

NURSING HOME STAFFING DISPARITIES WERE EXACERBATED DURING THE COVID-19 PANDEMIC IN 2020

KEY POINTS

- All types of nursing homes faced unprecedented difficulties with staffing in 2020, but some types of nursing homes were better able to maintain adequate staffing hours per resident day (HPRD).
- During the COVID-19 pandemic, nursing homes:
 - that were nonprofit and not affiliated with a chain had greater increases in nurse staffing HPRD than other types of nursing homes.
 - in rural areas lost nursing staff HPRD relative to nursing homes in metropolitan areas.
 - with lower pre-pandemic Centers for Medicare & Medicaid Services 5-star quality ratings lost nursing staff HPRD relative to nursing homes with higher pre-pandemic ratings.
 - with a higher percentage of racial or ethnic minority residents had lower nurse staffing HPRD in 2019, and these disparities tended to widen during the COVID-19 pandemic.
 - with higher staffing HPRD in 2019 tended to lose nursing staff HPRD relative to those with lower pre-pandemic staffing levels.

BACKGROUND

Nursing homes are an integral part of the health care system and provide long-term services and supports and short-term post-acute care to almost 4 million Americans each year.¹ Adequate staffing is a prerequisite to providing quality care. Staffing is an important predictor of nursing home quality, and the mix of professional staff and staffing stability are important contributors to quality.²⁻⁶ Nursing homes rely on approximately 1.2 million health care practitioners and health care support workers,¹ with most of the hands-on care provided by certified nursing assistants (CNAs). Even before the COVID-19 pandemic, nursing homes often failed to maintain adequate staffing.⁷ An important reason for this difficulty is the low wages, limited possibilities for advancement, and difficult working conditions, particularly for CNAs.⁸

The COVID-19 pandemic introduced new challenges for nursing home staff that exacerbated the substantial ongoing challenges.⁹ The COVID-19 pandemic imposed many new caregiving and infection control responsibilities on workers, often in hazardous working conditions without adequate personal protective equipment.^{9,10} Additionally, daycare and school closures have increased caregiving responsibilities at home⁹ for staff. In November 2021, the American Health Care Association, citing recent Bureau of Labor Statistics data, reported that the nursing home sector lost 221,000 jobs (14% of its total workforce), threatening closure to many nursing homes.¹¹

Due to decreases in the number of residents, which coincided with the reduction in the absolute level of nurse staffing (whether measured as staffing hours or as number of employees), nursing homes were able to maintain and even slightly increase their nurse staffing hours per resident day (HPRD) during 2020.^{10,12} However, they did so with great effort and difficulty, including through increasing their reliance on contract staff.¹³ Higher nurse staffing levels were necessary during the pandemic in 2020 due to several factors, including requirements to implement new infection control procedures.

Currently, little is known about how the impact of the pandemic on nurse staffing has differed among different types of nursing homes. This issue brief is one of three produced under this study,^{*} which explores the impact of the pandemic on direct care staffing including registered nurses (RNs), licensed practical or vocational nurses (LPNs), and CNAs in nursing homes. In the current issue brief, we are examining whether staffing losses were concentrated within particular types of nursing homes, and whether the pandemic may have exacerbated existing disparities in nursing home staffing between different types of nursing homes. The nursing home characteristics we examined were profit status and chain affiliation; the urbanicity of the nursing home's location; the Centers for Medicare & Medicaid Services (CMS) nursing home 5-star quality rating; the proportion of residents who identify as a member of a racial/ethnic minority group; and the pre-pandemic staffing level.

DATA AND METHODS

This issue brief includes findings from descriptive and multivariate data analyses, and from interviews with subject matter experts on the relationship between nursing home characteristics and changes in staffing in 2020. We used data from the Payroll-Based Journal (PBJ) for the number of residents and staffing hours and linked those data with other publicly available data sources, including the CMS Care Compare/Provider Data Catalog (formerly Nursing Home Compare),¹⁴ LTCFocus,¹⁵ Area Health Resource Files,¹⁶ and USAFacts,¹⁷ to obtain nursing home and area-level characteristics.

We measured nurse staffing as HPRD. When we use the term *nurse staffing* we are referring to nurse staffing measured as HPRD, unless we note otherwise, and we are including RNs, LPNs, and CNAs. We calculated the nurse staffing HPRD for each month in 2019 and 2020 for each facility, and we present those averaged across facilities for each month by various nursing home characteristics.

We then constructed regression models to predict the monthly change in nurse staffing HPRD from 2019 to 2020 per facility, with key nursing home characteristics as predictor variables including profit status and chain affiliation (whether the nursing home was for-profit or nonprofit and if the nursing home was owned or leased by an organization with more than one facility), location of the nursing home (rural, urban nonmetropolitan, or urban metropolitan),[†] star rating in 2019 from CMS's 5-star quality rating system, the percentage of residents that were a member of a racial-ethnic minority group,[‡] and the pre-pandemic baseline staffing level (the last two categorized into quartiles). We also controlled for other factors, including whether the nursing home was in a hospital, the number of nursing home residents pre-pandemic, the acuity index,¹⁸ the percentage of staff who were contracted in 2019, and the monthly COVID-19 death rate in the county in which the nursing home was located. We present the full model specifications and results, and results of our sensitivity analyses, in **Appendix A**.

To provide additional context for the study findings, we conducted interviews with three experts from academia, three from industry associations, and three nursing home providers (one large for-profit chain, one

^{*} The two other issue briefs in this series are *Nursing Home Nurse Staff Hours Declined Notably During the COVID-19 Pandemic in 2020, with CNAs Experiencing the Largest Decreases*,¹² and *COVID-19 Pandemic Increased Nursing Homes' Reliance on Contract Staff to Address Staffing Shortages in 2020*.¹³

[†] If a nursing home is in a county with a population of 50,000 or more people, we considered it to be in an urban metropolitan location; if it is in a county with a population of more than 2,500 but less than 50,000 people, it is in an urban nonmetropolitan location; and if its location is rural, it is in a county with a population of less than 2,500 people.

[‡] This includes any resident that was not nonHispanic White.

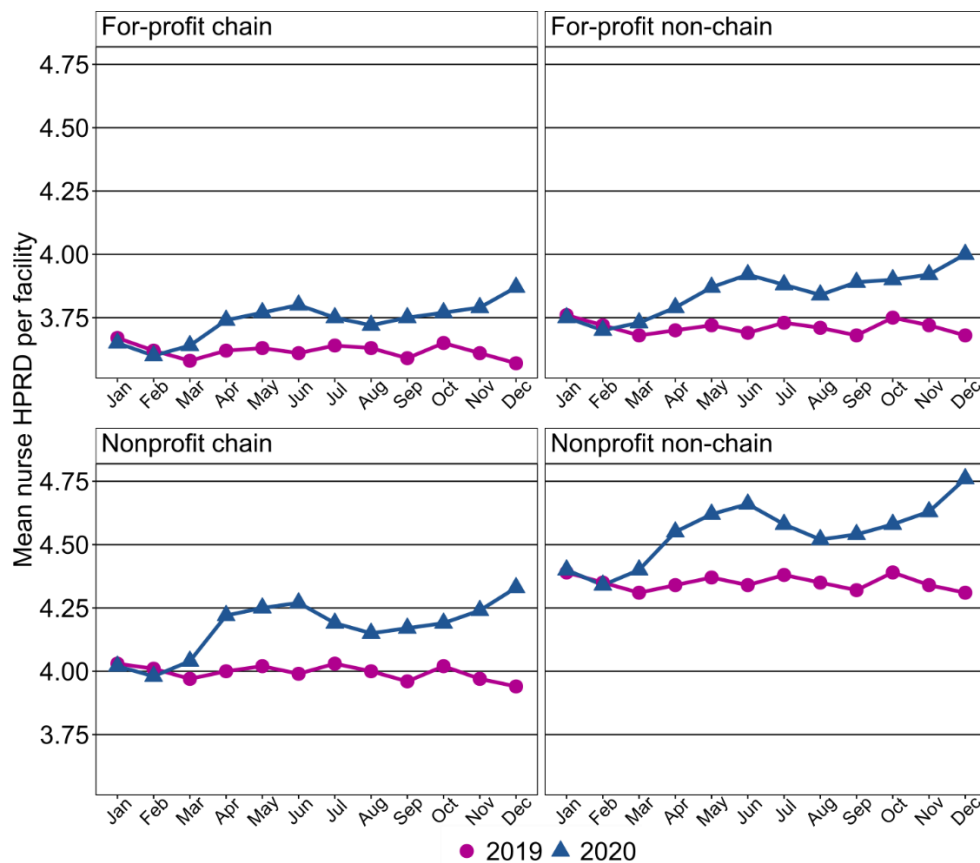
small nonprofit chain, and one independent nonprofit). We thematically categorized each interview and aggregated our findings across interviewees for this brief.

FINDINGS

In 2020, nursing staff HPRD increased most in nonprofit nursing homes that were not affiliated with a chain.

A number of studies have shown that nursing homes with different profit statuses and chain affiliations have different staffing levels.^{19,20} In our analyses, we found that for-profit nursing homes have lower nurse staffing HPRD than nonprofit nursing homes and that nursing homes affiliated with a chain have lower nurse staffing HPRD than nursing homes not affiliated with a chain. When looking at a combination of these characteristics, pre-pandemic, nonprofit nursing homes not affiliated with a chain had the highest nurse staffing HPRD, whereas for-profit nursing homes affiliated with a chain had the lowest nurse staffing HPRD. In all types of nursing homes, on average, nurse staffing HPRD was higher in March through December 2020 than in 2019 (**Figure 1**). Although the relative pattern from 2019, described above, stayed the same in 2020, the differences in the average staffing HPRD, especially between for-profit chains and nonprofit nonchains, widened in 2020. After keeping all other factors constant, nurse staffing HPRD in nonprofit nursing homes not affiliated with a chain increased by 0.28 hours or about 17 minutes per resident per day more than nurse staffing HPRD in for-profit chain nursing homes (**Figure 2**). Nonprofit chains and for-profit nonchains experienced increases in staffing between these two extremes.

