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Regular Research Article

Did the COVID-19 Pandemic Affect the Use of Antipsychotics Among Nursing Home Residents With ADRD?

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ABSTRACT

Objective: To examine whether and how the COVID-19 pandemic affected the use of antipsychotics among residents with Alzheimer's disease and related dementias in nursing homes. **Design:** Observational study based on the Minimum Data Set and Medicare claims. **Setting:** Medicare- and/or Medicaid-certified nursing homes. **Participants:** Nursing home residents diagnosed with Alzheimer's disease and related dementias between 2017 and 2020. **Measurements:** The main outcome variable was any antipsychotic use during a quarter. The secondary outcome was certified nursing assistants' staffing hours per bed per day in a quarter. We categorized nursing homes into quartiles based on the distribution of nursing home racial and/or ethnic composition. To explore the relationship between the COVID-19 pandemic and the frequency of antipsychotic use, we estimated a linear probability model with robust standard errors, individual and facility random effects. We used a similar model for certified nursing assistant hours. **Results:** About 23.7% of residents with ADRD had antipsychotic uses during the study period. The frequency of antipsychotic use declined from 23.7%–23.1% between the first quarter of 2017 (2017Q1) and the first quarter of 2020 (2020Q1) but increased to 24.8% by the last quarter of 2020 (2020Q4). Residents in all four racial and/or ethnic groups experienced an increase in antipsychotic use during the COVID-19 pandemic, but the extent of the increase varied by race and/or ethnicity. For example, while residents in the very-high minority nursing homes experienced a greater increase in antipsychotic use than did the residents of other nursing homes at the beginning of the pandemic, the increasing trend during the pandemic was smaller in the very-high minority nursing homes compared to the low-minority nursing homes (0.2 percentage points less, $p < 0.001$, based on

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*heteroskedasticity-robust t statistics, $t = 3.67$, $df = 8,155,219$). On average, the certified nursing assistant hours decreased from 1.8–1.7 hours per bed per day between 2017Q1 and 2020Q1, and further decreased to 1.5 hours per bed per day by 2020Q4. There was also a decreasing trend in staffing hours across all racial and/or ethnic groups during the pandemic. **Conclusions and Relevance:** The COVID-19 pandemic was associated with an increase in the use of antipsychotics among nursing home residents with Alzheimer's disease and related dementias and decreased staffing of certified nursing assistants, especially among nursing homes with a high minority penetration. Future research is needed to explore means for reducing antipsychotic use, particularly in homes with a high penetration of minority residents. (Am J Geriatr Psychiatry 2022; ■■■:■■–■■)*

Highlights**What is the primary question addressed by this study?**

- Did the COVID-19 pandemic increase the use of antipsychotics among nursing home residents with Alzheimer's disease and related dementias (ADRD)?
- How did the impact of the pandemic on antipsychotic use vary by nursing home racial and/or ethnic minority composition?

What is the main finding of this study?

- The COVID-19 pandemic was associated with higher antipsychotic uses among nursing home residents with ADRD. At the beginning of the pandemic, very-high minority nursing homes were associated with an additional 2.9 percentage-points increase ($p = 0.005$) in the probability of antipsychotic use compared to low-minority nursing homes.

What is the meaning of the finding?

- The COVID-19 pandemic has contributed to an increase in the use of antipsychotics and nursing homes with high minority penetration experienced more severe adverse impacts from the pandemic.

INTRODUCTION

The COVID-19 pandemic has disproportionately affected nursing home (NH) residents, whose deaths have accounted for 17% of all COVID-related deaths in the US.^{1,2} The pandemic has created challenges in caring for NH residents, and in particular for those most vulnerable, such as the residents with Alzheimer's disease and related dementias (ADRD), who represent almost half of the NH population.³ The pandemic also impacted NH staff, with more than one million infected by COVID-19,² and many leaving the industry due to stress, burnout, and increasing workloads.^{4,5} To mitigate the nursing staff

shortage, states lowered the training requirements for newly hired nursing aides.⁶

Not surprisingly, the pandemic appears to have worsened NH care quality as measured by increased risks of falls with injury and higher rates of pressure ulcers.^{7,8} During the pandemic, NHs have implemented policies to reduce in-person contacts and restrict family visits.⁹ For patients with ADRD, such restrictions may have additionally impacted their mental health, increased the incidence of psychiatric and behavioral symptoms, and exacerbated verbal and physical aggressiveness.^{4,10–12}

Antipsychotics are commonly used to manage behavioral and psychological symptoms among residents with ADRD and to reduce the burden on staff. However, there are serious concerns about the safety of antipsychotic use among older adults.^{13,14} Studies

found that antipsychotic use among older adults with ADRD was associated with higher risks of mortality,¹⁵ cardiovascular diseases,¹⁶ fractures,¹⁷ and pneumonia.^{18–20} Historically, the lack of training in managing the care of residents with ADRD and staffing shortages, were associated with higher risks of antipsychotic use and other adverse health conditions among NH residents.^{21–23}

NH staff shortage, reduced staff training, and the effects of social isolation have raised the concern of the possible overuse of antipsychotic medications during the pandemic.²⁴ While there has been a steady declining trend in the use of antipsychotics in NHs in the past decade,²⁵ the pandemic may have reversed it, exposing more residents to antipsychotic use. Indeed, a recent study found a statistically significant increase in antipsychotic use during the COVID-19 pandemic in NHs in Ontario, Canada, between March and September of 2020.²⁶ However, there have been no studies on the possible impact of the COVID-19 pandemic on antipsychotic use among residents with ADRD in NHs in the U.S. Moreover, the impacts of the pandemic may have disproportionately affected NHs serving high proportions of racial/ethnic minority residents. NHs serving a high proportion of minorities are known to have fewer resources, lower quality of care,²⁷ and have experienced more COVID-19 cases and deaths than low-minority NHs.^{28–31} To date, there is no empirical study on how the pandemic influenced antipsychotic use in NHs serving a high- versus low-proportion of minorities.

The main aim of our study was to examine whether the COVID-19 pandemic significantly increased the use of antipsychotics among residents with ADRD in NHs. We further assessed how the impact of the pandemic on antipsychotic use among residents with ADRD varied by NH racial and/or ethnic minority composition. Because certified nurse assistants (CNAs) were essential in providing non-pharmacological care,³² we also examined whether the COVID-19 pandemic reduced CNA staffing in NHs.

