


Original Article

Trends in racial and ethnic disparities in coronavirus disease 2019 (COVID-19) outcomes among nursing home residents

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Abstract

Objectives: To evaluate trends in racial and ethnic disparities in weekly cumulative rates of coronavirus disease 2019 (COVID-19) cases and deaths in Connecticut nursing homes.

Design: Longitudinal analysis of nursing-home COVID-19 reports and other databases. Multivariable negative binomial models were used to estimate disparities in COVID-19 incidence and fatality rates across nursing-home groups with varying proportions of racial and ethnic minority residents, defined as low-, medium-, medium-high-, and high-proportion groups. Trends in such disparities were estimated from week 1 (April 13) to week 10 (ending on June 19, 2020).

Setting: The study was conducted across 211 nursing homes.

Results: The average number of cases ranged from 6.1 cases per facility for the low-proportion group to 11.7 cases per facility for the high-proportion group in week 1, and from 26.7 to 58.5 cases per facility in week 10. Compared to the low-proportion group, the adjusted incidence rate ratios (IRRs) for the high-proportion group were 1.18 (95% confidence interval [CI], 0.77–1.80; $P > .10$) in week 1 and 1.54 (95% CI, 1.05–2.25; $P < .05$) in week 10, showing a 30% (95% CI, 5%–62%) relative increase ($P < .05$). The average weekly number of COVID-19–related deaths ranged from 0 to 0.3 deaths per facility for different groups in week 1, and from 7.6 to 13.3 deaths per facility in week 10. Adjusted disparities in fatalities similarly increased over time.

Conclusions: Connecticut nursing homes caring for predominately racial and ethnic minority residents tended to have higher COVID-19 incidence and fatality rates. These across-facility disparities increased during the early periods of the pandemic.

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The coronavirus disease 2019 (COVID-19) pandemic poses a disproportionate threat to residents of long-term care (LTC) facilities such as nursing homes and assisted living communities.^{1–6} Severe acute respiratory coronavirus virus 2 (SARS-CoV-2) was known to be present in almost all of the >15,500 nursing homes in the United States. By October 14, >537,000 COVID-19 cases and 84,000 related deaths were reported in LTC facilities, representing 8% of all COVID-19 cases and 40% of COVID-19 deaths.⁷

Compelling evidence indicates that racial and ethnic minority persons are at higher risk of COVID-19 infection, hospitalization, and death, compared to non-Hispanic white individuals.^{8–11} A study by the Kaiser Family Foundation¹¹ analyzed the electronic health records of 50 million patients and found that although little difference existed in testing rates by race and ethnicity, black, Hispanic, and Asian patients were 2–3 times as likely to test

positive for SARS-CoV-2 and were at least twice as likely as white patients to be hospitalized and die due to COVID-19.

Several reports suggest similar racial and ethnic disparities in COVID-19 morbidity and mortality among LTC residents.^{2,3,12–14} In a national study of nursing homes, Li et al¹⁴ revealed that COVID-19 cases and deaths per facility were 2–4 times as high in nursing homes with the highest proportions of racial and ethnic minority residents as in nursing homes with low proportions.

The disparities reported in these early studies are rather disturbing and have to be addressed at the system level. Despite recent government efforts to ameliorate coronavirus transmission and associated health inequity,¹⁵ whether such disparities might be improved (or exacerbated) over time as the COVID-19 crisis continues remains unknown. To date, research has focused on cross-sectional analyses of disparities, offering no insight into the longitudinal trend of these disparities.

Connecticut is among the few states that have reported weekly counts of COVID-19 cases and deaths in nursing homes beginning in early April 2020.² We analyzed these reports and tracked disparities between nursing homes with higher proportions of racial and ethnic minorities and those with lower proportions during a 10-week period from April to late June.