Figure 1. Nurse Staffing HPRD, by Month and by Profit and Chain Status, 2019-2020



Note: The number of nursing homes included varies by month. We included fewer facilities in quarter 1 because CMS waived the requirement to submit PBJ data in quarter 1 2020 (see **Appendix A**).

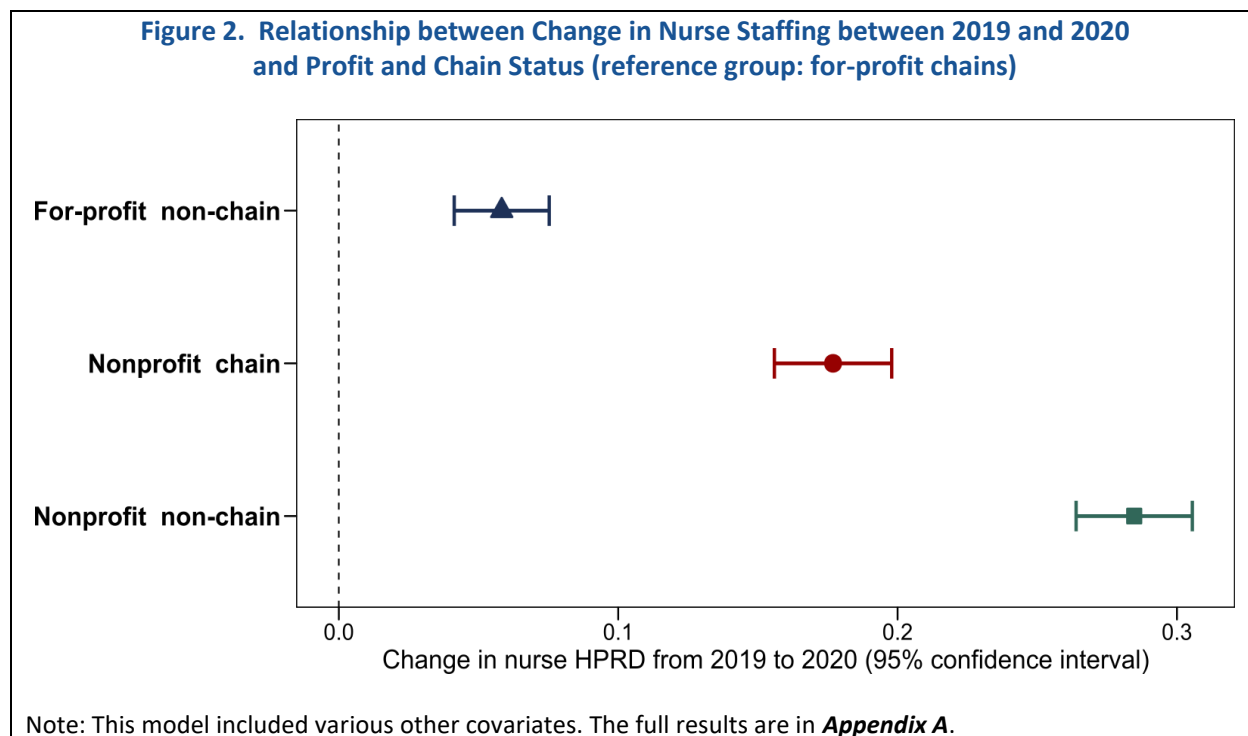


Figure 2 (and the similar figures below) depicts the regression coefficient estimate and 95% CI for each type of nursing home. If the coefficient estimate is positive (negative), this means that on average this type of nursing home increased (decreased) their nurse staffing HPRD in 2020 more than the reference group. If the CI does not cross the 0.0 axis, then the difference is statistically significant.

It did not surprise stakeholders that nurse staffing HPRD increased more in nonprofit nursing homes in 2020 than in for-profit chains. Almost all agreed that pre-pandemic, nonprofit nursing homes typically had higher staffing levels than for-profit nursing homes (which is what we saw in our analysis as shown above in **Figure 1**).

An industry expert explained how nonprofit facilities and for-profits differ with regards to their approach and operations,

"[nonprofits] have a moral, more mission driven orientation... but I don't think we should underestimate the ability of some of the nonprofits to actually draw their [higher] private pay [income]".

Some stakeholders suggested that one explanation for this difference in pre-pandemic staffing levels between nonprofits and for profits and for some of the differences seen in 2020 are the larger profit margins that for-profit providers seek compared to the mission driven orientation of nonprofit providers.

Many stakeholders noted that nonprofit providers usually serve a higher proportion of private-pay residents than for-profit facilities, which usually serve a higher proportion of Medicaid-funded residents. Some studies support this assertion from the stakeholders, suggesting that nursing homes with a higher proportion of Medicaid-funded residents are more likely to be for-profits.^{21,22} One provider from a large for-profit chain, confirmed that these facilities often accept more indigent admissions than nonprofit facilities. Most stakeholders agreed

that nonprofits may have more resources and greater financial stability, so they can more easily offset costs associated with retaining more workers (e.g., through bonuses, higher wages, hiring of agency staff).

Two nonprofit providers confirmed this assertion, with one stating they had offered bonuses to nursing staff to help acknowledge the hazardous working conditions and the other stating they had offered an hourly pay

increase. One industry provider cautioned that all types of nursing homes had staffing shortages and were not increasing staffing hours in 2020.

Separating out chain affiliation from profit status, an academic expert expected that chains would have been able to share nursing staff more easily than nonchain nursing homes in 2020. Another academic expert added, some chains, especially those owned by private equity and larger chains, provide bonuses that incentivize monitoring staffing very carefully to maintain set staffing levels and limiting use of overtime and more costly temporary staff. A large for-profit provider added that its chain’s staffing resources enabled it to fluidly address staffing shortages. However, our quantitative findings showed the opposite; the nursing homes not affiliated with a chain maintained higher staffing levels, even among nonprofit nursing homes.

A for-profit provider confirmed differences in operational priorities as compared to nonprofit facilities,

“nonprofits... have always had generally higher staffing levels within their nursing departments as compared to for-profit facilities... they [nonprofits] have additional sources of revenues to work with as compared to for-profit facilities and oftentimes a different payer mix.”

In 2020, rural nursing homes lost more nursing staff HPRD than nursing homes in urban metropolitan areas.

In 2019, nursing homes in urban metropolitan areas had the highest nurse staffing HPRD, followed by nursing homes in rural areas. Nursing homes in urban nonmetropolitan locations had the lowest staffing HPRD on average, although the staffing levels were not very different from nursing homes in rural areas. Nursing homes in all areas experienced slight increases in nurse staffing HPRD in March through December of 2020 (Figure 3). After controlling for the other characteristics in our model, we found that rural and urban nonmetropolitan nursing homes lost nursing staff HPRD relative to urban metropolitan nursing homes. In 2020, rural nursing homes lost 0.13 hours or about 8 minutes per resident per day more than urban metropolitan nursing homes lost (Figure 4).

