine are required to mitigate the impact of systemic racial injustice on health outcomes of people of color residing in NHs.

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In the United States, the COVID-19 epidemic has disproportionately affected older people residing in skilled nursing facilities and long-term nursing homes (NHs).[1,2] A previous study reported approximately 40% of COVID-19–related deaths among NH residents.[1] Although the impact of COVID-19 on NHs was evident earlier in the year, information regarding COVID-19 cases and deaths was not required to be reported by the federal government until May 17, 2020. However, some states opted not to publicly report this information, leading to a knowledge gap for patients, families, and policy makers.[3] Although studies have reported that communities of color have experienced disproportionate effects of COVID-19,[4,5] these studies have used cross-sectional data. There is limited information about association of COVID-19 mortality rate with the proportion of racial- and ethnic-minority groups within NHs over time.[2,3,5,6] Therefore, using the Centers for Medicare & Medicaid Services (CMS) Nursing Home COVID-19 public data reported to the National Healthcare Safety Network System (NHSNS), we examined the effect of racial composition in NHs and its association with COVID-19–related mortality rate longitudinally from June to December 2020.

Methods

Data and Variables

We linked data from 4 different sources: (1) COVID-19 Public Files from CMS; (2) Nursing Home Compare data; (3) Long-Term Care: Facts on Care in the U.S. (LTCfocus.org); and (4) US county-level data on COVID cases and deaths published by the *New York Times* (compiled from state and local governments and health departments).[7]

The NH COVID-19 Public File provided the COVID-19 mortality rates per 1000 residents.[8] NH reporting of deaths in the initial phase of the COVID-19 pandemic has been characterized as inaccurate. To address this, we excluded the initial reporting period (May 1–May 31, 2020) and focused on the period from June 1 to December 27, 2020. After excluding observations that did not pass CMS's quality assurance check and observations with missing data on covariates, our final sample was composed of 345,954 observations from 11,718 NHs measured over a span of 30 weeks. Our study sample is an unbalanced panel data structure where 97% of NHs in our final sample had data for at least 28 weeks and 9397 NHs had data for all 30 weeks.

Time invariant covariates

From the CMS Nursing Home Compare website, we obtained NH star ratings, a composite measure of quality rating, staff rating, and health inspection rating.[9] We obtained the percentage of whites, blacks, and Hispanic residents in the NH, facility-level characteristics, and facility acuity index, which captures facility-level case mix from the LTCfocus.org data.[10] We also included the average age of residents and percentage of female residents in the NH. Finally, we adjusted for NH ownership (profit vs nonprofit vs government) and NH's chain affiliation. NH locations were classified into rural or urban based on the 2013 Rural-Urban Continuum Code (RUCC) assigned to their county developed by the US Department of Agriculture.[11]

Time variant covariates

To estimate weekly COVID-19 mortality rates per 1000 NH residents, we also included weekly COVID-19 confirmed cases per 1000 NH residents, occupancy rate at the NH [defined as the (number of occupied beds/numbers of total beds) × 100], any shortage of nursing staff that week, and any supply of surgical masks or gowns that week. Finally, to capture community (county-level) death rates, we retrieved COVID death data from the *New York Times*[7] and county-level

Table 1
Characteristics of Nursing Homes by the Proportion of Race and COVID-19 Deaths in 2020

