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Relationship Between Shortage of Nursing Staff and COVID-19 Mortality and Infection in Rural and Urban Nursing Homes in the State of Minnesota

Annam Asif Inayatullah
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Walden University

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Walden University
2024

Abstract

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in Rural and Urban Nursing Homes in the State of Minnesota

by

Annam Inayatullah

MS, Walden University, 2018

BS, The College of Saint Rose, 2012

Doctoral Study Submitted in Partial Fulfillment
of the Requirements for the Degree of
Doctor of Healthcare Administration

Walden University

November 2024

Abstract

The COVID-19 pandemic posed challenges for nursing homes in the United States, including those in Minnesota, due to shortages of nursing staff and the impact on resident care quality. This study aimed to assess the relationship between nursing staff shortages and COVID-19 mortality and infections among nursing home residents in Minnesota. The analysis used data from the Centers for Medicare and Medicaid Services public database, considering rural and urban locations. The independent variables were nursing staff shortages, and the dependent variables were COVID-19 total resident deaths and COVID-19 total resident infections in nursing homes in Minnesota. Following the Donabedian theory, the study used a retrospective cohort quasi-experimental research design to determine the impact of nursing staff shortages on COVID-19 deaths and infections among nursing home residents. Multiple linear regression was used with a significance level of 0.05 to check for the null hypothesis. The findings revealed that nursing staff shortages did not significantly correlate with COVID-19 deaths in Minnesota. However, when accounting for rural and urban locations, the data showed a significant connection between rural and urban nursing homes and COVID-19 deaths in Minnesota. As for the second research question, the study found a substantial link between nursing staff shortages and confirmed COVID-19 infection rates in Minnesota after adjusting for urban and rural locations. The study's findings can contribute to positive social change by assisting healthcare administrators in making more informed decisions during medical emergencies, especially for rural communities, and improving patient care quality within their organizations.

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Section 1: Foundation of the Study and Literature Review

Introduction

Nursing home residents are a vulnerable population because of their older age and multiple comorbidities for the coronavirus disease. Coronavirus disease (COVID-19) is an infectious disease caused by the SARS-CoV-2 virus that causes mild to moderate respiratory illness in some patients, while in others, it causes severe illness that requires medical attention (World Health Organization [WHO], 2022). Older people and those with underlying medical conditions such as heart problems, diabetes, chronic respiratory issues, or cancer are the ones who develop severe illness from this virus (WHO, 2022). Because of this, the virus can be devastating in older individuals. The virus spreads from an infected person's mouth or nose in small liquid particles when they cough, speak, sneeze, or breathe, thus making nursing homes and other congregate living settings one of the most significant risks for outbreaks and deaths (WHO, 2022).

On top of everything else that was happening, nursing homes throughout the United States suffered due to limited nursing staff during the coronavirus pandemic, putting nursing home residents' health at an even greater risk. The impact of the COVID-19 pandemic on nursing facility residents and staff brought increased attention to workforce issues that affect care quality and safety, especially staffing shortages and high turnover, according to the Kaiser Family Foundation (KFF) (Ochieng et al., 2022). Many nursing homes were already short-staffed before the pandemic hit; the pandemic caused facilities to risk resident care due to nursing staff shortages (Quinton, 2020). Shortages of staff in nursing homes have compromised the quality-of-care delivery to residents. Also,

staff shortages put extra pressure on the staff present to provide quality care because of the increased workload.

The KFF website (Chidambaram, 2022) mentioned that more than 200,000 COVID-19 deaths occurred among long-term care residents and staff, and 150,000 of these deaths occurred among residents and staff in nursing facilities that were certified to receive Medicare and Medicaid payments. Another study also mentioned that the coronavirus pandemic impacted nursing homes even more in disadvantaged and low-quality rural locations (Xu et al., 2020). Poor COVID-19 management caused nursing home facilities not to be able to control infection rates and prevent the deaths of residents and staff.

An earlier study reported that Georgia and Minnesota had the highest shortages in nursing staff during the pandemic (Xu et al., 2020). To back this study with more recent data, the KFF website (Ochieng et al., 2022) mentioned that Minnesota, as of March 20, 2022, reported 64% staffing shortages in nursing facilities, whereas Alaska, the state with the highest staffing shortages, reported 80% of staffing shortages in facilities. Because of this, the focus of this study was on the state of Minnesota, predominantly rural and urban locations, to determine whether there were disparities based on the locations of nursing homes. Rural nursing homes reported staffing shortages and increased turnover compared to urban nursing homes before the pandemic (Yang et al., 2021). On average, rural populations are older and more susceptible to coronavirus infections than urban populations (Yang et al., 2021).