Figure 3. Nurse Staffing HPRD, by Month and Location Type, 2019-2020

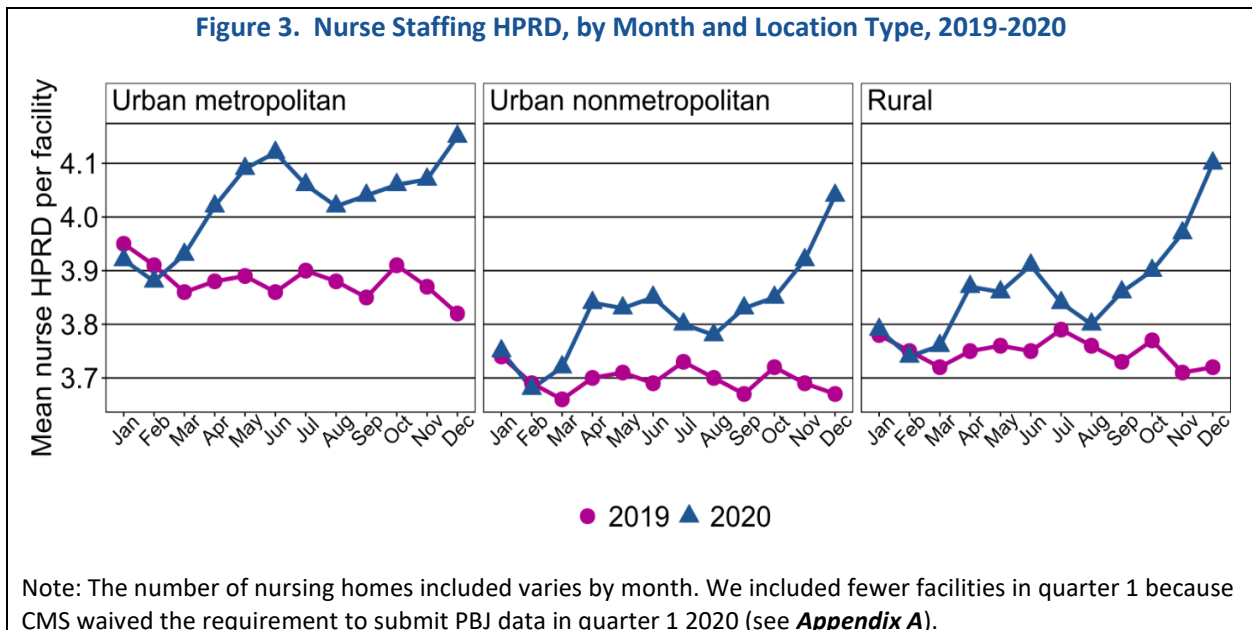
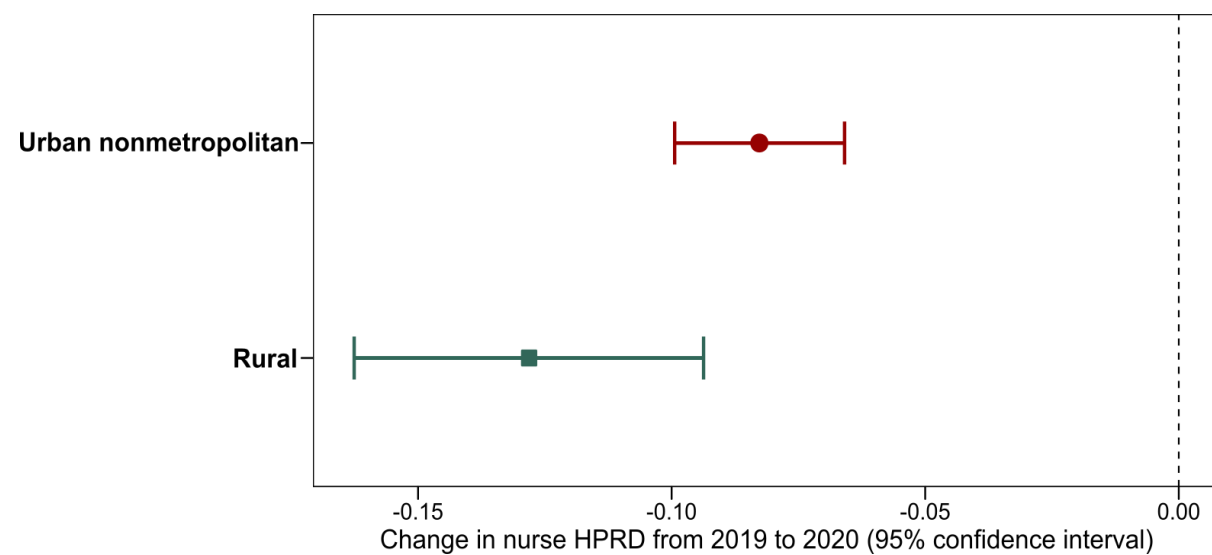


Figure 4. Relationship between Change in Nurse Staffing between 2019 and 2020 and Location Type (reference group: urban metropolitan nursing homes)



Note: This model included various other covariates. The full results are in **Appendix A**.

A for-profit provider explained how the rural locality of a nursing home affects facilities' ability to maintain staffing, especially with regards to temporary nursing staff, "Because they're rural, they have very limited resources to begin with for getting staff in those centers... availability of both travelers and casual or per diem staff are going to be more accessible in markets where there's obviously greater population, where we have a greater density of facilities and services and beds."

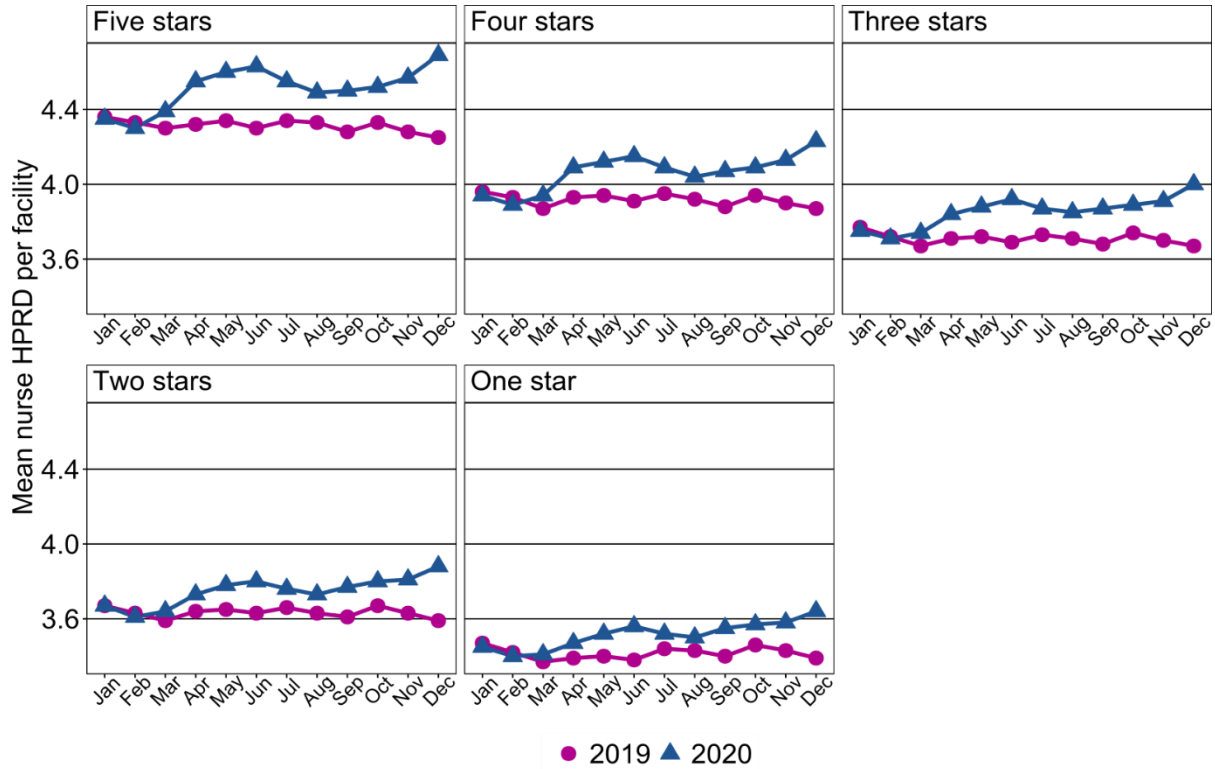
Most stakeholders expected rural facilities to struggle more with staffing than metropolitan facilities in 2020, as pre-pandemic staffing availability in rural areas was already challenging. Providers highlighted some reasons why rural facilities may have had more difficulty with staffing in 2020. A large chain provider explained that rural facilities can be more difficult to reach, reducing the availability of staff, especially for nursing staff who must fill in per diem (or as needed) and not on a regular schedule.

A nonprofit provider added that a lack of housing in both rural and urban areas reduced the availability of agency nursing staff to add to their staffing. Two providers added that job competition in urban areas, where more hospitals and physician clinics that can pay higher wages are located, has also had a negative effect on staffing in urban areas, especially in 2020.

In 2020, nursing homes with higher CMS quality ratings in 2019 increased their nursing staff HPRD more than nursing homes with lower 2019 ratings.

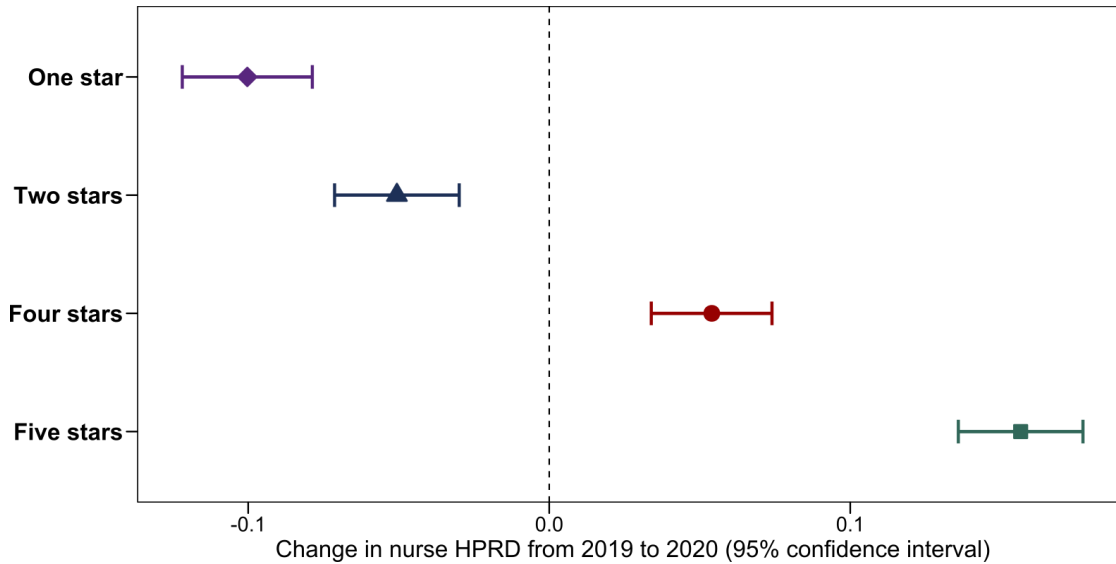
During the pandemic in 2020, 1-star nursing homes in 2019 had the lowest staffing HPRD, and 5-star nursing homes had the highest. Although nursing staff levels HPRD increased slightly on average for nursing homes beginning in March 2020 regardless of star rating, nursing staff levels for 5-star nursing homes increased the most, and staffing levels for 1-star and 2-star nursing homes increased the least in 2020 (**Figure 5**). For illustration, nurse staffing HPRD for 5-star nursing homes was 4.34 in July 2019 and 4.55 in July 2020, increasing by about 5%, whereas nurse staffing HPRD for 1-star nursing homes was 3.44 in July 2019 and 3.52 in July 2020, increasing by about 2%. Our multivariate analysis confirmed this pattern. After controlling for other nursing home characteristics, we found that, in 2020, 1-star and 2-star nursing homes lost more nurse staffing HPRD than 3-star nursing homes did and that nurse staffing HPRD increased more in 4-star and 5-star nursing homes than in 3-star nursing homes (**Figure 6**).