Nursing Home Characteristics	All (N = 345,954)	Nursing Homes With High Proportion of White (n = 298,485)	Nursing Homes With High Proportion of Blacks (n = 3332)	Nursing Homes With High Proportion of Hispanics (n = 24,137)	P Value
Average COVID-19–related deaths per 1000 residents, mean (SD)	2.6 (14.4)	2.6 (14.4)	2.2 (15.5)	2.4 (13.5)	<.001
Average confirmed COVID-19 cases per 1000 residents, mean (SD)	13.2 (56.8)	13.4 (57.5)	10.9 (50.5)	13.6 (54.5)	<.001
Average county COVID-19 deaths per 1000, mean (SD)	8.3 (70.8)	8.8 (73.0)	7.0 (32.4)	4.3 (70.1)	<.001
Occupancy rate, mean (SD)	71.7 (20.5)	71.9 (20.9)	71.6 (16.1)	69.8 (18.5)	<.001
Acuity index, mean (SD)	12.2 (1.4)	12.1 (1.3)	12.6 (1.5)	12.6 (2.3)	<.001
Average age, mean (SD)	79.6 (6.8)	80.5 (6.2)	73.2 (7.0)	75.4 (9.2)	<.001
Proportion of female, mean (SD)	66.6 (11.8)	68.0 (11.0)	56.5 (12.3)	58.8 (12.8)	<.001
Overall nursing home star rating, %					
1 (low)	18.0	76.6	13.0	10.4	<.001
2 (low)	20.2	83.6	8.1	8.3	
3 (low)	18.0	86.5	6.3	7.2	
4 (high)	21.1	89.9	4.8	5.3	
5 (high)	22.7	92.8	2.7	4.5	
Affiliated with a chain, %					
Yes	60.5	85.7	7.1	7.2	<.001
No	39.5	87.1	6.2	6.7	
Nursing home ownership, %					
For profit	68.9	83.4	8.2	8.4	<.001
Nonprofit	24.6	93.6	3.3	3.1	
Government	6.5	88.9	4.1	7.1	
Nursing home location, %					
Urban	69.5	83.0	8.2	8.8	<.001
Rural	30.5	93.7	3.5	2.8	
Any shortage of nursing staff, %	17.7	88.0	8.4	3.6	<.001
Any supply of surgical masks, %	96.7	86.2	6.8	7.1	<.001
Any supply of gowns, %	97.4	86.2	6.8	7.0	<.001
Any supply of gloves, %	99.3	86.3	6.7	7.0	.012

We only kept observations if they passed quality assurance check as defined by CMS and had no missing data.

population from the Robert Wood Johnson Foundation county health ranking data for 2020.[12,13] We computed the weekly COVID-19 death rate per 1000 for each county. Table 1 reports the descriptive analysis of our study sample.

Statistical Analyses

First, we examined NH characteristics (n = 11,718) by the proportion of minority residents in the NH. We classified NHs into 3 categories: NHs with a high proportion of black residents (proportion of black residents ≥41.2%) and NHs with a high proportion of Hispanic residents (proportion of Hispanic residents ≥13.1%), and the rest were classified as NHs with a high proportion of white residents. The cutoff points for classification were chosen based on the 90th percentile of the variables—"percentage of blacks" and "percentage of Hispanics" obtained from the LTCfocus data. This approach has been used previously to classify majority black or Hispanic NH.[14] Next, we conducted a longitudinal data analysis (repeated measures) in SAS 9.4. (PROC MIXED; SAS Institute Inc, Cary, NC). The Mixed Model was adjusted for all covariates. From the model, we generated weekly adjusted mean COVID-19 mortality rates (per 1000 residents) for NHs with high proportions of white, black, and Hispanic residents.

Results

Figure 1 shows weekly changes in COVID-19 cases and mortality rate over the 30-week study period for all NHs. Of the 11,718 NHs, 797 (6.8%) NHs were categorized as facilities with a high proportion of black residents and 819 (7%) NHs were categorized as facilities with a high proportion of Hispanic residents. In addition, 17% of urban NHs had higher proportions of blacks and Hispanics compared with 6.3% of rural NHs. Residents in NHs with a high concentration of white residents were on average 5-7 years older than residents in NHs with a high concentration of blacks and Hispanics (80.5 years vs 73 and 75 years, respectively). Higher minority-serving NHs also had lower proportions of female residents (56.5% and 58.8%) compared with NHs with majority white residents (68%). There were also differences in the quality of care provided to residents among these NHs, with minority-serving NHs having lower quality ratings compared with white-serving NHs.