METHODS

Data. We linked the Minimum Data Set (MDS) 3.0 with Medicare Master Beneficiary Summary File (MBSF) for the calendar years (CY) 2017–2020. We used 100% national MDS and MBSF data files. The MDS is an

assessment tool conducted for all residents in Medicare- and/or Medicaid- certified NHs. The MDS assessments contain information on residents' use of antipsychotics as well as on their health conditions and diagnoses. The MBSF contains basic information on individual demographics, such as race, ethnicity, gender, and age. We also used the CMS Nursing Home Compare (NHC) data and Payroll-Based Journal data (PBJ). NHC contains information on NH characteristics, such as ownership and bed size. PBJ contains information on NH staffing for registered nurses (RNs), licensed practical nurses (LPNs), and CNAs. We obtained the 2018 national Area Deprivation Index (ADI) from the Neighborhood Atlas website.³³ ADI captures the socio-economic status of a neighborhood, and its values range from 1–100, with a higher value indicating a more economically deprived community.

Cohort. The study cohort included Medicare-eligible NH residents reported as Hispanic, Black (non-Hispanic), or White (non-Hispanic) in the MBSF who were diagnosed with ADRD between CY2017 and 2020. The identification of ADRD was based on the MDS (diagnosis checkboxes and International Classification of Diseases version 10, ICD-10). In total, the analytical sample included 10,958,967 person-quarters over the 2017–2020 time period (2,787,961 unique individuals). A total of 15,751 NHs were included in the study cohort.

Variables. The main outcome variable was any antipsychotic use during a quarter. The secondary outcome was CNA hours per bed per day in a quarter. We used PBJ rather than the NHC to define CNA hours because PBJ reported actual working hours, while NHC reported adjusted working hours and changed the method to calculate the CNA hour measure in 2018.³⁴ The key independent variables of interest included the racial and/or ethnic composition of an NH, an indicator for the onset of the COVID-19 pandemic (i.e., after April 1, 2020), a time trend variable representing the 16 quarters in the study period, and another time trend variable representing three quarters of the COVID pandemic. The NH racial and/or ethnic composition was calculated as the percentage of Black and Hispanic residents among all NH residents across the study period. We then categorized NHs into quartiles based on the distribution of NH racial and/or ethnic composition, with homes in the first quartile serving the fewest Black and/or Hispanic residents and in the 4th quartile serving the highest percentage.

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We also accounted for individual age, gender, race, marital status, aggressive behavior, and cognitive impairment as covariates in the regression analyses. Aggressive behavior was measured by the aggressive behavior scale (ABS). ABS was a composite score based on the MDS.³⁵ The scale ranged from 0–12, with a higher score indicating more severe behavioral problems. Based on the literature, we considered those with ABS greater than one as having any behavioral issues.³⁶ The cognitive function scale (CFS) measured cognitive performance based on the MDS items. The CFS ranges from 0–6, with six as the highest level of impairment. As in prior studies, we defined the CFS score of 5–6 as a severe impairment.³⁷ We linked the individual residential zip codes with the Neighborhood Atlas data and used ADI as a proxy for individual-level socioeconomic status. We categorized a community as being disadvantaged if the ADI was at least 85.³⁸

Facility-level characteristics included the ownership and the total number of beds. We also linked NH zip codes with the Neighborhood Atlas data and obtained the ADI.

Statistical Analysis. We first examined the frequency of antipsychotic use and CNA hours per bed per day across NHs with different racial and/or ethnic minority compositions. To explore the relationship between the COVID-19 pandemic and the frequency of antipsychotic use, we estimated a linear probability model³⁹ with robust standard errors, individual and facility random effects. We used the linear probability model because it was computationally efficient, given the study's large sample size, and allowed for the direct interpretation of the coefficients (i.e., the difference in the probability of antipsychotic use across NH groups), especially the interaction terms.⁴⁰ In the regression model, we created variables containing a linear spline of time (with knots as the starting of the pandemic [2020Q2]) to allow for different trends in antipsychotic use before and during the pandemic. We also included NH racial and/or ethnic minority composition, an indicator of the onset of the COVID-19 pandemic period, and sets of two-way interactions in the regression model. More specifically, we included a set of interactions between NH racial and/or ethnic subgroups and the time splines to examine variations in the trend of antipsychotic use across NH subgroups before and during the pandemic; and a set of interactions between NH

subgroups and the COVID-19 pandemic indicator to examine variations in the discrete change in antipsychotic use across NH subgroups at the beginning of the pandemic. In all analyses, we controlled for other individual-level and facility-level covariates. We used linear models and performed similar analyses to examine the relationship between the pandemic and CNA staffing at the NH level.

Sensitivity Analysis. Previous studies have suggested that NH ownership status and its location, especially the socio-economic status of the community, may affect health providers' response to policies and public health issues.^{41,42} Therefore, we performed analyses among NHs by profit versus non-profit and among NHs in poor versus more affluent communities, similar to the analyses among NH racial and/or ethnic subgroups. In addition, because facility size may be closely related to the COVID outbreak,³⁹ we also tested whether the relationship between antipsychotic use and the pandemic varied by NH size. Lastly, we performed analyses to examine the relationship between the pandemic and LPN/RN staffing at the NH level.

The statistical analyses were performed by SAS 9.4 (SAS Institute Inc.) and STATA 17 (StataCorp LLC.) The University of Rochester Research Subjects Review Board has reviewed and approved this study.