Figure 5. Nurse Staffing HPRD, by Month and Nursing Home Star Rating, 2019-2020



Note: The number of nursing homes included varies by month. We included fewer facilities in quarter 1 because CMS waived the requirement to submit PBJ data in quarter 1 2020 (see **Appendix A**).

Figure 6. Relationship between change in nurse staffing between 2019 and 2020 and star rating (reference group: 3-star facilities)



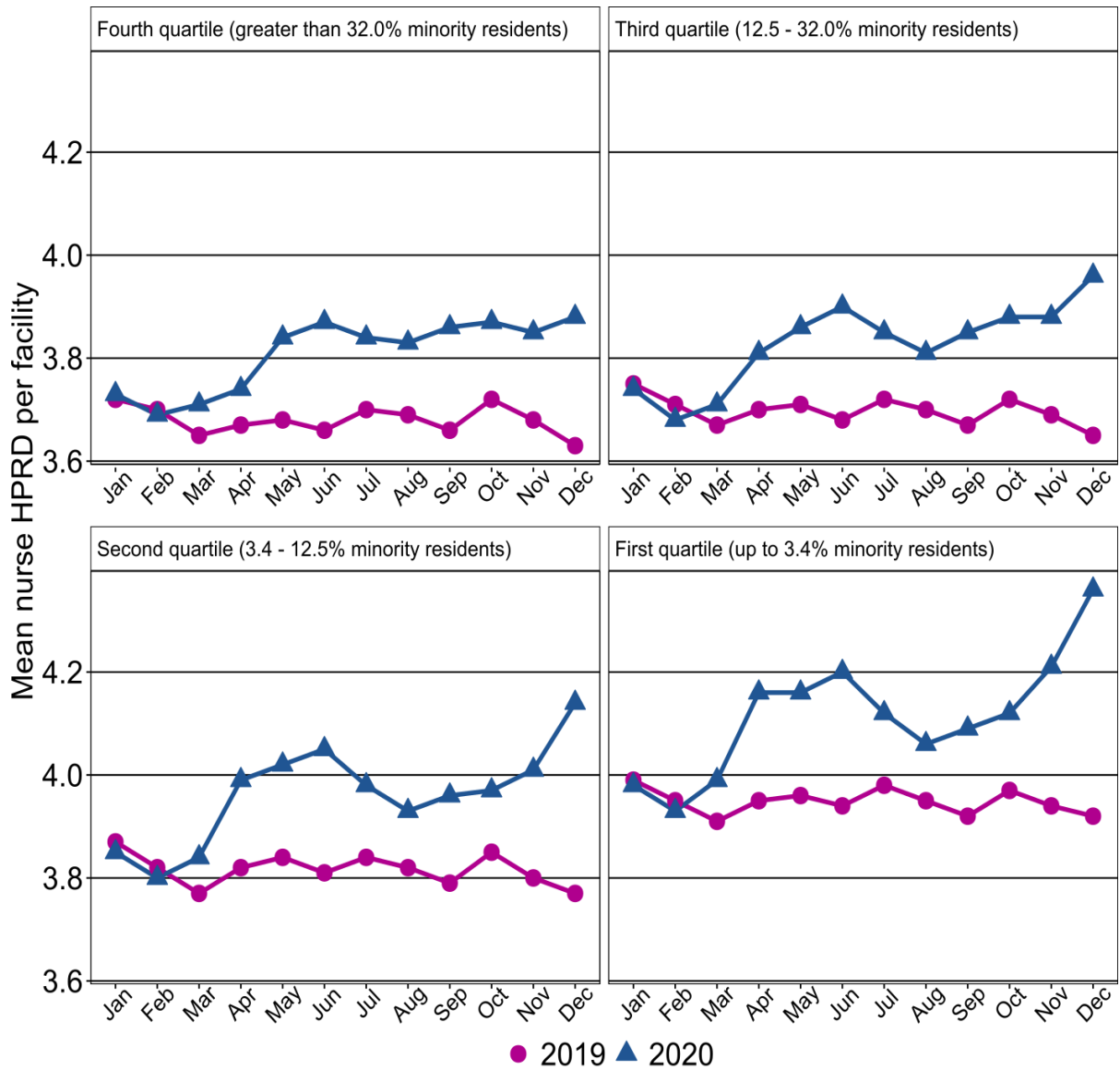
Note: This model included various other covariates. The full results are in **Appendix A**.

Both academic and industry experts stated that this finding was consistent with their expectations. Most stakeholders agreed that 4-star and 5-star facilities generally have more resources and were better able to pay both nurses and CNAs in 2020. All providers offered a slightly different perspective, stating that facilities with high star ratings have strong administrators and nursing leadership, leading to better staff management. A for-profit provider explained that strong leadership often leads to better operations and management of staffing throughout the pandemic. Other nonprofit providers said strong leadership led to collaborative teamwork and better support for staff during the pandemic.

Nursing homes with a higher percentage of residents identifying as a member of a racial-ethnic minority group had lower nurse staffing HPRD in 2019, and these differences tended to widen in 2020.

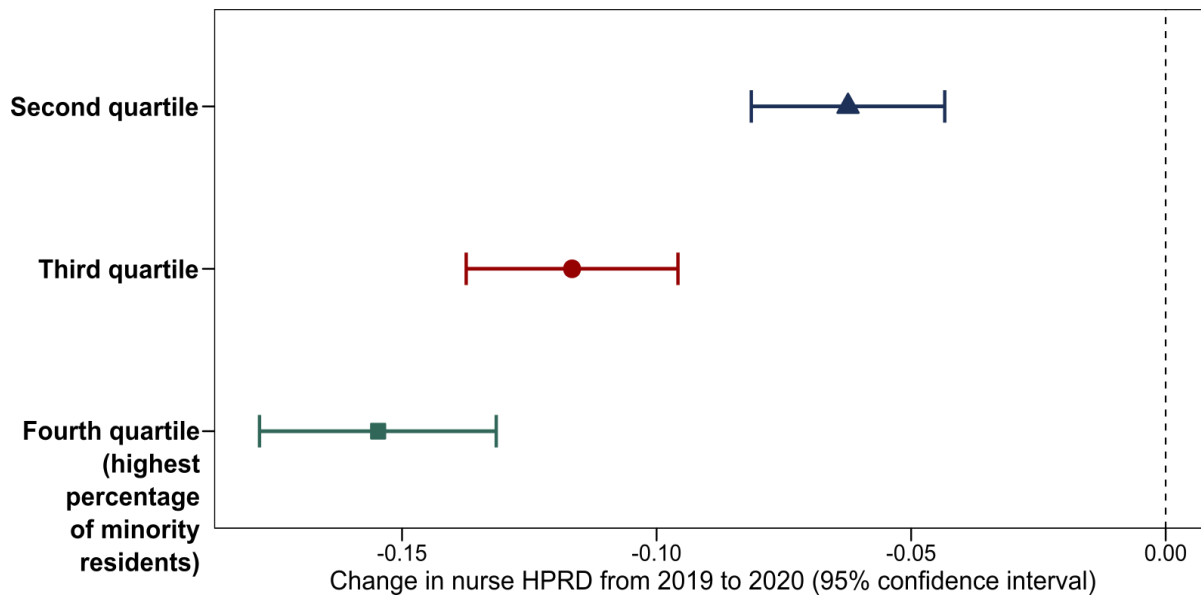
Throughout 2019, nursing homes with a higher percentage of residents belonging to racial-ethnic minority groups had lower nurse staffing HPRD. For example, in January 2019, nursing homes with the highest percentage of minority residents (fourth quartile or greater than 32% minority residents) had 3.72 HPRD of nurse staffing, whereas nursing homes with the lowest percentage of minority residents (first quartile or less than 3.4% minority residents) had 3.99 HPRD, a difference of 16 minutes per resident day. These differences widened in 2020. Although unadjusted nurse staffing HPRD increased across all four quartiles beginning in March 2020, the increases in most months were larger in nursing homes in the lowest quartile of percentage of minority residents than in the highest quartile (**Figure 7**). After adjusting for other nursing home characteristics, nursing homes in higher quartiles of percentage of minority residents lost more nurse staffing HPRD than nursing homes in the lowest quartile of minority residents (**Figure 8**). For example, nursing homes with the highest percentage of minority residents lost 0.15 nurse staffing HPRD, or 9 minutes per resident day, more on average between 2019 and 2020 than nursing homes in the lowest quartile.

Figure 7. Nurse Staffing HPRD, by Month and Resident Minority Population (quartiles), 2019-2020



Notes: The number of nursing homes included varies by month. We included fewer facilities in quarter 1 because CMS waived the requirement to submit PBJ data in quarter 1 2020 (see **Appendix A**). The first quartile of nursing homes had a resident population where less than or equal to 3.4% of residents were racial/ethnic minority residents in 2018; the second quartile had a resident population where 3.4%-12.5% were; the third quartile had 12.5%-32.0%; and the fourth quartile had greater than 32%.