Figure 2 shows results from the repeated measures mixed model (full model information is provided in the **Supplementary Tables S1 and S2**). We found that at the beginning of our study period, NHs with a high proportion of blacks had estimated COVID-19 mortality

rates per 1000 NH residents that were significantly higher than NHs with higher proportions of Hispanics and whites (eg, 6.6 deaths compared with 3.8 and 3.4 deaths, respectively, in the first week of June). NHs with a high proportion of Hispanic residents also reported significantly higher COVID mortality rates compared with NHs with majority white residents (eg, 3.7 vs 2.9 deaths respectively in week 2). Mid-July onward (week 7 in our data), there was a shift in trend where NHs with a higher proportion of Hispanic residents had a spike in COVID-19 mortality compared with NHs with a higher proportion of white residents. Overall, for the first 12 weeks of our study period (June-August), we observed higher estimated COVID mortality rates in minority-serving NHs compared with NHs serving white residents. From September 2020 until November 2020 (week 23), the disparity in mortality rates between the 3 groups decreased, and it was not statistically significant for most of these weeks. Mid-November, there was another shift in trend again, and NHs with a high proportion of white residents had increased COVID mortality rates. These NHs reported significantly higher death rates per 1000 residents compared with NHs with higher minority population. The highest mortality rates among NHs with a higher proportion of white residents are in weeks 28 and 29, with average deaths of 6.3 per 1000 residents compared with approximately 3.3 deaths per 1000 in NHs with high proportions of blacks and Hispanics.

Discussion

In this nationally representative study of COVID-19–related deaths in NHs, we found that NHs with a high proportion of black and Hispanic residents had significantly higher COVID-19 mortality rates during the first 12 weeks of the study period. The overall mortality rate decreased in fall 2020, with few differences between higher proportions of black, Hispanic, and white NHs. However, NHs with a high proportion of white residents experienced higher COVID-19 deaths after mid-November 2020 (week 24). Our findings are consistent with a prior study using cross-sectional analysis of nursing home COVID-19 data for a 1-week period from May 25 to May 3, 2020, that highlighted disparities in COVID-19 cases and deaths by a proportion of racial and ethnic minority residents in NHs.[5,15] However, this is the first study to explore weekly COVID-19 deaths among NHs with different proportions of minority residents. We also used multiple quarters to assess mortality rates among NHs.

As COVID-19 emerged and spread across the United States, it became evident early that this pandemic was disproportionately affecting minority communities.[2,16] The Centers for Disease Control
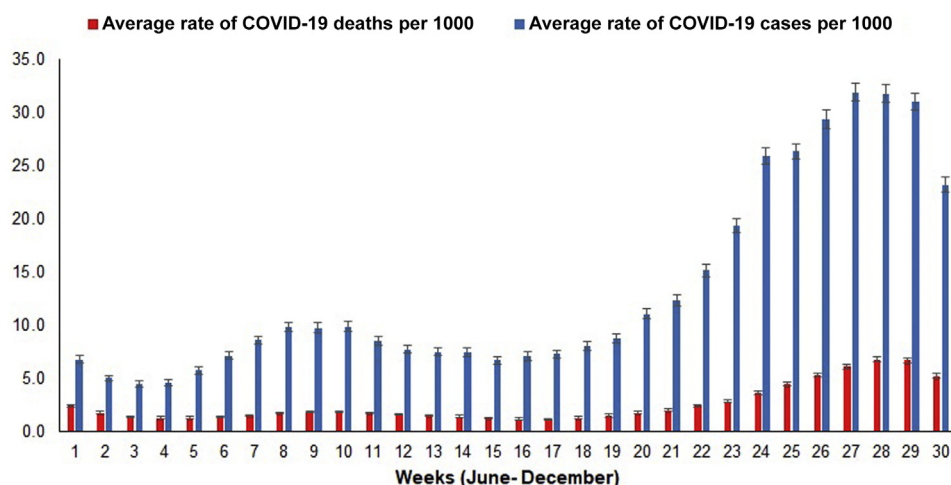

