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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

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). A previous study reported approximately 40% of COVID-19–related deaths among NH residents. 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. Therefore, using the Centers for Medicare & Medicaid Services (CMS) Nursing Home Compare 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).

The NH COVID-19 Public File provided the COVID-19 mortality rates per 1000 residents. 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.

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, %                          | 18.0            | 76.6            | 13.0            | 10.4            | <.001          |
| 1 (low)                                                       | 20.2            | 83.6            | 8.1             | 8.3             | <.001          |
| 2 (low)                                                       | 18.0            | 86.5            | 6.3             | 7.2             | <.001          |
| 3 (low)                                                       | 21.1            | 89.9            | 4.8             | 5.3             | <.001          |
| 4 (high)                                                      | 22.7            | 92.8            | 2.7             | 4.5             | <.001          |
| 5 (high)                                                      | 60.5            | 85.7            | 7.1             | 7.2             | <.001          |
| 6.5 (high)                                                    | 39.5            | 87.1            | 6.2             | 6.7             | <.001          |
| Affiliated with a chain, %                                    | 68.9            | 83.4            | 8.2             | 8.4             | <.001          |
| No                                                           | 24.6            | 93.6            | 3.3             | 3.1             | <.001          |
| Government                                                   | 4.5             | 88.9            | 4.1             | 7.1             | <.001          |
| Nursing home location, %                                     | 30.5            | 93.7            | 3.5             | 2.8             | <.001          |
| 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             | <.001          |

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.\textsuperscript{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 previously used to classify majority black or Hispanic NH.\textsuperscript{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% vs 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.\textsuperscript{3,15} 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.\textsuperscript{2,16} The Centers for Disease Control
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. 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 Angeles, Chicago, Detroit, and New Orleans. Between September and December 2020, COVID-19 incidence increased in the Midwest region, which has many metropolitan areas and a high concentration of NHs. Also, rural areas saw a stark increase in infection rates during the latter part of fall 2020. 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. 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). 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. However, subsequent reporting periods are rigorously quality checked by CMS and NHSNS. 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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### 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 | 56.61 | 11.82 |
| Acuity index | 12.17 | 1.37 |
| **Nursing home characteristics (n=11,718)** | | |
| 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    | 3.8327             | 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              | 0.51           | <.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         | <.0001|   |
| 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   | 2.4                | 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          | <.0001|   |
| High Hispanic              | 24   | 3.0036             | 0.5056         | <.0001|   |
| High White                 | 24   | 3.5167             | 0.2014         | <.0001|   |
| High Black                 | 25   | 1.7948             | 0.5145         | <.0005|   |

(continued on next page)
| 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   | 5.0035             | 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.