Figure 8. Relationship between Change in Nurse Staffing between 2019 and 2020 and Resident Minority Population (reference group: 1st quartile [lowest percentage of minority residents])



Notes: This model included various other covariates. The full results are presented in **Appendix A**. The first quartile of nursing homes had a resident population where less than or equal to 3.4% of residents were racial/ethnic minority residents in 2018; the second quartile had a resident population where 3.4%-12.5% were; the third quartile had 12.5%-32.0%; and the fourth quartile had greater than 32%.

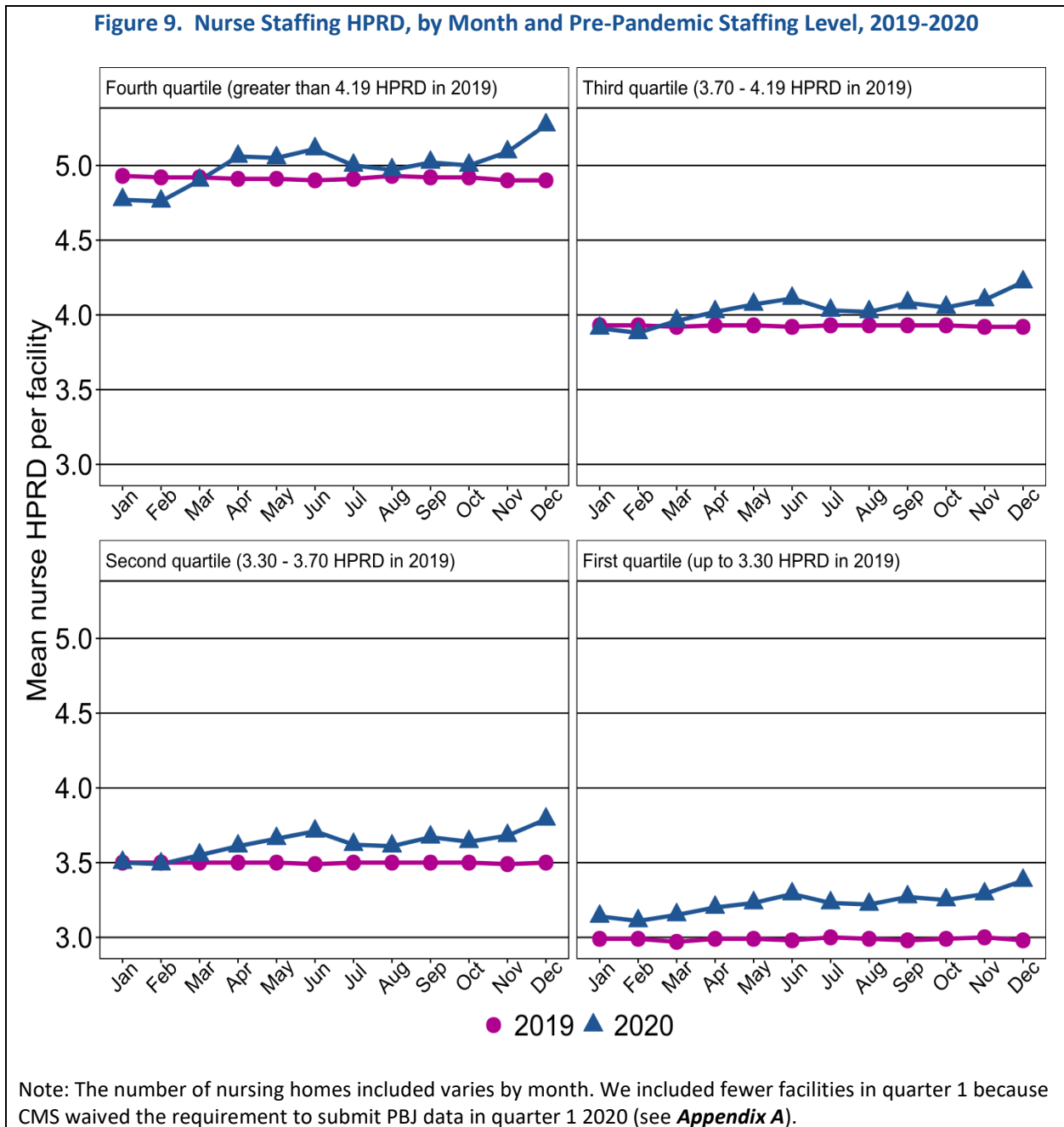
Stakeholders discussed this finding mostly as a reflection of the community in which the nursing home is located, agreeing that nursing homes faced reduced CNA staffing because of the disproportionate impact of COVID-19 on vulnerable communities including the nursing staff who work in these facilities and reside in these communities. Although we did control for county-level monthly COVID-19 death rates in our model, it did not account for the more granular impact of COVID-19 on different communities and neighborhoods within a county. Prior research shows that most CNAs are a part of a vulnerable population with half of the workforce reportedly being persons of color and over a third of them identifying as Black or African American. Furthermore, they have historically been inadequately compensated and almost half of all CNAs live in low-income households.²³

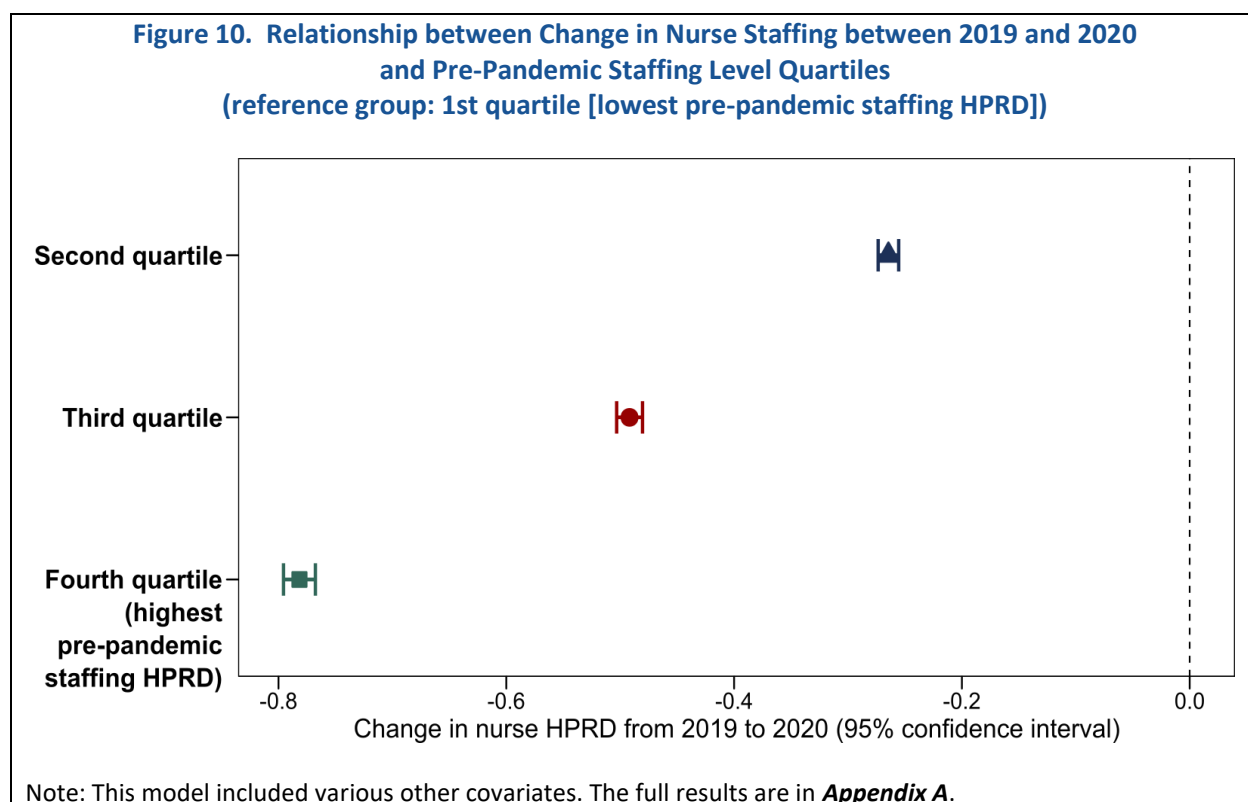
Stakeholders commented that reductions in CNA staffing were because these staff lack resources and benefits that would have allowed them more flexibility in maintaining their jobs, such as access to childcare. Academic stakeholders noted that nursing homes with higher percentages of minority residents also tend to perform lower (1-star or 2-star) and are primarily reliant on Medicaid funding, which may indicate they have fewer resources than other nursing homes. Published studies^{21,24} support this assertion.

An academic expert confirmed this disproportionate affect COVID-19 had on vulnerable communities and the nursing assistants working in facilities located there: “These facilities were located in communities with more people of color, where there were more COVID infections... And then the nursing assistants also were more exposed in those communities. It's so complex. It's very hard to tease out what happened first, but many of those staff may have been sick and ended up having to stay home and take care of sick family members, or maybe their kids were out of school.”

In 2020, nursing homes with higher nurse staffing HPRD in 2019 tended to lose nurse staffing HPRD relative to those with lower pre-pandemic nurse staffing HPRD.

Next, we examined whether nursing homes with already higher nurse staffing HPRD before the pandemic increased their nurse staffing HPRD more or less than nursing homes with lower pre-pandemic nurse staffing HPRD. Beginning in April 2020, all nursing homes experienced increases in staffing, regardless of their pre-pandemic staffing levels (**Figure 9**). However, nursing homes with lower pre-pandemic nurse staffing HPRD increased their nurse staffing HPRD more than nursing homes with higher pre-pandemic staffing. We found that nursing homes with the highest pre-pandemic staffing levels lost 0.78 HPRD, or about 47 minutes per resident day, more than nursing homes with the lowest pre-pandemic staffing levels (**Figure 10**).