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Methods

Data sources

The Connecticut Department of Health and Human Services first publicly reported cumulative numbers of laboratory-confirmed COVID-19 cases and associated deaths among residents in every Connecticut nursing home on April 13, 2020. These numbers were updated on a weekly basis until June 19, 2020 (<https://data.ct.gov/Health-and-Human-Services/Nursing-Homes-with-Residents-Positive-for-COVID-19/wyn3-qphu>), after which the state public reporting was discontinued due to the national COVID-19 nursing-home reports initiated by the Centers for Medicare and Medicaid Services (CMS).¹⁴

We assembled a longitudinal nursing-home database based on the weekly state reports and linked the data (1) to the Nursing Home Compare (NHC) files (updated on March 31, 2020) to obtain nursing home covariates;¹⁶ (2) to the LTCFocus file created by the Brown University for additional nursing home characteristics; (3) to the Area Healthcare Resource File (<https://data.hrsa.gov/topics/health-workforce/ahrf>) for key county covariates; and (4) to numbers of lab-confirmed COVID-19 cases and deaths in Connecticut counties from the national database published by the *New York Times* (<https://github.com/nytimes/covid-19-data>). These numbers have been compiled and updated in real time by the *Times* based on reports from state and local public health agencies since the first reported coronavirus case in Snohomish County, Washington, on January 20, 2020.¹⁷

Variables

The dependent variables were the weekly cumulative numbers of COVID-19 laboratory-confirmed cases and deaths among residents in each nursing home for the 10 weeks from April 13 to June 19. The independent variable was percentage of racial and ethnic minority residents (ie, African Americans, Hispanics, Asians or Pacific Islanders, and American Indians or Alaskan Natives) in the nursing home (obtained from the LTCFocus file). Similar to a recent study,¹⁴ we categorized Connecticut nursing homes into quartiles of concentration of racial and ethnic minority residents to capture possible nonlinear associations it has with COVID-19 outcomes as follows: nursing homes with low proportions of racial and ethnic minority residents (<2.70%, the 25th percentile), medium proportions (2.70%–8.95%, the median), medium-high proportions (8.95%–21.70%, the 75th percentile), and high proportions (\geq 21.70%).

Nursing home covariates included number of beds, average daily resident census, for-profit ownership (yes or no), chain affiliation (yes or no), percentage of Medicare residents, percentage of Medicaid residents, average staffing levels (hours per resident day) for registered nurse and for all nursing staff (including registered nurse, licensed practical nurse, and certified nursing assistant) in 2019, and total number of healthcare deficiency citations received by the nursing home in 2019. Registered nurse and other nurse staffing levels were calculated based on daily resident census and the CMS Payroll-Based Journal system that nursing homes are required to use to electronically track and submit paid work hours for agency and contract staff each day. The payroll-based data are submitted quarterly and audited by the CMS to ensure accuracy.¹⁸ We further defined a variable for facility-level case mix that was calculated by averaging the acuity scores of all residents in the facility, with a higher value indicating greater average acuity.

County-level covariates included (1) the total number of COVID-19–confirmed cases as of June 11, 2020, less nursing-home confirmed cases; (2) the total number of COVID-19 deaths as of June 11 in the county, less nursing home deaths; and (3) the county population size.

Statistical analyses

We compared differences in nursing-home and county characteristics by nursing-home quartile groups of racial compositions. Analyses of variance for continuous variables and χ^2 tests for categorical variables were used in statistical inference. We also plotted trends in mean numbers of nursing-home COVID-19–confirmed cases and deaths by quartile groups.

In multivariable analyses, we first fit 2 separate random-effects negative binomial models for cumulative counts of COVID-19 cases and deaths,¹⁹ with the unit of observation being a nursing-home week. The models included 3 indicators for medium, medium-high, and high minority groups (with the group of low proportions of racial and ethnic minorities as reference); a continuous variable for week (1–10); its squared term; and interactions of nursing home minority groups with the linear and squared terms for time trend. We fit 2 more random-effects negative binomial models that were specified in the same way but further adjusted for nursing home and county covariates. Negative binomial regression is a common method used to model the number of occurrences (counts) of an event that can be assumed to follow a Poisson-like process but with the variation being greater than that of a true Poisson process (ie, overdispersion).¹⁹ The negative binomial models we fit explicitly estimated the overdispersion of event occurrence, and used nursing-home random effects to account for the repeated measures of nursing home outcomes over the 10-week period. In other words, the random effects addressed the issue that nursing home outcomes over time are not independent observations. After model fit, we performed linear combination tests to determine disparities across nursing home groups in week 1 and week 10, as well as changes in adjusted disparities from week 1 to week 10.