RESULTS

Relationships Between Antipsychotic Use and the Pandemic

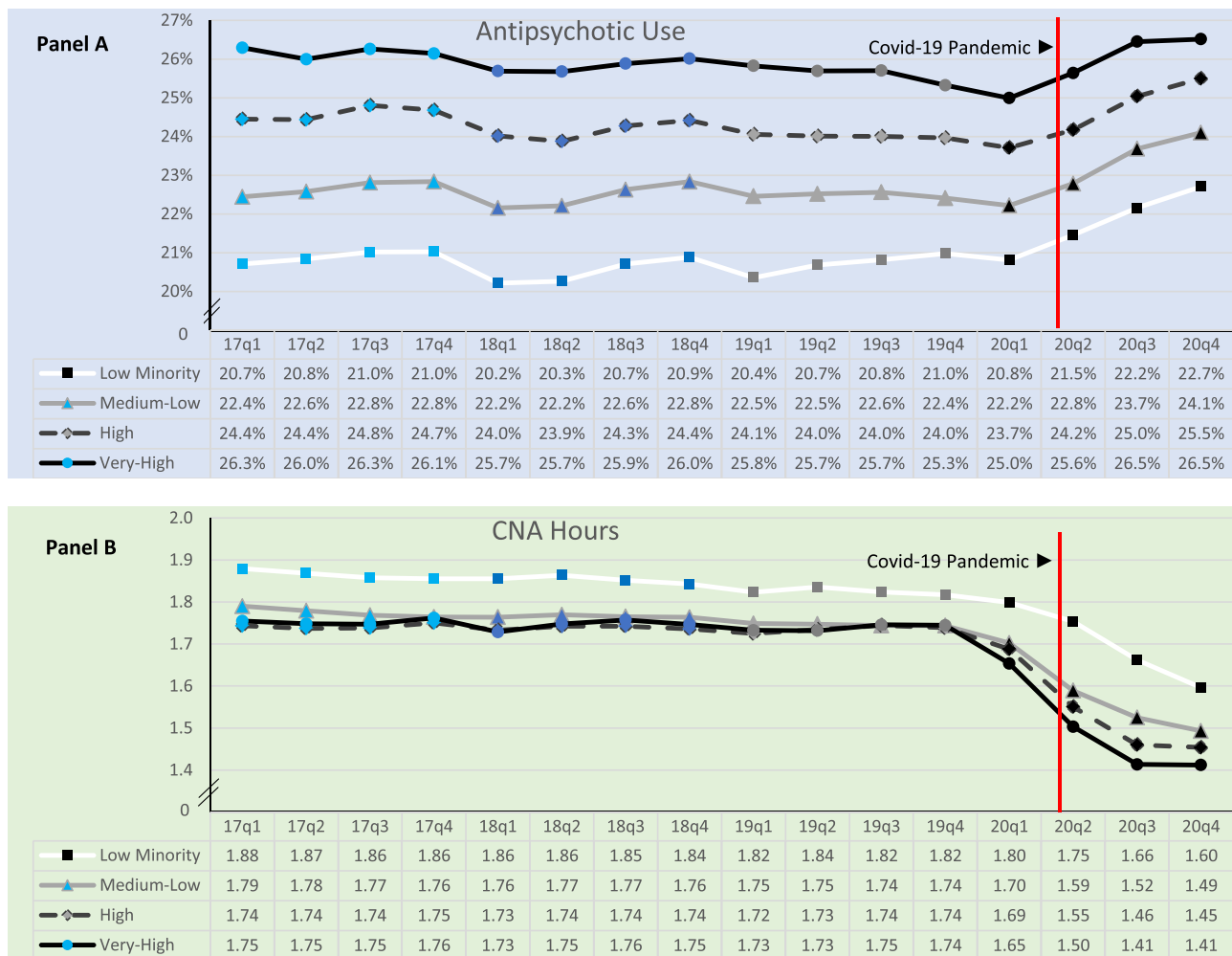
About 23.7% of residents with ADRD had antipsychotic uses during the study period. Between 2017Q1 and 2020Q1, the frequency of antipsychotic use declined from 23.7%–23.1% (t test, df = 1,400,250, t = 1.10, p = 0.136). However, by 2020Q4 it increased to 24.8% (t test, 23.7% versus 24.8%, df = 1,283,154, t = 19.35, p<0.001). Overall, antipsychotic use was higher in NHs with a greater minority penetration. For example, antipsychotic use across the study period was 20.9%, 22.7%, 24.3%, and 25.9% (ANOVA test, df [3; 10,958,963], F = 232.76, p<0.001) in low, medium-low, high, and very-high minority NHs, respectively. In [Figure 1](#) Panel A, we presented the frequency of antipsychotic use across the study period by NH groups. Model 1 in [Table 1](#) presents regression results for the use of antipsychotics,

controlling for individual and facility random effects. NHs with a higher percentage of minorities generally had a higher likelihood of antipsychotic use. For example, high- and very-high-minority NHs had a 6.2 (95% CI: [5.7, 6.6], $p < 0.001$, based on heteroskedasticity-robust t statistics, $t = 26.67$, $df = 8,155,219$) and 9.3 (95% CI: [8.9, 9.8], $p < 0.001$, based on heteroskedasticity-robust t statistics, $t = 39.53$, $df = 8,155,219$) percentage-points higher

probability of antipsychotic use among residents with ADRD than low-minority NHs at the beginning of the study period (2017Q1). Full results from the model were shown in Table A2.

All four NH groups experienced an increasing trend in antipsychotic use during the COVID-19 pandemic. At the beginning of the pandemic (2020Q2), there was a 0.7 (95% CI: [0.5, 0.8], $p < 0.001$, based on heteroskedasticity-robust t statistics, $t = 9.03$, $df =$

FIGURE 1. Average Antipsychotic Use and CNA Hours in Each Quarter By NH Groups, 2017–2020. We calculated racial and/or ethnicity composition of a nursing home (NH) as the average percent of Blacks and/or Hispanics between 2017 and 2020, then we categorized NHs into four mutually exclusive groups based on the percent of Blacks and/or Hispanics: low (0% to <1.5%), medium-low (1.5% to <7.2%), high (7.2% to <23.7%), and very-high ($\geq 23.7\%$) percent minorities, with each accounting for approximately 25% of all NHs. The Covid-19 pandemic period was defined as the second to fourth quarter of 2020 (2020Q2 to Q4). Antipsychotic use was defined as percent of NH resident with ADRD who has any antipsychotic use during a quarter based on the Minimum Data Set. Certified nursing aide (CNA) hours was defined as CNA hours per bed per day based on the Nursing Home Compare data and Payroll-Based Journal data.



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TABLE 1. Antipsychotics Use and CNA Hours Changes during Covid-19 Pandemic, 2017–2020. Linear Probability Models with Selected Variables, Adjusting County, Facility, and Individual Covariates

Outcome Variables	Model 1 Antipsychotics Use β Coefficients (Robust Standard Errors)	Model 2 CNA Hours Per Bed Per Day β Coefficients (Robust Standard Errors)
NH Subgroups (Ref: Low Minority)		
Medium-Low $\geq 1.5\%$ to $< 7.2\%$	0.0291 ^b (0.00229)	-0.0275 (0.0226)
High $\geq 7.2\%$ to $< 23.7\%$	0.0616 ^b (0.00231)	-0.0728 ^a (0.0362)
Very High $\geq 23.7\%$	0.0933 ^b (0.00236)	-0.142 ^b (0.0409)
Time ^c	-0.000705 ^b (0.0000576)	-0.00742 ^b (0.000571)
NH Groups \times Time ^d		
Medium-Low \times Time	-0.00126 ^b (0.0000773)	0.00175 ^a (0.000814)
High \times Time	-0.00250 ^b (0.0000758)	0.00489 ^b (0.000887)
Very High \times Time	-0.00346 ^b (0.0000747)	0.00544 ^b (0.000766)
Pandemic indicator ^e	0.00659 ^b (0.000730)	-0.0470 ^b (0.00486)
NH Groups \times Pandemic indicator ^f		
Medium-Low \times Pandemic	-0.000640 (0.0100)	-0.465 ^a (0.0499)
High \times Pandemic	0.0178 (0.0105)	-0.464 ^a (0.0526)
Very High \times Pandemic	0.0290 ^a (0.0103)	-0.508 ^a (0.0495)
Post Pandemic Time ^g	0.00561 ^b (0.000513)	-0.0689 ^b (0.00245)
NH Groups \times Post Pandemic Time ^h		
Medium-Low \times Post Pandemic Time	-0.000193 (0.000664)	0.0278 ^b (0.00344)
High \times Post Pandemic Time	-0.00151 ^a (0.000662)	0.0250 ^b (0.00351)
Very High \times Post Pandemic Time	-0.00242 ^b (0.000660)	0.0261 ^b (0.00340)
Individual Characteristics	Yes	–
Facility Characteristics	Yes	Yes
Area Deprivation Index	Yes	Yes
Individual Random Effects	Yes	–
Facility Random Effects	Yes	Yes
N of Individual-quarter	10,958,967	–
N of Individuals	2,787,961	–
N of NH-quarter	–	202,147
N of NHs	15,751	15,751