As a possible explanation for these findings, experts and providers suggest that nursing homes with somewhat higher staffing HPRD pre-pandemic could lose more staffing before getting to the point of a true crisis due to lack of staff. Those nursing homes that were already operating at a level that was closer to the bare minimum required to function simply could not lose any more staff and had to maintain staffing levels. Academic experts referred to this as a *floor effect*. An industry expert added that facilities that had pre pandemic staffing shortages had “no margin for error” in 2020 and added that facilities were starting to limit admissions as a result of staffing shortages.

LIMITATIONS

We note several limitations. First, in the early days of the pandemic, CMS waived the requirement for nursing homes to submit their staffing data through the PBJ system. This meant that nursing homes did not need to submit their staffing data for quarter 1 (January-March) of 2020. Thus, only about 78% of nursing homes reported staffing data for this quarter, compared to 95% or above for other quarters. To address the possibility that inclusion in our analysis of nursing homes that reported data in other quarters but not in quarter 1 of 2020 might impact our results, we ran a sensitivity analysis dropping those nursing homes that did not report in this quarter. We found the results to be consistent with our main analysis (see further discussion in **Appendix A**).

In addition, due to data availability, we had to use data from 2018 to obtain chain affiliation, the percentage of residents that were racial or ethnic minorities, and the acuity index. These nursing home characteristics could have changed in 2019, but we would not expect to see any large difference in these characteristics in more-recent data. Additionally, while we controlled for county-level monthly COVID-19 death rate, we did not control more specifically for the facility-level impact of COVID-19. And, as with all observational studies, there may be other impactful factors for which we did not control in this analysis (omitted variable bias).

Lastly, when we discussed our quantitative findings with stakeholders, we presented findings measuring staffing in total staffing hours and in HPRD. Stakeholders may have responded thinking of staffing in terms of the total number of staff or the total number of staffing hours rather than HPRD in certain cases, and we attempted to capture the essence of their thinking as we applied the information to HPRD.

CONCLUSION

The COVID-19 pandemic in the United States has greatly affected staffing in nursing homes. There were large decreases in the population of residents and the absolute amount of nurse staffing. Although nurse staffing HPRD increased slightly, it happened with great difficulty, including by increasingly relying on contract staff, and occurred when the need for nurse staffing increased greatly due to pandemic-related challenges. This pandemic has affected nursing homes of all types and has caused unprecedented challenges with nursing home staffing.

The pandemic exacerbated existing disparities between different types of nursing homes. Pre-pandemic, for-profit chain nursing homes, nursing homes in rural locations, nursing homes with low star ratings, and nursing homes with a higher percentage of minority residents, had lower staffing levels. These types of facilities struggled the most in 2020, losing staffing relative to other types of facilities. Future research should explore the relationship between changes in staffing and the percentage of residents that are on Medicaid, nurse wages, the stability of leadership in nursing homes, resident experience, and quality of care. It would also be important for future research to examine the relationship between nursing home characteristics and staffing later in the pandemic (from 2021 onward), as staffing needs and the way different types of facilities responded to staffing challenges may have changed as the pandemic progressed.

APPENDIX A. QUANTITATIVE METHODS

In this appendix, we provide additional information about our study sample construction, the covariates we used in our models, our full model specifications and results, and our statistical methods for addressing the clustering of observations, with up to 12 observations for each nursing home. We also describe several sensitivity analyses we performed.

Details on Study Sample

Our study sample included monthly observations for all nursing homes that reported data through the PBJ system for 2019-2020, after applying several exclusions. When creating the nursing home-month observations, we excluded all days in the month that had no nurse staffing or a census of zero. We also required that nursing homes reported data for all quarters in 2019 and 2020, except for calendar quarter 1 (Q1, January-March) of 2020 and that, for a given month, there was an average daily census of at least ten in both 2019 and 2020. For the multivariate analyses, we excluded any facilities that had missing information for any of the covariates of interest in our models. Note that our study sample included slightly different numbers of facilities for each month due to the monthly census requirement, and the sample is considerably smaller for months in Q1 2020 than for months in other quarters because facilities were not required to report their staffing data for Q1 2020. **Table A-1** shows the exclusions that we made and the number and percentage of facilities meeting the criteria at each stage, using June as an example.

Independent Variables Used in Models

Independent variables included: profit and chain affiliation status, location of the nursing home (rural, urban, or metropolitan), star rating in 2019 from CMS's 5-star quality rating system, the percentage of residents who are racial/ethnic minorities in 2018 categorized into quartiles, and the pre-pandemic baseline staffing level categorized into quartiles. We also controlled for a variety of other factors, including if the facility was in a hospital, the pre-pandemic census, the acuity index,¹⁸ and the percentage of nursing staff that were contracted in 2019. We also controlled for county-level monthly COVID-19 death rates to account for the variation in where and when COVID-19 outbreaks occurred. The characteristics of the nursing homes used in our model are displayed below in **Tables A-2** and **A-3**. Although we show the descriptive statistics for the continuous variables in **Table A-3**, in the models, we categorized these continuous variables into quartiles. We then present the monthly COVID-19 county-level death rates in **Table A-4**, which was modeled as a continuous variable and which we recoded to 0 when values were negative.

Additional Statistical Modeling Details and Results for Multivariate Analyses

The results detailed in the main body of the issue brief focus on our main outcome of interest: change in total nurse HPRD from 2019 to 2020. Those full model results including the coefficient, standard error (SE), 95% confidence interval (CI), and *p*-value are presented in **Table A-5**. In this main model, our primary method for addressing multiple observations per nursing home was through including random effects in our regression model. We also included state-month fixed effects to account for variations in state policies and other state-specific factors that were not measured but could influence the outcome.

We also ran additional models on the change in RN, LPN, and CNA HPRD from 2019 to 2020. These had identical model specifications as those of the total nurse HPRD model, just the outcomes differed. The coefficients and statistical significance of those coefficients from those models are side-by-side in **Table A-6**. For the most part, the findings we describe the main body of brief hold when examining the changes in staffing levels for the different types of nursing staff. There are just a few differences. We found that, after controlling for various factors, RN staffing decreased more in for-profit nonchain facilities than in for-profit chain facilities, and that there were no significant differences in the change in LPN staffing in 2020 between 3-star nursing homes and 1-star, 4-star, and 5-star nursing homes.

As a sensitivity analysis, we used a regression model without random effects and estimated robust standard errors to account for nursing home-level clustering. This model did not allow for nursing home heterogeneity to impact the effect estimates, only their statistical significance. In general, the magnitude of the effects we observed were considerably stronger with the random effects model, but the patterns were similar across both models, **Table A-7** displays the results of this sensitivity analysis.

We decided to categorize our predictor variables (except for COVID-19 county-level death rate) because of concerns with how outlier values, especially with baseline staffing, could impact our model results. Because of the possible concern that outlier values of our dependent variable could impact our model results, we ran models after winsorizing our dependent variable at the 99th percentile as a sensitivity analysis (results not shown). The results were consistent with results from our primary model.

We also ran two sensitivity analyses dropping some observations. Both models had the same outcome, covariates, and model specifications as the main model predicting change in nurse HPRD, except some additional observations were dropped. We ran one sensitivity analysis dropping those facility-month observations of those facilities that did not report their staffing data for Q1 2020. We decided to run this sensitivity analysis because there was some indication that those that did not report their staffing data systematically differed from those who did.¹² We ran another sensitivity analysis wherein we dropped observations from January and February, because during this time, COVID 19 was not widely in the United States. The results of both sensitivity analyses were consistent with results from our primary model (results not shown).

As an additional sensitivity analysis, we also ran models based on the change in average daily staffing hours instead of HPRD as the dependent variable. Because the magnitude of the change in staffing depends so heavily on facility size, we used the percentage change in average daily staffing hours instead of the raw change as the dependent variable. Average daily staffing hours were defined for each month for each facility, and the percentage change was defined as the change divided by the value in 2019. Below, we show the model results after including random effects (**Table A-8**), and without random effects and adjusting standard errors to reflect facility-level clustering (**Table A-9**).

The relationships between facility characteristics and change in HPRD staffing for the most part held with the models based on change in average daily staffing hours. One important difference is that, based on the model with random effects, facilities with a higher percentage of minority residents gained more (rather than lost more) nurse staffing compared to facilities with fewer minority residents, and this difference was statistically significant. However, this finding did not hold in the model without random effects. Additionally, unadjusted bivariate results (not shown) indicate facilities with a higher percentage of minority residents lost more staffing.

Table A-1. Study Sample Exclusions using June 2019 and 2020 as an Example

Sample/Restriction	Number of Facilities	Percentage of Total Facilities (of 15,507)
Total number of facilities in at least one of the PBJ files	15,507	100.00%
In original PBJ file in June 2019	15,020	96.86%
In original PBJ file in June 2020	14,763	95.20%
After removing facilities where all days in the month had no nurse staffing or a census of zero (2019)	14,985	96.63%
After removing facilities where all days in the month had no nurse staffing or a census of zero (2020)	14,732	95.00%
In both PBJ files for June	14,374	92.69%
Only keeping facilities that were in all PBJ quarterly files except not requiring Q1 2020	13,365	86.19%
Only keeping facilities that had an average daily census of 10 or greater in both June 2019 and June 2020	13,320	85.90%
Total facilities with nonmissing values for all covariates of interest	12,190	78.61%
Note: Total facility-month observations meeting all inclusion criteria and included in our multivariate analyses: 139,113.		