This study will help identify statistically significant relationships between rural and urban counties in the state of Minnesota that suffered the highest nursing staff

shortages, which impacted nursing home residents' health. The results of this study can help rural nursing home leaders find solutions to better prepare for future emergency disaster situations. For healthcare administrators, it is essential to prepare healthcare organizations for future disaster response ahead of time. Identifying patterns of nursing homes with the most serious difficulty can help identify challenges to address this issue for future emergencies in nursing homes.

The specific research problem addressed throughout this study was whether rural nursing homes experienced higher nursing staff shortages and more coronavirus outbreaks and deaths compared to urban nursing homes in Minnesota from the beginning of the pandemic until July 2022. This study aimed to examine nursing staff shortages impacting resident quality of care in rural and urban nursing homes in Minnesota and to compare trends. Section 1 addresses the study background, purpose of the study, research questions and hypotheses, theoretical framework, nature of the study, literature review, definitions, assumptions, scope and delimitations, and significance, ending with a summary. Next, the section will discuss the background and the knowledge gap this study will address.

Background

Coronavirus Pandemic and Nursing Homes

The COVID-19 pandemic had a devastating effect on nursing home residents, workers, and visitors. This virus was first identified in Wuhan, China, as a new RNA coronavirus named Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) that caused several cases of pneumonia in December 2019 (Thompson et al., 2020). The WHO declared COVID-19 a pandemic on March 11, 2020, when it spread to various

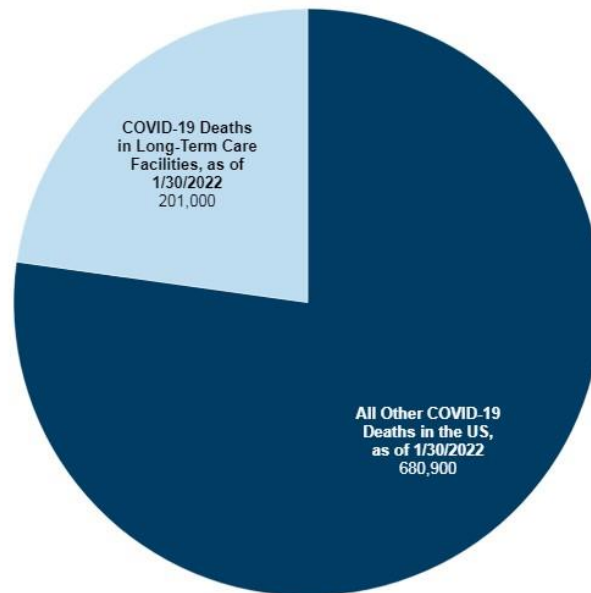
continents. Based on data sets from nursing homes from June 20, 2020, there were 107,389 confirmed cases and 71,278 suspected coronavirus cases among residents (Xu et al., 2020). According to a New York Times analysis, one-third of the coronavirus deaths in the United States were from nursing home residents (Xu et al., 2020). According to the KFF website (Chidambaram, 2022), more than 200,000 long-term care facility residents and staff have died due to COVID-19 since the start of the pandemic. Figure 1, from the KFF website, shows a pie chart with total COVID-19 deaths as of January 30, 2022. This pie chart is a great way to see the dangers of congregate care settings, especially for vulnerable populations.

Long-term care facility residents and staff accounted for more than 201,000 COVID-19 deaths, which were at least 23% of all COVID-19 deaths in the United States as of January 30, 2022 (Chidambaram, 2022).

Figure 1

Kaiser Family Foundation Pie Chart

Long-Term Care Facility Residents and Staff Account for More Than 201,000 COVID-19 Deaths, and At Least 23% of All COVID-19 Deaths in the U.S., As of 1/30/2022.



NOTE: LTCF death count is an undercount since this count excludes deaths in non-nursing home LTCF settings after June 30th, 2021 and also reflects some incomplete state reporting prior to that date. Some of the "All Other COVID-19 Deaths in the US" count likely reflect LTCF deaths that have not been categorized as such.