Results

Our sample included 211 of the 215 nursing homes in Connecticut, with 4 nursing homes being excluded due to missing data on the composition of racial and ethnic minority residents. Table 1 shows that nursing homes with higher proportions of minority residents tended to be larger, for-profit, and chain facilities serving a higher proportion of Medicaid residents. These facilities also tended to have fewer nurse staffing hours and more deficiencies in care, and to be located in counties with more COVID-19 cases and deaths as well as larger population size.

The weekly cumulative number of confirmed cases was higher for nursing homes with more minority residents and these disparities increased over time (Fig. 1, panel A, and Table 2). For example, in week 1, the average cumulative numbers were 6.1 cases per facility among nursing homes with low proportions of minority residents and 11.7 cases per facility among nursing homes with high proportions (disparity, 5.6 cases per facility). In week 10, the corresponding numbers increased to 26.7 and 58.5 cases per facility (disparity, 31.8 cases per facility). Multivariable negative binomial regression revealed higher COVID-19 incidence rate among minority-concentrated nursing homes, which persisted

Table 1. Connecticut Nursing Home and County Characteristics by Nursing Home Quartile Groups of Proportion of Racial and Ethnic Minority Residents

Nursing Home Characteristic	Nursing Homes by Proportion of Racial and Ethnic Minority Residents ^a				
	All Nursing Homes (n=211)	Low (<2.70%), (n=50)	Medium (2.70%–8.95%) (n=56)	Medium-High (8.95%–21.7%), (n=53)	High (≥21.7%), (n=52)
% of racial and ethnic minority residents, mean ± SD	14.7 ± 15.6	1.0 ± 0.9	5.3 ± 2.0	14.6 ± 3.6	38.0 ± 12.4
Total no. of beds, mean ± SD	120.4 ± 58.6	96.0 ± 56.0	117.8 ± 51.1	122.2 ± 54.6	144.6 ± 62.6
No. of residents, mean ± SD	103.7 ± 50.3	87.7 ± 50.0	101.9 ± 44.8	103.3 ± 47.1	121.0 ± 53.8
For-profit ownership, no. (%)	176 (83.4)	32 (64.0)	45 (80.4)	48 (90.6)	51 (98.1)
Chain affiliated, no. (%)	109 (51.7)	18 (36.0)	29 (51.8)	28 (52.8)	34 (65.4)
% of Medicaid residents, mean ± SD	64.6 ± 21.1	56.5 ± 25.1	60.5 ± 17.7	64.3 ± 22.3	77.2 ± 11.2
% of Medicare residents, mean ± SD	15.0 ± 11.4	15.6 ± 10.5	17.0 ± 13.3	15.6 ± 12.5	11.4 ± 7.7
Case mix index score, mean ± SD	1.1 ± 0.1	1.2 ± 0.1	1.1 ± 0.1	1.1 ± 0.1	1.1 ± 0.1
Adj. RN hours per resident day, mean ± SD	0.8 ± 0.5	1.1 ± 0.8	0.9 ± 0.3	0.8 ± 0.3	0.7 ± 0.2
Adj. total nurse hours per resident day, mean ± SD	3.9 ± 0.8	4.2 ± 1.2	3.9 ± 0.6	3.9 ± 0.5	3.7 ± 0.5
No. of healthcare deficiencies, mean ± SD	7.0 ± 4.9	4.9 ± 3.0	6.3 ± 5.0	7.9 ± 4.6	8.9 ± 5.5
County characteristic, mean ± SD					
Total no. of COVID-19 cases as of June 11, ×1,000	9.2 ± 5.4	7.6 ± 5.7	8.3 ± 5.8	9.7.9 ± 5.3	11.1 ± 4.2
Total no. of COVID-19 deaths as of June 11, ×1,000	0.8 ± 0.5	0.7 ± 0.5	0.8 ± 0.5	0.9 ± 0.5	1.1 ± 0.4
Total population, ×100,000	7.0 ± 3.2	6.0 ± 3.6	6.5 ± 3.4	7.2 ± 3.0	8.2 ± 2.2

Note. SD, standard deviation; RN, registered nurse.