Table A-2. Categorical Characteristics for Nursing Homes in Model, using June as an Example

Characteristic	N with Characteristic	% of Facilities
For-profit	8,663	71.07
Affiliated with a chain	7,555	61.98
Profit status and chain affiliation		
For-profit chain	5,867	48.13
For-profit nonchain	2,796	22.94
Nonprofit chain	1,688	13.85
Nonprofit nonchain	1,839	15.09
Hospital-based	336	2.76
Overall rating		
1-star	2,122	17.41
2-star	2,388	19.59
3-star	2,255	18.50
4-star	2,746	22.53
5-star	2,679	21.98
Urban-rural		
Metropolitan	8,687	71.26
Urban nonmetropolitan	2,966	24.33
Rural	537	4.41
Note: Descriptives are based on 12,190 facilities.		

Table A-3. Continuous Characteristics of Nursing Homes in Model, using June as an Example

Characteristic	Mean	SD	Min	25th Percentile	50th Percentile	75th Percentile	Max
2019 census (facility size)	89.68	52.30	11.63	54.87	81.87	110.13	749.80
Percentage of residents who were a racial/ethnic minority in 2018	20.87	22.06	0.00	3.45	12.59	32.14	100.00
Case-mix acuity index*	12.22	1.34	0.00	11.59	12.27	12.87	23.68
Percentage of total nursing staff who were contracted in 2019	3.09	7.86	0.00	0.00	0.00	2.05	100.00
2019 nurse HPRD	3.77	0.77	0.01	3.28	3.67	4.14	11.52
2019 RN HPRD	0.63	0.36	0.00	0.40	0.56	0.78	6.41
2019 LPN HPRD	0.85	0.33	0.00	0.65	0.85	1.04	4.35
2019 CNA HPRD	2.30	0.52	0.00	1.94	2.23	2.58	6.04

Notes: Descriptives are based on 12,190 facilities.

* Case-mix index is a weighted sum of the variables for the proportion of residents in a facility with specific health-related characteristics. Higher case-mix index indicates higher acuity care needs.

Table A-4. COVID-19 County-Level Death Rate (new deaths per 100,000 people) by Month in 2020

Month	N	Mean	SD	Min	25th Percentile	50th Percentile	75th Percentile	Max
January	9,780	0.00	0.00	0.00	0.00	0.00	0.00	0.00
February	9,773	0.00	0.01	0.00	0.00	0.00	0.00	0.10
March	9,736	0.74	2.08	0.00	0.00	0.00	0.63	63.34
April	12,190	13.79	27.55	0.00	0.74	3.79	12.68	280.32
May	12,216	12.18	17.21	0.00	0.28	4.34	16.93	260.14
June	12,190	6.72	9.59	0.00	0.32	3.42	10.03	204.82
July	12,210	7.10	9.08	0.00	1.55	4.76	9.22	152.85
August	12,216	8.73	12.34	0.00	1.63	5.07	11.58	218.34
September	12,197	7.68	10.62	0.00	1.97	5.14	9.27	218.18
October	12,203	9.44	14.72	0.00	2.88	5.21	10.98	455.24
November	12,210	15.62	20.91	0.00	5.01	9.71	18.78	492.61
December	12,192	29.64	28.57	0.00	13.43	23.35	36.00	486.70

Notes: We calculated death rates at the county-level. For each month, each facility was matched with the death rate of the county they were located in. These descriptives are at the facility-level.

Table A-5. Association between Change in Nurse Staffing from 2019 to 2020 and Nursing Home Characteristics, Main Random Effects Model

Covariates	Coefficient	SE	95% CI		p-value
Profit and chain affiliation status (reference: for-profit chain)					
For-profit nonchain	0.0583***	0.0087	0.0413	0.0753	0.0000
Nonprofit chain	0.1769***	0.0107	0.1559	0.1979	0.0000
Nonprofit nonchain	0.2847***	0.0106	0.2639	0.3055	0.0000
Hospital-based	0.0528**	0.0207	0.0122	0.0934	0.0109
Star rating (reference 3-stars)					
1-star overall rating	-0.1003***	0.0110	-0.1219	-0.0787	0.0000
2-star overall rating	-0.0506***	0.0105	-0.0713	-0.0299	0.0000
4-star overall rating	0.0540***	0.0102	0.0339	0.0740	0.0000
5-star overall rating	0.1566***	0.0105	0.1359	0.1773	0.0000
Location type (reference: Metropolitan)					
Urban nonmetropolitan	-0.0827***	0.0086	-0.0994	-0.0659	0.0000
Rural	-0.1281***	0.0176	-0.1626	-0.0937	0.0000
2019 census quartiles (reference: 1st quartile)					
2nd quartile	0.0278***	0.0069	0.0143	0.0413	0.0001
3rd quartile	0.0318***	0.0081	0.0160	0.0476	0.0001
4th quartile	0.0528***	0.0090	0.0350	0.0705	0.0000
Percentage of minority residents in quartiles (reference: 1st quartile)					
2nd quartile	-0.0624***	0.0097	-0.0814	-0.0434	0.0000
3rd quartile	-0.1166***	0.0106	-0.1374	-0.0958	0.0000
4th quartile	-0.1547***	0.0119	-0.1780	-0.1315	0.0000
Acuity Index quartiles (reference: 1st quartile)					
2nd quartile	0.0312***	0.0096	0.0124	0.0501	0.0012
3rd quartile	0.0313***	0.0100	0.0118	0.0509	0.0017
4th quartile	0.0490***	0.0105	0.0285	0.0696	0.0000
Percentage of nursing staff that are contracted in quartiles (reference: 1st quartile)[^]					
3rd quartile	-0.0028	0.0046	-0.0118	0.0062	0.5437
4th quartile	-0.0158***	0.0050	-0.0256	-0.0061	0.0015
Pre-pandemic nursing staff level in quartiles					
2nd quartile	-0.2645***	0.0046	-0.2735	-0.2555	0.0000
3rd quartile	-0.4918***	0.0058	-0.5031	-0.4804	0.0000
4th quartile	-0.7816***	0.0071	-0.7956	-0.7676	0.0000
COVID-19 county-level death rate	0.0019***	0.0001	0.0017	0.0021	0.0000
Notes: We controlled for state by month fixed effects, but those estimates are not shown.					
[^] More than half of the facility-month observations had 0% of their nursing staff contracted; thus, there are only three quartiles.					
*/**/** = Significantly different from zero based on a p-value cutoff of 0.1/0.05/0.01.					
Green shows increase.			Gold shows decrease.		

Table A-6. Association between Change in Total Nurse, RN, LPN, and CNA Staffing from 2019 to 2020 and Nursing Home Characteristics, Random Effects Model

Covariates	Outcome			
	Change in Total Nurse HPRD (main model)	Change in RN HPRD	Change in LPN HPRD	Change in CNA HPRD
Profit and chain affiliation status (reference: for-profit chain)				
For-profit nonchain	0.0583***	-0.0064*	0.0110***	0.0537***
Nonprofit chain	0.1769***	0.0481***	0.0162***	0.1110***
Nonprofit nonchain	0.2847***	0.0423***	0.0341***	0.2125***
Hospital-based	0.0528**	0.0614***	0.0009	-0.0090
Star rating (reference 3-stars)				
1-star overall rating	-0.1003***	-0.0400***	-0.0060	-0.0544***
2-star overall rating	-0.0506***	-0.0141***	-0.0093**	-0.0258***
4-star overall rating	0.0540***	0.0262***	-0.0054	0.0346***
5-star overall rating	0.1566***	0.0655***	-0.0001	0.0960***
Location type (reference: Metropolitan)				
Urban nonmetropolitan	-0.0827***	-0.0351***	-0.0268***	-0.0173***
Rural	-0.1281***	-0.0522***	-0.0311***	-0.0344***
2019 census quartiles (reference: 1st quartile)				
2nd quartile	0.0278***	-0.0009	0.0208***	0.0123***
3rd quartile	0.0318***	-0.0085***	0.0308***	0.0180***
4th quartile	0.0528***	-0.0113***	0.0407***	0.0340***
Percentage of minority residents in quartiles (reference: 1st quartile)				
2nd quartile	-0.0624***	-0.0139***	-0.0073*	-0.0433***
3rd quartile	-0.1166***	-0.0325***	-0.0074*	-0.0826***
4th quartile	-0.1547***	-0.0449***	-0.0150***	-0.1053***
Acuity Index quartiles (reference: 1st quartile)				
2nd quartile	0.0312***	0.0076**	0.0204***	0.0048
3rd quartile	0.0313***	0.0123***	0.0171***	0.0064
4th quartile	0.0490***	0.0165***	0.0173***	0.0214***
Percentage of nursing staff that are contracted in quartiles (reference: 1st quartile)[^]				
3rd quartile	-0.0028	-0.0003	0.0001	-0.0022
4th quartile	-0.0158***	0.0017	-0.0078***	-0.0104***
Pre-pandemic nursing staff level in quartiles				
2nd quartile	-0.2645***	-0.0991***	-0.1217***	-0.2003***
3rd quartile	-0.4918***	-0.1970***	-0.2259***	-0.3811***
4th quartile	-0.7816***	-0.3266***	-0.3511***	-0.5990***
COVID-19 county-level death rate	0.0019***	0.0005***	0.0007***	0.0008***
Notes: We controlled for state by month fixed effects, but those estimates are not shown.				
[^] More than half of the facility-month observations had 0% of their nursing staff contracted; thus, there are three quartiles.				
*/**/** = Significantly different from zero based on a <i>p</i> -value cutoff of 0.1/0.05/0.01.				
Green shows increase.		Gold shows decrease.		