SOURCE: Long-term care death count is from KFF analysis of CMS COVID-19 Nursing Home Data, available state reports, press releases, and official state data through news reports. Total COVID-19 death count is from CDC. All data sources are as of January 30th, 2022. • PNG

KFF

Note. From *Over 200,000 Residents and Staff in Long-Term Care Facilities Have Died From COVID-19*,

by P. Chidambaram, 2022, Kaiser Family Foundation (<https://www.kff.org/policy-watch/over-200000-residents-and-staff-in-long-term-care-facilities-have-died-from-covid-19/>). Copyright 2024 by Kaiser

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Not only were residents of nursing homes at risk of getting sick, but the nursing home workforce also suffered during the early stages of the pandemic. There was a lack of lifesaving personal protection equipment for nursing home workers, which put staff at risk of contracting the virus (Xu et al., 2021). Staff who contracted the virus or were exposed were quarantined for 14 days, thus impacting care for the residents in nursing homes. Though some studies have noted that nursing staff shortages predicted higher COVID-19 infection rates and deaths among nursing home residents, very few studies have investigated whether the two variables are statistically significant, especially adjusting for rural and urban locations in a state that reported high staffing shortages. In this study, I looked closely at the significance of reported nursing staff shortages compared to nursing homes with high infection rates and deaths.

Staffing Shortages in the State of Minnesota

Xu et al. (2021) mentioned the District of Columbia, Georgia, Minnesota, and Rhode Island as having the highest reporting of nursing staff shortages. The KFF (Ochieng et al., 2022) mentioned that 80% of staffing shortages in Alaska, 64% in Minnesota, 59% in Maine, 58% in Kansas, and 56% in Wyoming. Variation in staffing shortages also depends on individual state variations in local economies, labor markets, and how staffing shortages are defined (Ochieng et al., 2022). Through this research, I examined the statistical significance of nursing staff shortages and increased infections and deaths of residents from COVID-19 infection, adjusting between rural and urban counties in Minnesota. According to Asche and Macht (2021), workforce shortages have been a problem in Greater Minnesota since the end of the Great Recession. Asche and Macht (2021) blamed workforce aging, workers heading towards retirement, and having

fewer young workers as replacements for challenges facing employers seeking to hire staff. Shortage of staffing is seen as a long-term problem in Minnesota, not a short-term problem. The pandemic only worsened things for employers, especially nursing home employees, managing resident care. Rural areas in Minnesota are experiencing an unprecedented number of job vacancies. Macht and Schffhauser (2021) mentioned that Minnesota is experiencing an unprecedented healthcare workforce shortage to the point that emergency room patients cannot be moved to a hospital room because there are not enough staff to open more patient beds. The state of Minnesota is experiencing a healthcare crisis regarding recruitment efforts. Macht and Schffhauser mentioned that during the pandemic, healthcare workers continued to work under stress; thus, a record number of them retired or left the industry. This study's findings may help address the seriousness of this crisis. This study may also help healthcare administrators investigate further and create ways to approach the staffing shortage crisis in rural Minnesota, especially in nursing homes.

Rural Nursing Homes

In the United States, 72% of the land is considered rural, and 14% of the population lives in rural areas (Pourat et al., 2020). Pourat et al. (2020) found that rural areas have worse patient care quality than urban areas. Rural populations have socioeconomically lower standards than urban populations.

There was an 85% primary care health professional shortage in rural counties in America from 1996 to 2005, which affected access to care, quality of care, and performance (Pourat et al., 2020). A recent study by Smith et al. (2021) addressed the safety of long-term care patients in rural nursing homes, especially in cases of disruption

in care that can lead to adverse events and rehospitalization. Taking care of residents in nursing homes requires strong coordination practices and communication to ensure that patient's needs are met; lower staffing levels can create challenges for patient care. Rural nursing homes experience additional challenges with nursing home residents. Smith et al. mentioned that rural areas have an older population, higher rates of disability, and more health conditions compared to urban areas, therefore demanding more excellent care for rural nursing home residents. Rural populations also have fewer economic resources, creating additional strain on nursing home residents and nursing home facilities (Smith et al., 2021). According to a recent report by the Minnesota Department of Health (2021), an estimated 122,000 people lived in concentrated poverty areas in rural Minnesota. Rural emergency medical services rely on volunteers because of inadequate staff to cover shifts, and there are very few licensed healthcare providers in rural areas (Minnesota Department of Health, 2021). These facts indicate a need for more general staffing in Minnesota's rural areas.

The Minnesota Department of Health (2021) also mentioned that the nursing home population has been decreasing because of increases in-home care and assisted living becoming more common.