^aAll *P* values were <.01 for comparisons of group differences based on analyses of variance for continuous variables, and χ^2 tests for categorical variables.

after adjustment for nursing home and county covariates and increased over time (Table 2). Compared to nursing homes with low proportions of minorities, the adjusted incidence rate ratios (IRRs) for facilities with medium proportions of minorities were 0.75 (95% confidence interval [CI], 0.49–1.13; *P* > .10) in week 1 and 1.34 in week 10 (95% CI, 0.95–1.90; *P* < .10), representing an 80% (95% CI, 40%–131%; *P* < .001) relative increase in adjusted IRR (or disparity) from week 1 to week 10. Similarly, the adjusted IRRs for nursing homes with medium-high proportions of minorities were 1.73 (95% CI, 1.13–2.65; *P* < .05) in week 1 and 1.92 (95% CI, 1.31–2.81; *P* < .001) in week 10, showing an 11% (95% CI, –10% to 37%; *P* > .10) relative increase in disparity. The adjusted IRRs for nursing homes with high proportions of minorities were 1.18 (95% CI, 0.77–1.80; *P* > .10) in week 1 and 1.54 (95% CI, 1.05–2.25; *P* < .001) in week 10, showing a 30% (95% CI, 5%–62%; *P* < .05) relative increase in disparity.

The weekly cumulative number of COVID-19–related deaths was also higher for nursing homes more predominated by minorities, and these disparities increased over time (Fig. 1, panel B, and Table 3). In week 1, the average numbers were 0 deaths per facility among nursing homes with low proportions of minority residents and 0.3 deaths per facility among nursing homes with high proportions (disparity, 0.3 deaths per facility). In week 10, these numbers increased to 7.6 and 13.3 cases per facility, respectively (disparity, 5.7 deaths per facility). Multivariable negative binomial regression further revealed higher COVID-19 death rates among minority-concentrated nursing homes, which persisted after adjustment for nursing home and county covariates and increased over time (Table 3). For example, compared to nursing homes with low

proportions of minority residents, the adjusted IRRs for nursing homes with high proportions increased from 1.73 (95% CI, 0.75–3.98; *P* > .10) in week 1 to 2.17 (95% CI, 1.02–4.65; *P* < .05) in week 10, showing a 26% (95% CI, –4% to 65%; *P* < .10) relative increase in disparity.

Discussion

During the 10-week period from April 13 to June 19, 2000, Connecticut nursing homes caring for higher proportions of racial and ethnic minority residents tended to have more weekly COVID-19–confirmed cases and deaths. These across-facility disparities persisted after adjustment for nursing home and county covariates and were exacerbated over time. Adjusted disparities between nursing homes with high and low proportions of minorities increased by 25%–30% from week 1 to week 10. In week 10, the COVID-19 incidence rate was 54% higher, and the fatality rate was 117% higher, in nursing homes with high proportions of minority residents than in nursing homes with low proportions.

Our findings support a recent study reporting substantial racial and ethnic disparities across US nursing homes in new COVID-19 cases and deaths in the week of May 25, 2020.¹⁴ However, the federally reported nursing-home COVID-19 data used by that study were not available until the last week of May, which has prevented researchers from evaluating nursing home COVID-19 outcomes during early periods of the pandemic. Taking advantage of the early reports available in Connecticut, we were able to track the trend in cumulative counts and in cross-facility disparities since early April when COVID-19 started to emerge in Connecticut