Table A-7. Association between Change in Nurse Staffing from 2019 to 2020 and Nursing Home Characteristics, Sensitivity Analysis with Clustering at the Nursing Home Level

Covariates	Coefficient	SE	95% CI		p-value
Profit and chain affiliation status (reference: for-profit chain)					
For-profit nonchain	0.0283***	0.0086	0.0114	0.0451	0.0010
Nonprofit chain	0.1022***	0.0114	0.0798	0.1246	0.0000
Nonprofit nonchain	0.1502***	0.0122	0.1263	0.1741	0.0000
Hospital-based	-0.0076	0.0280	-0.0625	0.0472	0.7846
Star rating (reference 3-stars)					
1-star overall rating	-0.0613***	0.0103	-0.0815	-0.0411	0.0000
2-star overall rating	-0.0356***	0.0098	-0.0549	-0.0163	0.0003
4-star overall rating	0.0189*	0.0098	-0.0004	0.0381	0.0547
5-star overall rating	0.0811***	0.0108	0.0600	0.1023	0.0000
Location type (reference: Metropolitan)					
Urban nonmetropolitan	-0.0580***	0.0083	-0.0743	-0.0418	0.0000
Rural	-0.0885***	0.0172	-0.1223	-0.0547	0.0000
2019 census quartiles (reference: 1st quartile)					
2nd quartile	-0.0026	0.0101	-0.0224	0.0172	0.7983
3rd quartile	-0.0208*	0.0107	-0.0418	0.0002	0.0518
4th quartile	-0.0194*	0.0113	-0.0415	0.0027	0.0856
Percentage of minority residents in quartiles (reference: 1st quartile)					
2nd quartile	-0.0368***	0.0103	-0.0571	-0.0165	0.0004
3rd quartile	-0.0642***	0.0113	-0.0864	-0.0420	0.0000
4th quartile	-0.0791***	0.0124	-0.1035	-0.0547	0.0000
Acuity Index quartiles (reference: 1st quartile)					
2nd quartile	0.0134	0.0098	-0.0059	0.0327	0.1726
3rd quartile	0.0101	0.0102	-0.0100	0.0301	0.3251
4th quartile	0.0127	0.0106	-0.0082	0.0335	0.2339
Percentage of nursing staff that are contracted in quartiles (reference: 1st quartile)[^]					
3rd quartile	0.0024	0.0069	-0.0111	0.0158	0.7290
4th quartile	-0.0138*	0.0078	-0.0290	0.0014	0.0749
Pre-pandemic nursing staff level in quartiles					
2nd quartile	-0.1486***	0.0064	-0.1612	-0.1360	0.0000
3rd quartile	-0.2178***	0.0087	-0.2348	-0.2007	0.0000
4th quartile	-0.3038***	0.0122	-0.3277	-0.2799	0.0000
COVID-19 county-level death rate	0.0021***	0.0002	0.0018	0.0024	0.0000

Notes: We controlled for state by month fixed effects, but those estimates are not shown.
[^] More than half of the facility-month observations had 0% of their nursing staff contracted; thus, there are three quartiles.
 */**/** = Significantly different from zero based on a p-value cutoff of 0.1/0.05/0.01.

Green shows increase.	Gold shows decrease.
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Table A-8. Association between Percent Change in Nurse Staffing Hours from 2019 to 2020 and Nursing Home Characteristics, Random Effects Sensitivity Analysis

Covariates	Coefficient	SE	95% CI		p-value
Profit and chain affiliation status (reference: for-profit chain)					
For-profit nonchain	0.5236**	0.2306	0.0716	0.9756	0.0232
Nonprofit chain	0.5018*	0.2838	-0.0544	1.0580	0.0770
Nonprofit nonchain	2.2450***	0.2786	1.6990	2.7910	0.0000
Hospital-based	-0.1438	0.5515	-1.2248	0.9372	0.7943
Star rating (reference 3-stars)					
1-star overall rating	0.0658	0.2927	-0.5079	0.6396	0.8220
2-star overall rating	-0.0173	0.2805	-0.5670	0.5324	0.9507
4-star overall rating	-0.1323	0.2720	-0.6654	0.4009	0.6268
5-star overall rating	-0.4164	0.2794	-0.9639	0.1312	0.1361
Location type (reference: Metropolitan)					
Urban nonmetropolitan	-1.2840***	0.2277	-1.7304	-0.8377	0.0000
Rural	-3.1972***	0.4680	-4.1144	-2.2800	0.0000
2019 census quartiles (reference: 1st quartile)					
2nd quartile	2.1659***	0.1827	1.8078	2.5241	0.0000
3rd quartile	4.7709***	0.2369	4.3067	5.2351	0.0000
4th quartile	6.6040***	0.2857	6.0441	7.1639	0.0000
Percentage of minority residents in quartiles (reference: 1st quartile)					
2nd quartile	0.4498*	0.2583	-0.0564	0.9560	0.0816
3rd quartile	0.7126**	0.2824	0.1592	1.2661	0.0116
4th quartile	0.9802***	0.3148	0.3633	1.5971	0.0018
Acuity Index quartiles (reference: 1st quartile)					
2nd quartile	0.2506	0.2561	-0.2514	0.7526	0.3279
3rd quartile	0.3092	0.2651	-0.2103	0.8288	0.2434
4th quartile	0.4266	0.2787	-0.1196	0.9729	0.1258
Percentage of nursing staff that are contracted in quartiles (reference: 1st quartile)^					
3rd quartile	-0.1814*	0.1085	-0.3940	0.0313	0.0946
4th quartile	-1.0996***	0.1199	-1.3345	-0.8646	0.0000
Pre-pandemic nursing staff level in quartiles					
2nd quartile	-9.9619***	0.1758	-10.3065	-9.6173	0.0000
3rd quartile	-17.4192***	0.2272	-17.8646	-16.9738	0.0000
4th quartile	-23.1776***	0.2800	-23.7265	-22.6287	0.0000
COVID-19 county-level death rate	-0.0307***	0.0022	-0.0349	-0.0264	0.0000
Notes: We controlled for state by month fixed effects, but those estimates are not shown.					
^ More than half of the facility-month observations had 0% of their nursing staff contracted; thus, there are three quartiles.					
*/**/*** = Significantly different from zero based on a p-value cutoff of 0.1/0.05/0.01.					
Green shows increase.			Gold shows decrease.		

Table A-9. Association between Percent Change in Nurse Staffing Hours from 2019 to 2020 and Nursing Home Characteristics, Sensitivity Analysis with Clustering at the Nursing Home Level

Covariates	Coefficient	SE	95% CI	p-value	
Profit and chain affiliation status (reference: for-profit chain)					
For-profit nonchain	0.3229	0.2244	-0.1169	0.7626	0.1501
Nonprofit chain	-0.1428	0.2930	-0.7171	0.4315	0.6260
Nonprofit nonchain	1.2293***	0.2724	0.6954	1.7632	0.0000
Hospital-based	0.6213	0.5348	-0.4270	1.6695	0.2454
Star rating (reference 3-stars)					
1-star overall rating	-0.0103	0.2992	-0.5967	0.5762	0.9726
2-star overall rating	-0.1748	0.2714	-0.7068	0.3572	0.5196
4-star overall rating	-0.0068	0.2581	-0.5127	0.4991	0.9790
5-star overall rating	0.0568	0.2639	-0.4604	0.5741	0.8295
Location type (reference: Metropolitan)					
Urban nonmetropolitan	0.0550	0.2264	-0.3888	0.4988	0.8081
Rural	-0.1744	0.4465	-1.0495	0.7008	0.6962
2019 census quartiles (reference: 1st quartile)					
2nd quartile	3.0957***	0.3287	2.4515	3.7399	0.0000
3rd quartile	5.2807***	0.4331	4.4318	6.1296	0.0000
4th quartile	6.8269***	0.5070	5.8332	7.8206	0.0000
Percentage of minority residents in quartiles (reference: 1st quartile)					
2nd quartile	-0.0828	0.2550	-0.5825	0.4169	0.7452
3rd quartile	-0.0782	0.2820	-0.6309	0.4745	0.7814
4th quartile	-0.2595	0.3135	-0.8740	0.3549	0.4077
Acuity Index quartiles (reference: 1st quartile)					
2nd quartile	-0.3828	0.2544	-0.8813	0.1158	0.1324
3rd quartile	-0.5351**	0.2658	-1.0560	-0.0143	0.0440
4th quartile	-0.1768	0.2806	-0.7268	0.3731	0.5285
Percentage of nursing staff that are contracted in quartiles (reference: 1st quartile)[^]					
3rd quartile	0.0936	0.1803	-0.2599	0.4470	0.6039
4th quartile	-0.0340	0.1970	-0.4201	0.3520	0.8629
Pre-pandemic nursing staff level in quartiles					
2nd quartile	-5.8842***	0.3302	-6.5315	-5.237	0.0000
3rd quartile	-10.2570***	0.4385	-11.1164	-9.3975	0.0000
4th quartile	-13.7456***	0.5204	-14.7655	-12.7257	0.0000
COVID-19 county-level death rate	-0.0350***	0.0034	-0.0417	-0.0283	0.0000
Notes: We controlled for state by month fixed effects, but those estimates are not shown.					
[^] More than half of the facility-month observations had 0% of their nursing staff contracted; thus, there are three quartiles.					
*/**/** = Significantly different from zero based on a p-value cutoff of 0.1/0.05/0.01.					
Green shows increase.			Gold shows decrease.		

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