CNA = certified nursing aide; NH = nursing home.

^a $p < 0.05$,

^b $p < 0.001$; p values were based on the Heteroskedasticity-robust t statistics. The df of Model 1 and 2 were 8,155,219 and 186,372, respectively.

^c: Time trend was coded as 0-15 to represent the 16 quarters in the study period. The coefficient captured trends in antipsychotic use /CNA hours in the low-minority NHs prior to the pandemic.

^d: The coefficients captured the differences in time trend in antipsychotic use/CNA hours between NH subgroups (low-minority NHs as the references) prior to the pandemic.

^e: The pandemic indicator was coded as 0/1; the coefficient captured the discrete change (i.e., intercept shift) in antipsychotic use/CNA hours in low-minority NHs at the beginning of the pandemic (i.e., 2020Q2).

^f: The coefficients captured differences in intercept shift across NH subgroups, with low-minority NHs as the reference.

^g: The post-pandemic trend was coded as 0-2, representing the three quarter in the pandemic. The coefficient captured the changes in the slope during the pandemic (relative to prior pandemic) in low-minority NHs.

^h: Coefficients captured the differences in slope changes across NH subgroups during the pandemic, with low-minority NHs as the reference. This table included selected variables. Full results were shown in [Appendix-Table 2&3](#).

8,155,219) percentage-points increase in the probability of antipsychotic use in low-minority NHs, and an additional 2.9 percentage-points increase (95% CI: [0.09, 0.49], $p = 0.005$, based on heteroskedasticity-robust t statistics, $t = 2.82$, $df = 8,155,219$) in the probability of antipsychotic use in very-high minority NHs (i.e., the coefficients for the interactions between NH groups and the pandemic indicator). We also observed varying increasing trends in antipsychotic

use across all NH subgroups during the pandemic. For example, compared with low-minority NHs, the increasing indicators in antipsychotic use (i.e., the coefficient of the interactions between NH groups and the post-pandemic indicator) was smaller for high-minority (slope difference = - 0.002, 95% CI: [-0.0028, -0.0002], $p = 0.023$, based on heteroskedasticity-robust t statistics, $t = 2.28$, $df = 8,155,219$) and very-high-minority (slope difference = - 0.002, 95%

CI: [-0.0037, -0.0011], $p < 0.001$, based on heteroskedasticity-robust t statistics, $t = 3.67$, $df = 8,155,219$) NHs during the pandemic. To ease the interpretation of these findings, we presented changes in the slopes and the interactions of antipsychotic use before and after the COVID-19 pandemic in [Figure 2 Panel A](#).

Relationship Between CNA Staffing and the Pandemic

NH staffing decreased during the pandemic ([Figs. 1 and 2 B panels](#)). On average, CNA hours decreased from 1.8–1.7 per bed per day between 2017Q1 and 2020Q1 (t test, $df = 29,254$, $t = 5.32$, $p < 0.001$), and further declined to 1.5 hours per bed per day by 2020Q4 (t test, 1.8 versus 1.5, $t = 38.90$, $df = 29,702$, $p < 0.001$). CNA hours were higher among NHs with the lowest minority concentration compared to the other three NH groups (ANOVA, $df [3; 202,143]$, $F = 491.89$, $p < 0.001$) across the study period. In [Figure 1 Panel B](#), we presented changes in the average CNA hours by NH groups across the study.

As presented in Model 2 in [Table 1](#), NHs with a higher proportion of minorities generally had lower CNA staffing compared to low-minority NHs. The pandemic further decreased CNA staffing in NHs. For example, at the beginning of the pandemic, the adjusted CNA hours declined by 0.05 hours per bed per day (95% CI: [0.04, 0.06], $p < 0.001$, based on heteroskedasticity-robust t statistics, $t = 9.67$, $df = 186,372$) in low-minority NHs and by an additional 0.51 hours per bed per day (95% CI: [0.41, 0.61], $p < 0.001$, based on heteroskedasticity-robust t statistics, $t = 10.52$, $df = 186,372$) in very high-minority NHs (i.e., the coefficient between NH groups and the pandemic indicator). There was a decreasing trend in CNA levels during the pandemic, but it varied by NH subgroups. For example, the decreasing trend in each quarter during the pandemic was 0.03 hours per bed per day smaller (95% CI: [0.02, 0.04], $p < 0.001$, based on heteroskedasticity-robust t statistics, $t = 7.68$, $df = 186,372$) in very-high-minority NHs compared with low-minority NHs. To ease the interpretation, we presented the changes in CNA hours before and during the pandemic in low-minority NHs and very high-minority NHs in [Figure 2 Panel B](#).

We also examined the effects of the COVID-19 pandemic on RN and LPN hours ([Table A3](#)). Compared to the time trend before the pandemic, RN and LPN

staffing hours also decreased during the pandemic. Changes in RN and LPN hours did not show significant differences across the four NH subgroups.

Effects of Other Covariates and Sensitivity Analyses

The results of full models are presented in [Tables A2 and A3](#). Older age (85 and above) and minority residents (Black/Hispanic) were less likely to use antipsychotics. Residents with severe cognitive impairment or aggressive behavior were more likely to have antipsychotic use. Although for-profit NHs and NHs in more disadvantaged communities were associated with lower staffing hours, residents in for-profit NHs or residing in disadvantaged communities were not associated with higher antipsychotic use. We further examined whether the impact of the COVID-19 pandemic on antipsychotic use varied among for-profit versus non-profit NHs, large versus small NHs, or among NHs in disadvantaged versus less-disadvantaged communities in [Table A4 and A5](#). The results did not show a significant difference in the impact of the COVID-19 pandemic on antipsychotic use among either for-profit versus non-profit, large versus small, or among NHs in disadvantaged versus less-disadvantaged communities.