Fig. 1. Patterns in COVID-19 cases and deaths in US nursing homes, 2020.
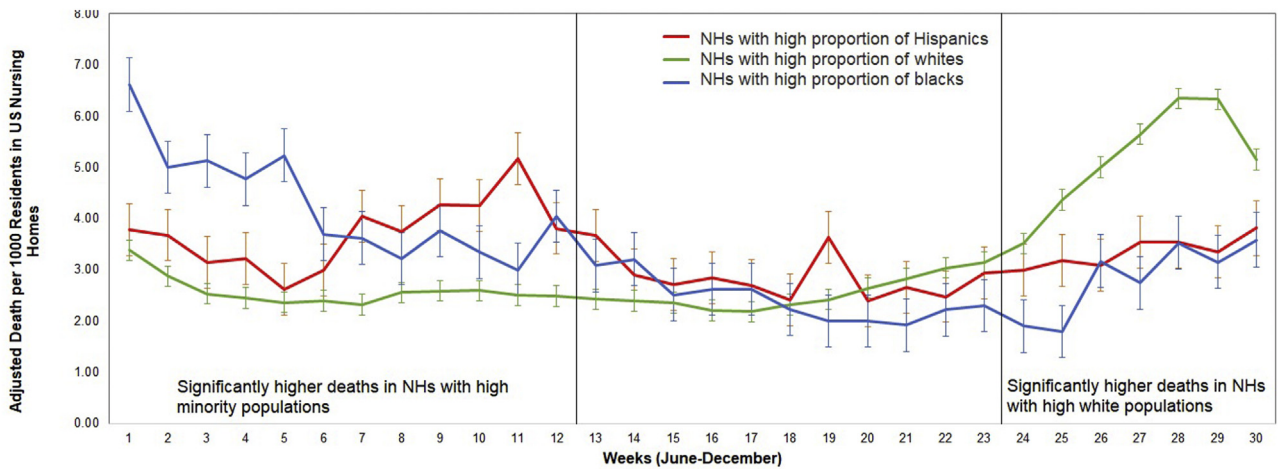
Fig. 2. Predictive marginal effect estimates on COVID-19–related-deaths per 1000 in nursing homes over the week by race and ethnicity. Adjusted for occupancy rate, facility level acuity index, average age at facility, proportion of female residents, facility affiliation, nursing home ownership status, urban or rural location of facility, shortage of nursing staff, availability of personal protective equipment, overall star rating of the facility, and county-level COVID-19 death rate after adjusting for county population.

and Prevention (CDC) identified a few pertinent factors contributing to the increased risk of death from COVID-19 for minorities, including social risk factors, occupational opportunities, housing availability, and financial resources.[17] These inequities appeared to have trickled down into NH in those communities and manifested as COVID-19 impact, disproportionately affecting NHs with a higher proportion of minority residents.

The change in the pattern of COVID-19 deaths among US NHs needs further investigation. The spread of COVID-19 across the United States has not been uniform, and these results may be partially explained by the geographic differences in the timing of COVID-19 outbreak, lockdown, the practice of social or physical distancing, and racial composition of the community. Early in the pandemic, COVID-19 incidence was higher in large metropolitan areas, especially in New York City, Atlanta, Baltimore, Philadelphia, Los Angles, Chicago, Detroit, and New Orleans.[18–21] Black and Hispanic residents tend to represent a higher percentage of the population in NHs located in metropolitan centers.[22,23] Between September and December 2020, COVID-19 incidence increased in the Midwest region, which has many metropolitan areas and a high concentration of NHs.[21,24,25] Also, rural areas saw a stark increase in infection rates during the latter part of fall 2020.[21,25] People living in rural areas tend to be older, white, have higher rates of underlying comorbidities, and have limited access to health care infrastructure such as intensive care units and emergency medical services.[26,27] We posit that the Midwest and rural NH population contributed to the change in the COVID-19 pattern and warrants funding for a more thorough investigation to clarify the contribution of race, geography, comorbidity, and health care access.

COVID-19 has presented new challenges for NHs. Prepandemic NHs were not expected or required to have an oversupply of personal protective equipment (ie, N95 masks) to protect health care workers and/or residents. Although the disparities among NHs were greater at the beginning of the pandemic, further investigation into why NHs with high proportions of white residents reported higher COVID-19–related deaths at the end of the study period is needed. Perhaps these NHs are located in areas where state or local governments implemented different or more restrictive measures. However, current data from the CDC show that mortality in NHs is declining (perhaps due to vaccinations; see Nursing Home Covid-19 Data Dashboard[28]).