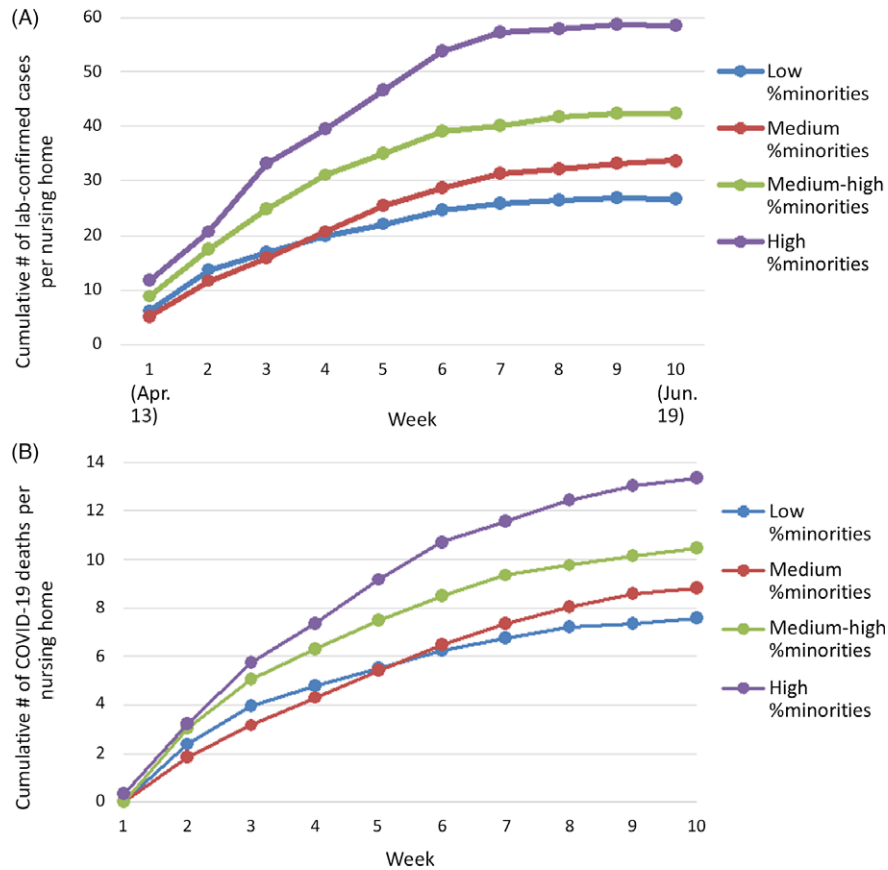


Fig. 1. Mean cumulative numbers of (A) laboratory-confirmed COVID-19 cases and (B) COVID-19-related deaths among residents per nursing home, by nursing home groups with different percentages of racial and ethnic minority residents and from April 13, 2020 (week 1) to June 19, 2020 (end of week 10) in Connecticut.

nursing homes. The increasing racial and ethnic disparities in COVID-19 outcomes documented in our study can serve as an important benchmark for future studies that continue to track nursing-home COVID-19 outcomes as the pandemic evolves.

Racial and ethnic disparities in nursing home outcomes had been widely reported before the COVID-19 pandemic.²⁰⁻²⁴ These disparities are largely due to system-level inequalities and segregation of care in that older residents of color are disproportionately concentrated in facilities that are located in marginalized communities, have limited resources, and provide poor resident care.²¹ In addition, these disparities tended to persist in the past several decades despite evidence of overall improved quality of care in nursing homes due to stronger government regulations and broadly targeted quality-improvement initiatives.^{20,25,26} Unfortunately, these efforts were rarely designed to address the issue of systematic disparities, and concerns have been repeatedly expressed that these color-blind initiatives might sustain or even widen existing racial disparities in nursing home outcomes.

The widened across-facility disparities in COVID-19 morbidity and mortality during the early pandemic period are just another manifestation of the structural inequalities in nursing home care that have existed for decades. Specifically, nursing homes serving disproportionately nonwhite residents tend to be faced with serious resource constraints such as inadequate testing capacities and lack of knowledge of and ability to respond to outbreaks of emerging infections. They also tend to operate within local healthcare systems that are also resource strained and thus easily overwhelmed by the pandemic.¹⁴ Moreover, most direct-care workers

in these facilities are people of color and immigrants²⁷ who have a higher COVID-19 contraction rate than the general population and who tend to work in multiple facilities of a region but without paid sick leave,²⁸ which may also contribute to the disparities across facilities found in this study.