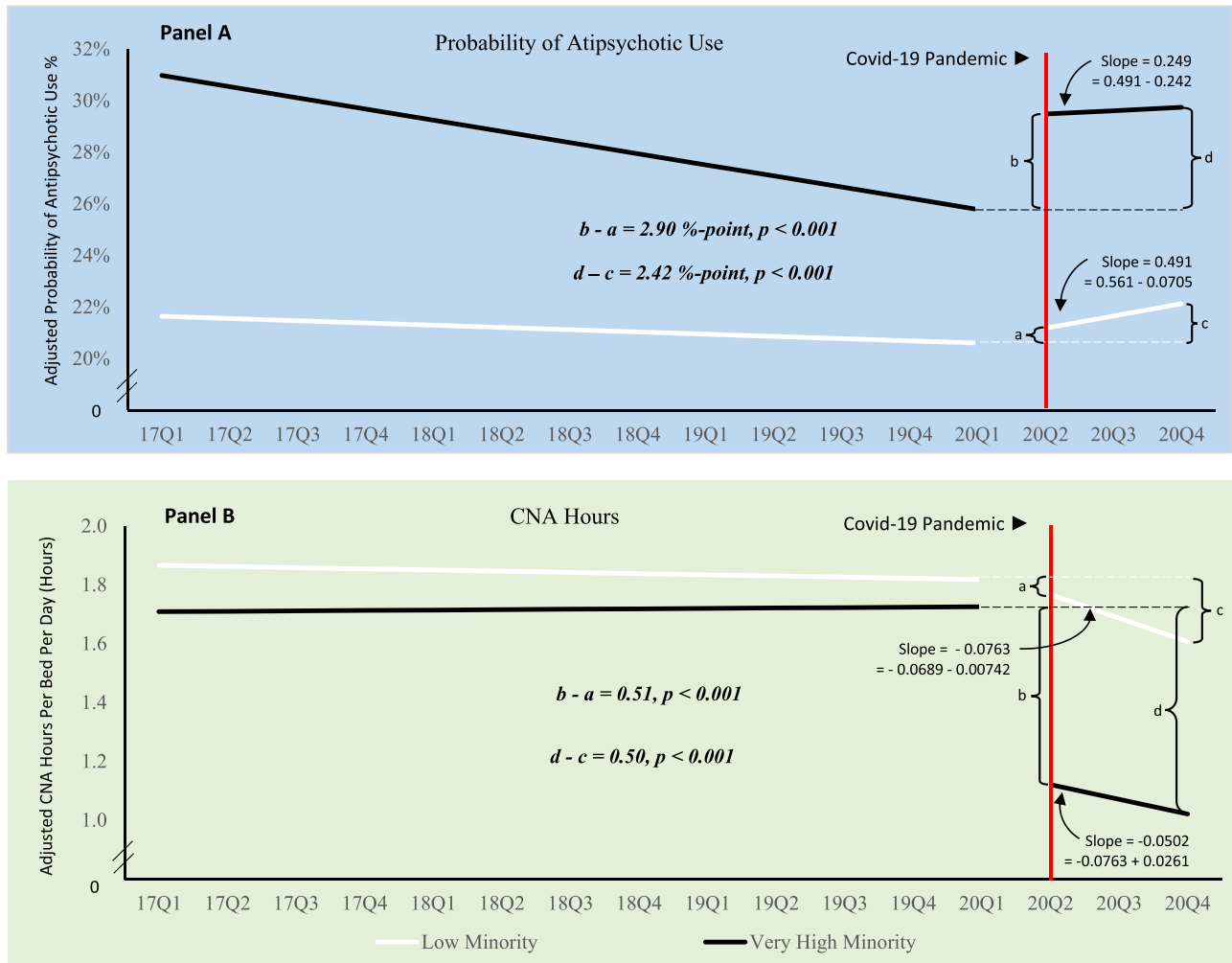
DISCUSSION

We examined the antipsychotic use among NH residents with ADRD before and during the COVID-19 pandemic and found an increase in antipsychotic use during the pandemic. In addition, we found that the COVID-19 pandemic was associated with a decrease in CNA hours. These changes varied by the racial and/or ethnic composition of NHs.

Consistent with the existing literature,^{26,43} we found an increase in antipsychotic use among NH residents with ADRD during the pandemic. The effect size was moderate but meaningful. For instance, the pandemic was associated with a 2.4 percentage point higher frequency of antipsychotic use by the end of 2020. In other words, the frequency of antipsychotic use increased by 8.9% three quarters into the pandemic. Many restrictions adopted by NHs during the pandemic were necessary to control the infection and protect residents

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FIGURE 2. Estimations of The Effects of Covid-19 Pandemic on Antipsychotic Use and CNA Hours by NH Groups. CNA represented certified nursing aide. We calculated racial and/or ethnicity composition of a nursing home (NH) as the average percent of Blacks and/or Hispanics between 2017 and 2020 then we categorized NHs into four mutually exclusive groups based on the percent of Blacks and/or Hispanics: low (0% to <1.5%), medium-low (1.5% to <7.2%), high (7.2 to <23.7%), and very-high ($\geq 23.7\%$) percent minorities, with each accounting for approximately 25% of all NHs. For easy of understanding, we just presented the estimations among low minority NHs and very high minority NHs. The Covid-19 pandemic period was defined as the second to fourth quarter of 2020 (2020Q2 to Q4). The estimations of slopes and the differences of intercepts were based on the Model 1 and 2 in Table 1. We used the Wald test to compare two adjusted probabilities (i.e., B–A and D–C) and the df of all Wald tests equal to one.



from becoming sick and perhaps dying. These restrictions, which increased isolation, may have exacerbated loneliness and disrupted routine activities, thus having had unintended consequences on residents' mental health, especially for individuals with AD/DRD. The pandemic and the added stress on staff made it more difficult to provide appropriate care and manage residents' behavioral problems, leading to increased antipsychotic use.

Furthermore, we found that the increase in antipsychotic uses was significantly greater in NHs with a higher concentration of minority residents, especially at the beginning of the pandemic. High-minority NHs are likely to be resource-poorer and have been especially affected by the pandemic in a number of ways.^{44–46} The challenges of balancing the efforts to control the infection, minimizing the impact on residents' mental health, and providing

proper management of behavioral issues, were even greater for minority-serving NHs.^{47,48} These NHs, even before the pandemic, were less likely to provide appropriate mental health-related services and had a higher frequency of antipsychotic use.^{49,50} The pandemic aggravated the pre-existing challenges in these NHs as they may have struggled to control the outbreak of COVID-19 cases while dealing with the staffing shortage. Indeed, we found that NHs with a high proportion of minorities experienced a greater decrease in CNA staffing at the beginning of the pandemic. To mitigate nursing staff shortage, states implemented policies to relax the requirement on training for newly hired workers during the pandemic.⁶ This policy may also have led to inadequate dementia care in NHs, especially in minority-serving NHs.