Our results should be interpreted with caution while considering several limitations. First, during the initial surveillance period of COVID-19 in NHs, preliminary data may be inaccurate because of reporting errors.[3] However, subsequent reporting periods are rigorously quality checked by CMS and NHSNS.[29] Therefore, we excluded the initial reporting period and focused on the time period of June 1 to December 27, 2020. Second, these are facility-level aggregated data and lack information at the patient-level comorbidities; however, we have adjusted the facility-level acuity index, which captures facility case mix, derived from all NH residents. Third, racial and ethnic minority populations may have low socioeconomic status, which was not accounted for in our study at the patient level. However, we have adjusted for zip code–level education and income.

Conclusion and Implications

Analyses of integrated new national data sets indicate shifting trends regarding COVID-19 mortality rates among NHs with a high proportion of minority residents. NHs have been affected differently throughout the pandemic. CMS should continue to monitor trends in COVID-19 mortality among different NHs, particularly within individual communities and especially in communities with a high proportion of people of color. Finally, future studies should provide information about what measures were taken in NHs to decrease COVID-19–related deaths among their residents.

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Appendix. Shifting US Patterns of COVID-19 Mortality by Race and Ethnicity From June to December 2020

Supplementary Table S1
Description of Longitudinal Study Cohort

Variable	Mean	Standard Deviation
Time-variant variables		
Weekly COVID-19 deaths per 1000		
Overall (N=345,954)	2.57	14.43
Between NHs (n=11,718)		4.42
Within NHs		13.82
Weekly COVID-19 cases per 1000		
Overall (N=345,954)	13.23	56.80
Between NHs (n=11,718)		12.87
Within NHs		53.38
Occupancy rate in NHs		
Overall (N=345,954)	71.70	20.46
Between NHs (n=11,718)		14.49
Within NHs		14.55
County COVID-19 death rate per 1000		
Overall (N=345,954)	8.32	70.82
Between NHs (n=11,718)		67.89
Within NHs		18.60
	Proportion	
Any shortage of nursing staff (0=No, 1=Yes)		
Overall (N=345,954)	17.68	0.38
Between NHs (n=11,718)		0.30
Within NHs		0.24
Any supply of gowns		
Overall (N=345,954)	97.36	0.16
Between NHs (n=11,718)		0.10
Within NHs		0.13
Any supply of gloves		
Overall (N=345,954)	99.27	0.09
Between NHs (n=11,718)		0.03
Within NHs		0.08
Time-invariant variables		
Average age of residents in NHs, y	79.63	6.84
Percentage of female residents in NHs	66.61	11.82
Acuity index	12.17	1.37
Nursing home characteristics (n=11,718)		Proportion
Overall Rating		
High		43.65
Low		56.35
Affiliated with a chain		
Yes		60.36
No		39.64
Ownership		
Nonprofit		24.60
For profit		68.89
Government		6.51

Supplementary Table S2
Output of LS Means and Marginal Effect on COVID-19–Related Deaths per 1000 in NHs Over the Week by Race