The US Congress passed several acts in early efforts to combat the pandemic. For example, the Coronavirus Aid, Relief, and Economic Security (CARES) Act was enacted on March 27, 2020 to blunt the impact of the economic downturn due to the pandemic through financial aid to businesses, individuals, and healthcare institutions.²⁹ Under the Provider Relief Fund authorized by the CARES Act, the federal government has allocated \$10 billion to nursing homes thus far which has helped all facilities in the nation to address shortages in PPE and staff and to improve testing capacities.³⁰ Moreover, in the wake of the novel coronavirus outbreaks in nursing homes in early March, the CMS, in coordination with state agencies and the Centers for Disease Control and Prevention, has immediately refocused inspections of nursing homes on compliance with infection control policies,³¹ and the CMS released a series of guidelines and rules, such as visitor restrictions and cohorting of residents,^{32,33} to combat the surge of COVID-19 infections and deaths in LTC facilities. More recently, the Paycheck Protection Program and Health Care Enhancement Act, passed on April 24, requires the Department of Health and Human Services to report COVID-19 data by race and ethnicity and to develop a strategic testing plan to address disparities.³⁴

Table 2. Trend in Racial and Ethnic Disparities in Cumulative Incidence Rate of Laboratory-Confirmed COVID-19 Cases Across Connecticut Nursing Homes from April 13, 2020 (Week 1) to June 19, 2020 (End of Week 10)

Proportion of Racial & Ethnic Minority Residents in Nursing Home	Cumulative No. of COVID-19 Cases per Nursing Home, Mean, Median (IQR)		Unadjusted Disparity in Incidence Rate, IRR (95% CI) ^c		Adjusted Disparity in Incidence Rate ^d		Relative Increase in Adjusted Disparity from Week 1 to Week 10, % (95% CI)
	Week 1 ^a	Week 10 ^b	Week 1	Week 10	Week 1	Week 10	
					IRR (95% CI)		
Low	6.1, 0 (0–11)	26.7, 3 (0–52)	... ^e	... ^e	... ^e	... ^e	... ^e
Medium	5.1, 0 (0–7.5)	33.6, 30 (1–59)	0.85 (0.57–1.27)	1.36 [^] (0.97–1.91)	0.75 (0.49–1.13)	1.34 [^] (0.95–1.90)	80%*** (40%–131%)
Medium–high	8.8, 2 (0–12)	42.3, 46 (3–66)	1.76** (1.19–2.60)	1.96*** (1.40–2.76)	1.73* (1.13–2.65)	1.92*** (1.31–2.81)	11% (–10% to 37%)
High	11.7, 7.5 (0–17.5)	58.5, 62.5 (23–84.5)	1.18 (0.81–1.71)	1.49* (1.08–2.06)	1.18 (0.77–1.80)	1.54* (1.05–2.25)	30%* (5%–62%)

Note. IQR, interquartile range; IRR, incidence rate ratio; CI, confidence interval.

^aCumulative number of cases as of April 13 (beginning of week 1).

^bCumulative number of cases as of June 19 (end of week 10).

^cNegative binomial model included nursing home random effects, overall linear and nonlinear time trend, disparities, and trend in disparities.

^dNegative binomial model included nursing home random effects, overall linear and nonlinear time trend, disparities, and trend in disparities, and adjusted for nursing home and county characteristics listed in Table 1.

^eReference group.

[^] $P < .10$; * $P < .05$; ** $P < .01$; and *** $P < .001$.