Technologies, such as telemedicine,⁵¹ may have the potential to improve residents' well-being and mental health without incurring an additional burden on infection control.^{52,53} For example, telecommunication can be used to allow residents to be connected to their family or friends and mitigate the negative impact on mental health among residents with ADRD. In fact, Alzheimer's Association published a guideline for current caregivers to improve the care delivery for people with ADRD during the pandemic by scheduling telephone or video calls with families and friends, active observation and response to dementia-related behaviors, and sharing of person-centered information across the care team.¹⁰ The extent to which NHs, including those serving a high proportion of minority residents, have adopted such technologies is not clear. As the reliance on these technologies will not likely disappear with the pandemic's waning, it may be important to ensure that all NHs are well equipped to use telehealth technologies.

IMPLICATIONS

Our findings showed an increase in antipsychotic use among residents with ADRD during the COVID-19 pandemic. This is troubling given the association between exposure to antipsychotics and safety risks for patients in general and COVID-19 patients in particular.⁵⁴ The results of this study also suggested a decrease in CNA hours during the pandemic. Although

restoring the healthcare workforce to the pre-pandemic levels has been challenging, NH providers and policy-makers may consider other possible avenues to ensure the quality of care for residents with ADRD. These may include specific training for current workers, strategies facilitating the connection between residents and their families and friends, and telemedicine approaches to improving access to mental health providers. NHs with high minority penetration experienced more severe adverse impacts from the COVID-19 pandemic. Future research is needed to explore the reasons underlying this increase in antipsychotic use and to explore means for reducing antipsychotic use, particularly in homes with high penetration of minority residents.

LIMITATIONS

There are some limitations of this study. First, the number of NH residents with ADRD decreased after the pandemic (Fig. A1). It is possible that residents with less severe health conditions may have been discharged from NHs during the COVID-19 pandemic. In that case, the probability of antipsychotic use would increase among the remaining residents with more severe cognitive and psychical impairments. Nonetheless, after adjusting for individual cognitive and behavioral function, the association between the COVID-19 pandemic and outcome variables was still significant. Second, the antipsychotic use measures (i.e., any antipsychotic use in a quarter) were based on the MDS assessments. We may not be able to capture all the prescriptions of antipsychotics. Nonetheless, MDS-based antipsychotic use is used as a NH quality measure by the CMS. In addition, as the MDS did not include information on prescriptions, dosage, generic and/or brand names, or length of use, we were not able to further evaluate whether the medication use was appropriate or not. Future studies may be needed to examine the misuse and/or overuse of antipsychotics during the pandemic.

CONCLUSIONS

The COVID-19 pandemic has contributed to an increase in the use of antipsychotics among residents with ADRD and a decrease in CNA hours within US NHs. The decrease in front-line nursing staff working hours made it more challenging to mitigate or reverse the increasing in antipsychotic use during the

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COVID-19 pandemic. Medicare beneficiaries with ADRD residing in NHs with higher penetration of minorities were more likely to receive antipsychotic medications than the residents in low minority NHs.

AUTHOR CONTRIBUTIONS

Di Yan was responsible for conceptualization, methodology, and writing the manuscript. Helena Temkin-Greener was responsible for the conceptualization, methodology, and writing - review and editing. Shubing Cai was responsible for the conceptualization, methodology, resources, writing - review and editing, and funding acquisition.

DATA STATEMENT

Study findings were presented at the Academy Health Annual Research Meeting in Washington DC., in June of 2022.

DISCLOSURE

None of the authors had any conflicts of interest.

APPENDIX

Tables A1-A5 and Fig. A1

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*Did the COVID-19 Pandemic Affect the Use of Antipsychotics Among Nursing Home***TABLE A1. Distribution of Key Variables by NH Groups, 2017–2020**

	Facility Level Minority% (Black and Hispanic) 17-20 Avg.				All
	Low Minority % / Mean (SD)	Medium-Low % / Mean (SD)	High % / Mean (SD)	Very-High % / Mean (SD)	% / Mean (SD)
N of ID-Quarter	2,190,514	2,773,362	2,974,703	3,020,388	10,958,967
%	(19.99)	(25.31)	(27.14)	(27.56)	(100.00)
Individual Characteristics					
Antipsychotic Use	20.93	22.66	24.31	25.87	23.65
Age ≥ 85	61.56	55.81	49.56	41.01	51.18
Male	27.99	29.65	31.56	36.79	31.80
Race					
White	99.03	94.94	83.31	47.98	79.66
Black	0.41	2.90	11.27	35.73	13.72
Hispanic	0.56	2.16	5.43	16.29	6.62
Married	25.42	24.62	22.81	18.93	22.72
Severe Cognitive Impairment	17.33	16.82	17.51	18.73	17.64
Any Aggressive Behavior	25.04	23.17	21.95	20.37	22.44
Facility Characteristics					
For Profit Facility	46.24	66.76	74.32	82.36	69.01
Bed Numbers	104.20	133.03	151.65	165.73	141.33
SD	(53.92)	(74.86)	(92.43)	(104.55)	(88.41)
RN Hours Per Bed Per Day	0.76	0.64	0.56	0.48	0.60
SD	(0.36)	(0.32)	(0.29)	(0.27)	(0.32)
LPN Hours Per Bed Per Day	0.59	0.66	0.69	0.69	0.66
SD	(0.26)	(0.26)	(0.28)	(0.25)	(0.27)
CNA Hours Per Bed Per Day	1.81	1.72	1.69	1.69	1.73
SD	(0.62)	(0.59)	(0.63)	(0.53)	(0.60)
NH Level Covid Resident Cases Per Quarter (2020Q2-Q4)					
No Covid Cases	48.05	35.05	27.14	20.78	32.03
0-20 Cases per 100 Beds	27.58	32.74	36.89	40.26	34.69
≥ 20 Cases per 100 Beds	24.37	32.21	35.97	38.96	33.28
Zip Level Factor					
2018 ADI ≥ 85	7.20	5.53	6.36	12.09	7.90

NH: nursing home; CNA: certified nursing aide; RN: registered nurse; LPN: licensed practical nurse

TABLE A2. Antipsychotics Use among Residents with ADRD, 2017–2020: Linear Probability Model with Facility and Individual Random Effects