NH With Proportion of Race	Week	LS Means Estimates	Standard Error	Pr > |t|
High Black	1	6.617	0.5166	<.0001
High Hispanic	1	3.7859	0.5029	<.0001
High White	1	3.3827	0.2013	<.0001
High Black	2	5.0029	0.5127	<.0001
High Hispanic	2	3.6809	0.5043	<.0001
High White	2	2.8749	0.2027	<.0001
High Black	3	5.1268	0.5126	<.0001
High Hispanic	3	3.152	0.5047	<.0001
High White	3	2.5368	0.2024	<.0001
High Black	4	4.7717	0.512	<.0001
High Hispanic	4	3.2271	0.5039	<.0001
High White	4	2.4491	0.2026	<.0001
High Black	5	5.2343	0.5124	<.0001
High Hispanic	5	2.6234	0.5048	<.0001
High White	5	2.3645	0.2022	<.0001
High Black	6	3.6943	0.5126	<.0001
High Hispanic	6	3.0032	0.5045	<.0001
High White	6	2.401	0.2022	<.0001
High Black	7	3.6233	0.5122	<.0001
High Hispanic	7	4.0432	0.5049	<.0001
High White	7	2.322	0.2012	<.0001
High Black	8	3.2163	0.51	<.0001
High Hispanic	8	3.7432	0.5044	<.0001
High White	8	2.5567	0.2006	<.0001
High Black	9	3.7691	0.5114	<.0001
High Hispanic	9	4.2789	0.5046	<.0001
High White	9	2.593	0.2007	<.0001
High Black	10	3.3453	0.5121	<.0001
High Hispanic	10	4.2549	0.505	<.0001
High White	10	2.5968	0.1998	<.0001
High Black	11	3.0019	0.5115	<.0001
High Hispanic	11	5.1673	0.504	<.0001
High White	11	2.5109	0.1999	<.0001
High Black	12	4.0472	0.5113	<.0001
High Hispanic	12	3.8105	0.5033	<.0001
High White	12	2.4912	0.1999	<.0001
High Black	13	3.085	0.511	<.0001
High Hispanic	13	3.6705	0.5042	<.0001
High White	13	2.4281	0.2009	<.0001
High Black	14	3.2117	0.5114	<.0001
High Hispanic	14	2.9048	0.5042	<.0001
High White	14	2.397	0.2009	<.0001
High Black	15	2.5147	0.5115	<.0001
High Hispanic	15	2.717	0.5044	<.0001
High White	15	2.3555	0.201	<.0001
High Black	16	2.6198	0.5112	<.0001
High Hispanic	16	2.8483	0.5043	<.0001
High White	16	2.2125	0.201	<.0001
High Black	17	2.6177	0.5113	<.0001
High Hispanic	17	2.6992	0.5048	<.0001
High White	17	2.1807	0.201	<.0001
High Black	18	2.2279	0.5125	<.0001
High Hispanic	18	2.4087	0.5042	<.0001
High White	18	2.3238	0.2013	<.0001
High Black	19	2.003	0.5117	<.0001
High Hispanic	19	3.6278	0.5041	<.0001
High White	19	2.4219	0.2011	<.0001
High Black	20	2.0021	0.5122	<.0001
High Hispanic	20	2.4	0.5051	<.0001
High White	20	2.645	0.2013	<.0001
High Black	21	1.9231	0.5129	<.0002
High Hispanic	21	2.6564	0.506	<.0001
High White	21	2.8332	0.2015	<.0001
High Black	22	2.2221	0.5143	<.0001
High Hispanic	22	2.48	0.5055	<.0001
High White	22	3.0392	0.2013	<.0001
High Black	23	2.3029	0.5137	<.0001
High Hispanic	23	2.9476	0.506	<.0001
High White	23	3.142	0.2016	<.0001
High Black	24	1.9021	0.514	<.0002
High Hispanic	24	3.0036	0.5056	<.0001
High White	24	3.5167	0.2014	<.0001
High Black	25	1.7948	0.5145	<.0005

Supplementary Table S2 (*continued*)

NH With Proportion of Race	Week	LS Means Estimates	Standard Error	$Pr > |t|$
High Hispanic	25	3.1857	0.506	<.0001
High White	25	4.3681	0.2018	<.0001
High Black	26	3.1745	0.5189	<.0001
High Hispanic	26	3.0964	0.509	<.0001
High White	26	5.0055	0.2025	<.0001
High Black	27	2.7488	0.5153	<.0001
High Hispanic	27	3.5406	0.5079	<.0001
High White	27	5.6489	0.2019	<.0001
High Black	28	3.5244	0.515	<.0001
High Hispanic	28	3.5444	0.5076	<.0001
High White	28	6.3451	0.202	<.0001
High Black	29	3.1494	0.5149	<.0001
High Hispanic	29	3.3463	0.5065	<.0001
High White	29	6.3304	0.2008	<.0001
High Black	30	3.5832	0.537	<.0001
High Hispanic	30	3.8132	0.5273	<.0001
High White	30	5.15	0.2051	<.0001

LS, least square; NHs, nursing homes.