Table 3. Trend in Racial and Ethnic Disparities in Cumulative Incidence Rate of COVID-19 Related Deaths Across Connecticut Nursing Homes from April 13, 2020 (Week 1) to June 19, 2020 (End of Week 10)

Proportion of Racial & Ethnic Minority Residents in Nursing Home	Cumulative # of COVID-19 deaths per Nursing Home, Mean, Median (IQR)		Unadjusted Disparity in Death Rate, IRR (95% CI) ^c		Adjusted Disparity in Death Rate ^d		Relative Increase in Adjusted Disparity from Week 1 to Week 10, % (95% CI)
	Week 1 ^a	Week 10 ^b	Week 1	Week 10	Week 1	Week 10	
					IRR (95% CI)		
Low	0, 0 (0–0)	7.6, 1.5 (0–13)	... ^e	... ^e	... ^e	... ^e	... ^e
Medium	0, 0 (0–0)	8.8, 7 (0–13.5)	1.18 (0.58–2.38)	1.73 [^] (0.96–3.13)	0.92 (0.45–1.87)	1.41 (0.77–2.61)	55%** (14%–110%)
Medium–high	0, 0 (0–0)	10.5, 11 (1–16)	1.62 (0.82–3.22)	1.66 [^] (0.93–2.96)	1.46 (0.70–3.03)	1.59 (0.84–3.01)	9% (–18% to 44%)
High	0.3, 0 (0–0)	13.3, 15 (2.5–18.5)	1.89 [^] (0.95–3.77)	2.09* (1.15–3.78)	1.73 (0.75–3.98)	2.17* (1.02–4.65)	26% [^] (–4% to 65%)

Note. IQR, interquartile range; IRR, incidence rate ratio; CI, confidence interval.

^a $P < .10$; * $P < .05$; ** $P < .01$; and *** $P < .001$.

^bCumulative number of deaths as of April 13 (beginning of week 1).

^cCumulative number of deaths as of June 19 (end of week 10).

^dNegative binomial model included nursing home random effects, overall linear and nonlinear time trend, disparities, and trend in disparities.

^eNegative binomial model included nursing home random effects, overall linear and nonlinear time trend, disparities, and trend in disparities, and adjusted for nursing home and county characteristics listed in Table 1.

[^]Reference group.

With the exception of the Paycheck Protection Program, however, these early pandemic response measures are “color blind” and do not explicitly incorporate stipulations to address systemic inequalities under the COVID-19 pandemic.¹⁵ Even the Paycheck Protection Program does not include details about equitable data collection and reporting, or allocation of funding to address disparities. Our findings of increased across-facility disparities in nursing-home COVID-19 outcomes from April to June indicate that although these broadly targeted policy and public health measures may have been effective in mitigating coronavirus transmissions in nursing homes, they have not helped reduce disparities in COVID-19 outcomes due to systemic inequalities in nursing home care.

Going forward, it is imperative that future federal, state, and local initiatives are designed to couple efforts to fight the pandemic and those designed to redress enduring disparities in health outcomes, while also avoiding programs that may perpetuate systematic inequalities and discrimination. It is also critical that concrete efforts are made to track disparities in COVID-19 outcomes at the national level and to determine the effectiveness, or lack thereof, of individual pandemic response measures on disparity reductions in the future.

This study has several limitations. First, we were only able to track disparities in COVID-19 outcomes among residents in Connecticut nursing homes due to the absence of national data for early periods of the pandemic. The CMS started to publicly report such data nationally in late May, and future studies can continue to track COVID-19 outcomes and disparities nationally as the pandemic progresses. Second, we were unable to determine whether or how the across-facility disparities are affected by individual policy and public health initiatives in response to the pandemic; this will be an important topic for future research. Finally, our ability to adjust for nursing home and county covariates may be somewhat limited in multivariable analyses. Therefore, the across-facility disparities may be partially mediated by unmeasured factors that affect COVID-19 outcomes.

In conclusion, despite multiple efforts that were made to mitigate coronavirus transmissions in nursing homes in early periods of the pandemic, Connecticut nursing homes serving predominantly higher proportions of racial and ethnic minority residents experienced increasingly worse COVID-19 outcome rates than other nursing homes in the state. Future initiatives to combat the COVID-19 pandemic should devote more attention to addressing systemic inequalities in health outcomes.

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Conflicts of interest. All authors report no conflicts of interest relevant to this article.

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