Variables	Model 1 Antipsychotics Use β coefficients (Robust Standard errors)
NH Groups (Ref: Low Minority)	
Medium-Low $\geq 1.5\%$ to $< 7.2\%$	0.0291 ^a (0.00229)
High $\geq 7.2\%$ to $< 23.7\%$	0.0616 ^a (0.00231)
Very High $\geq 23.7\%$	0.0933 ^a (0.00236)
Secular Trends: Quarter (0-15)	-0.000705 ^a (0.0000576)
Low-Minority Trends	
NH Groups \times Secular Trends	
Medium-Low \times Secular Trends	-0.00126 ^a (0.0000773)
High \times Secular Trends	-0.00250 ^a (0.0000758)
Very High \times Secular Trends	-0.00346 ^a (0.0000747)
Pandemic post Quarters (1: 2020Q2-Q4)	0.00659 ^a (0.000730)
Intercept shift of Low-Minority	
NH Groups \times Pandemic	
Medium-Low \times Pandemic	-0.000640 (0.0100)
High \times Pandemic	0.0178 (0.0105)
Very High \times Pandemic	0.0290 ^b (0.0103)
Post Pandemic Trends (0-2: Quarter 13-15)	0.00561 ^a (0.000513)
Low-Minority Post-Trends	
NH Groups \times Post Pandemic Trends	
Medium-Low \times Post Trends	-0.000193 (0.000664)
High \times Post Trends	-0.00151 ^b (0.000662)
Very High \times Post Trends	-0.00242 ^a (0.000660)
Individual Characteristics	
Age ≥ 85	-0.0667 ^a (0.000384)
Male	0.0218 ^a (0.000500)
Race (Ref: White)	
Black	-0.0511 ^a (0.000818)
Hispanic	-0.0106 ^a (0.00109)
Married	0.00463 ^a (0.000470)
Severe Cognitive Impairment	0.0169 ^a (0.000287)
Any Aggressive Behavior	0.0588 ^a (0.000220)
Reside in Poor Community (2018 ADI ≥ 85)	-0.00140 (0.000856)
Facility Characteristics	
For profit Facility	0.000913 (0.000566)
Bed Numbers	-0.00000967 (0.00000974)
NH Level COVID Cases Per Quarter (Ref: No Cases)	
0-20 Cases per 100 Beds	0.00117 ^b (0.000535)
≥ 20 Cases per 100 Beds	-0.0000876 (0.000598)
Constant	0.233 ^a (0.00188)
N of Individual-quarter	10,958,967
N of Individuals	2,787,961
N of NHs	15,751

^a $p < 0.05$
^b $p < 0.001$; p values were based on the Heteroskedasticity-robust t statistics.

*Did the COVID-19 Pandemic Affect the Use of Antipsychotics Among Nursing Home***TABLE A3. Covid-19 Pandemic and CNA Hours in Nursing Homes 2017–2020: Linear Regression Model with Facility Random Effects**

Outcome Variables	Model 2 CNA hours Coefficients (Robust Standard errors)	Model 3 LPN hours Coefficients (Robust Standard errors)	Model 4 RN hours Coefficients (Robust Standard errors)	Model 5 All staffinghours Coefficients (Robust Standard errors)
NH Groups (Ref: Low Minority)				
Medium-Low	−0.0275 (0.0226)	−0.126 ^b (0.00984)	−0.00260 (0.00928)	−0.158 ^b (0.0352)
≥1.5% to < 7.2%				
High	−0.0728 ^a (0.0362)	−0.212 ^b (0.0146)	−0.0321 ^b (0.0121)	−0.255 ^b (0.0579)
≥7.2% to < 23.7%				
Very High	−0.142 ^b (0.0409)	−0.280 ^b (0.0165)	−0.0516 ^b (0.0131)	−0.374 ^b (0.0653)
≥23.7%				
Secular Trends: Quarter (0-15)	−0.00742 ^b (0.000571)	−0.00149 ^b (0.000299)	0.00162 ^b (0.000266)	−0.00729 ^b (0.000765)
Low-Minority Trends				
NH Groups × Secular Trends				
Medium-Low × Secular Trends	0.00175 ^a (0.000814)	0.000279 (0.000443)	0.000116 (0.000375)	0.00214 (0.00113)
High × Secular Trends	0.00489 ^b (0.000887)	0.000228 (0.000460)	0.000523 (0.000384)	0.00564 ^b (0.00130)
Very High × Secular Trends	0.00544 ^b (0.000766)	−0.0000868 (0.000436)	0.000376 (0.000352)	0.00573 ^b (0.00108)
Pandemic post Quarters (1: 2020Q2-Q4)	−0.0470 ^b (0.00486)	−0.0169 ^b (0.00226)	−0.0106 ^b (0.00210)	−0.0744 ^b (0.00654)
Intercept shift of Low-Minority				
NH Groups × Pandemic				
Medium-Low × Pandemic	−0.465 ^a (0.0499)	−0.0359 (0.0249)	0.00422 (0.0223)	−0.498 ^a (0.0680)
High × Pandemic	−0.464 ^a (0.0526)	−0.0116 (0.0258)	0.0193 (0.0222)	−0.456 ^a (0.0719)
Very High × Pandemic	−0.508 ^a (0.0495)	0.0165 (0.0275)	0.000951 (0.0200)	−0.491 ^a (0.0684)
Post Pandemic Trends (0-2: Quarter 13-15)	−0.0689 ^b (0.00245)	−0.00618 ^b (0.00127)	−0.00212 ^a (0.00107)	−0.0773 ^b (0.00319)
Low-Minority Post-Trends				
NH Groups × Post Trends				
Medium-Low × Post Trends	0.0278 ^b (0.00344)	0.000963 (0.00174)	−0.000701 (0.00154)	0.0282 ^b (0.00469)
High × Post Trends	0.0250 ^b (0.00351)	−0.000484 (0.00182)	−0.00169 (0.00149)	0.0229 ^b (0.00477)
Very High × Post Trends	0.0261 ^b (0.00340)	−0.00268 (0.00192)	−0.000289 (0.00139)	0.0232 ^b (0.00472)
Facility Characteristics				
For Profit Facility	−0.0351 ^b (0.00611)	−0.00720 ^a (0.00350)	−0.000417 (0.00284)	−0.0479 ^b (0.00903)
Located in Poor Community 2018 ADI ≥ 85	−0.00554 ^b (0.000794)	−0.00230 ^b (0.000301)	−0.00202 ^b (0.000225)	−0.00989 ^b (0.00128)
Bed Numbers	−0.00691 ^b (0.00258)	0.0000156 (0.00131)	−0.00202 ^a (0.000939)	−0.00980 ^b (0.00365)
Constant	2.351 ^b (0.0647)	0.749 ^b (0.0248)	0.593 ^b (0.0191)	3.699 ^b (0.104)
N of NH-Quarter	202,147	202,147	202,147	202,147
N of NHs	15,751	15,751	15,421	15,421

^a p<0.05^b p<0.001; p values were based on the Heteroskedasticity-robust t statistics.

TABLE A4. Antipsychotics Use among Residents with ADRD, 2017–2020: Linear Probability Model with Facility and Individual Random Effects

Outcome Variables	Model 6 Antipsychotics Use β coefficients (Robust Standard errors)	Model 7 Antipsychotics Use β coefficients (Robust Standard errors)
Key Variables of Interest		
For Profit Facility	0.0140 ^a (0.000667)	0.000957 (0.000566)
Reside in Poor Community (2018 ADI \geq 85)	-0.00133 (0.000856)	0.00557 ^a (0.00103)
Secular Trends: Quarter (0-15) Pre-Slope of the Reference Group	-0.00144 ^a (0.0000461)	-0.00261 ^a (0.0000270)
For Profit Facility \times Secular Trends Pre-Slope Changes	-0.00182 ^a (0.0000555)	NA
Poor Community \times Secular Trends Pre-Slope Changes	NA	-0.00102 ^a (0.0000936)
Pandemic Post Quarters (1: 2020Q2-Q4) Intercept Shift of the Reference Group	0.00613 ^a (0.000631)	0.00562 ^a (0.000417)
For Profit Facility \times Pandemic Intercept Shift Changes	-0.00274 (0.00726)	NA
Poor Community \times Pandemic Intercept Shift Changes	NA	0.00719 (0.0124)
Post Pandemic Trends (0-2: Quarter 13-15) Post Slope Changes of the Reference Group	0.00573 ^a (0.000424)	0.00570 ^a (0.000272)
For Profit Facility \times Post Pandemic Trends Post Slope Changes	-0.000270 (0.000488)	NA
Poor Community \times Post Pandemic Trends Post Slope Changes	NA	0.000625 (0.000835)
Individual Characteristics		
Age \geq 85	-0.0666 ^a (0.000384)	-0.0666 ^a (0.000384)
Male	0.0219 ^a (0.000500)	0.0219 ^a (0.000500)
Race (Ref: White)		
Black	-0.0513 ^a (0.000818)	-0.0513 ^a (0.000818)
Hispanic	-0.0107 ^a (0.00109)	-0.0107 ^a (0.00109)
Married	0.00432 ^a (0.000470)	0.00423 ^a (0.000470)
Severe Cognitive Impairment	0.0170 ^a (0.000287)	0.0172 ^a (0.000287)
Any Aggressive Behavior	0.0590 ^a (0.000220)	0.0590 ^a (0.000220)
Facility Characteristics		
Large Facility (Beds \geq 120)	0.00156 (0.000926)	0.00138 (0.000926)
NH Groups (Ref: Low Minority)		
Medium-Low \geq 1.5% to $<$ 7.2%	0.0198 ^a (0.00224)	0.0199 ^a (0.00224)
High \geq 7.2% to $<$ 23.7%	0.0437 ^a (0.00227)	0.0439 ^a (0.00227)
Very High \geq 23.7%	0.0688 ^a (0.00232)	0.0690 ^a (0.00232)
NH Level COVID Cases Per Quarter (Ref: No Cases)		
0-20 Cases per 100 Beds	-0.00282 ^a (0.000522)	-0.00275 ^a (0.000523)
\geq 20 Cases per 100 Beds	-0.00388 ^a (0.000584)	-0.00485 ^a (0.000584)
Constant	0.238 ^a (0.00169)	0.246 ^a (0.00168)
N of Individual-quarter	10,958,967	10,958,967
N of Individuals	2,787,961	2,787,961
N of NHs	15,751	15,751

^a $p < 0.001$; p values were based on the Heteroskedasticity-robust t statistics.

*Did the COVID-19 Pandemic Affect the Use of Antipsychotics Among Nursing Home***TABLE A5. Antipsychotics Use Among Residents With ADRD, 2017–2020: Linear Probability Model With Facility and Individual Random Effects**

Outcome Variables	Model 8 Antipsychotics Use β coefficients (Robust Standard errors)
Key Variables of Interest	
Large Facility (Beds \geq 120)	0.00878 ^b (0.000981)
Secular Trends: Quarter (0-15)	-0.00212 ^b (0.0000395)
Pre-Slope of the Reference Group	
Large Facility \times Secular Trends	-0.000990 ^b (0.0000519)
Pre-Slope Changes	
Pandemic Post Quarters (1: 2020Q2-Q4)	0.00556 ^a (0.000529)
Intercept Shift of the Reference Group	
Large Facility \times Pandemic	-0.00123 (0.000696)
Intercept Shift Changes	
Post Pandemic Trends (0-2: Quarter 13-15)	0.00618 ^b (0.000382)
Post Slope Changes of the Reference Group	
Large Facility \times Post Pandemic Trends	-0.00050 (0.000463)
Post Slope Changes	
Individual Characteristics	
Age \geq 85	-0.0666 ^b (0.000384)
Male	0.0219 ^b (0.000500)
Race (Ref: White)	
Black	-0.0513 ^b (0.000818)
Hispanic	-0.0107 ^b (0.00109)
Married	0.00429 ^b (0.000470)
Severe Cognitive Impairment	0.0172 ^b (0.000287)
Any Aggressive Behavior	0.0590 ^b (0.000220)
Reside in Poor Community (2018 ADI \geq 85)	-0.00120 (0.000856)
Facility Characteristics	
For profit Facility	0.000797 (0.000566)
NH Groups (Ref: Low Minority)	
Medium-Low	0.0193 ^b (0.00223)
\geq 1.5% to $<$ 7.2%	
High	0.0428 ^b (0.00225)
\geq 7.2% to $<$ 23.7%	
Very High	0.0677 ^b (0.00229)
\geq 23.7%	
NH Level COVID Cases Per Quarter (Ref: No Cases)	
0-20 Cases per 100 Beds	-0.000947 (0.000538)
\geq 20 Cases per 100 Beds	-0.00301 ^b (0.000596)
Constant	0.242 ^b (0.00168)
N of Individual-quarter	10,958,967
N of Individuals	2,787,961
N of NHs	15,751
^a p<0.05	
^b p<0.001; p values were based on the Heteroskedasticity-robust t statistics.	

FIGURE A1. Study Sample Changes: Number of NH Residents with ADRD, 2017–2020.