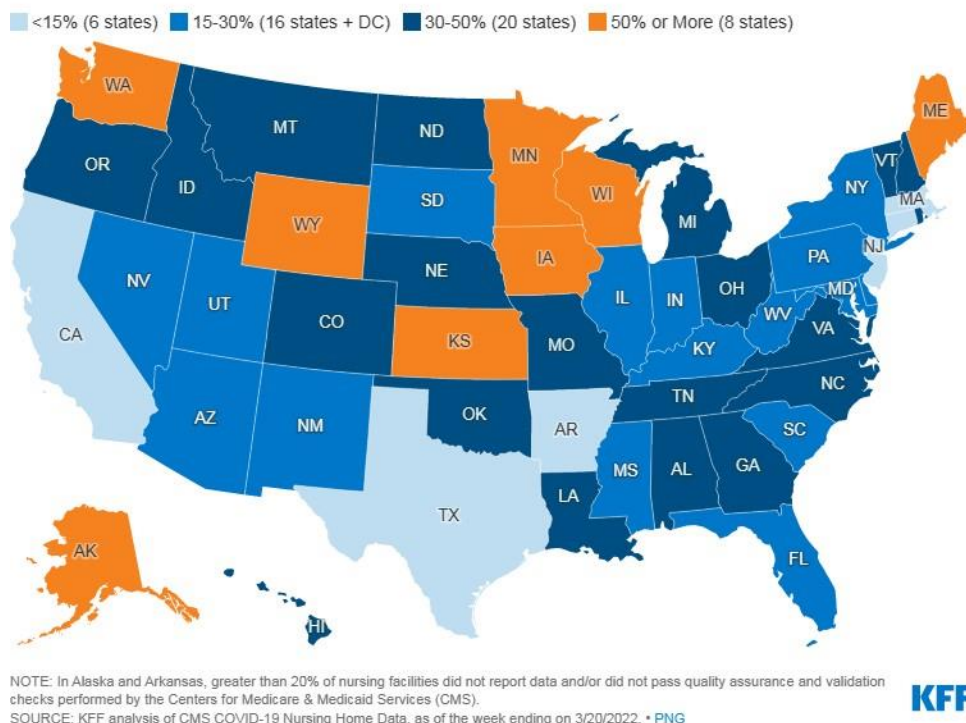
Nursing Staff and COVID-19

The Minnesota Nurse Association (2022) published a report on a survey of 748 nurses concerning why nurses left their healthcare jobs and if they planned on returning to their jobs. Some of the things shared in the survey by nurses were bad COVID-19 management, lack of support, short staffing, risk of losing license, lack of respect by supervisors, being overworked, being understaffed, feeling demoralized about the quality

of patient care, and inadequate action from hospital management on staffing shortages. The two most popular reasons for leaving were hospital management and chronic short staffing (Minnesota Nurse Association, 2022). Some of the suggestions proposed were to address staffing shortages unit by unit and to grant mental health support and loan forgiveness programs to nurses. The COVID-19 pandemic has increased attention to the longstanding workforce issues affecting patient care and safety in nursing facilities (Ochieng et al., 2022). Research has shown that more than 200,000 COVID-19 deaths occurred in long-term facilities, with 150,000 of these deaths occurring in nursing facilities that were receiving Medicare or Medicaid payments (Ochieng et al., 2022). Figure 2 shows nursing facilities reporting staffing shortages based on data collected until March 20, 2022. The KFF (Ochieng et al., 2022) mentioned that 80% of staffing shortages in Alaska, 64% in Minnesota, 59% in Maine, 58% in Kansas, and 56% in Wyoming. The Biden administration takes this matter seriously and has created new initiatives to improve care quality, nursing facility oversight, data transparency, career pathways, and pandemic and emergency preparedness (Ochieng et al., 2022).

Figure 2*Nursing Facility Reporting Staffing Shortages by Kaiser Family Foundation*

Share of Nursing Facilities Reporting Staffing Shortages, as of March 20th, 2022



Note. From *Nursing Facility Staffing Shortages During the COVID-19 Pandemic*, by N. Ochieng, P.

Chidambaram, and MB. Musumeci, 2022, Kaiser Family Foundation ([https://www.kff.org/coronavirus-](https://www.kff.org/coronavirus-covid-19/issue-brief/nursing-facility-staffing-shortages-during-the-covid-19-pandemic/)

[covid-19/issue-brief/nursing-facility-staffing-shortages-during-the-covid-19-pandemic/](https://www.kff.org/coronavirus-covid-19/issue-brief/nursing-facility-staffing-shortages-during-the-covid-19-pandemic/)). Copyright 2024

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Knowledge Gap

Investigating a state that reported 64% staffing shortages and looking at specific locations in that state can further help healthcare administrators create plans to improve care in those locations. In this study, I investigated whether the two variables, nursing staff shortages and total confirmed COVID-19 deaths and infections among nursing home residents in Minnesota, are statistically significant, adjusting for rural and urban locations.

Problem Statement

The COVID-19 pandemic affected nursing home staffing in a very negative way. Minnesota was one of the states that reported many nursing staff shortages in nursing homes. Because of this, the focus of this study was on the state of Minnesota, especially rural and urban locations of nursing homes, to see if there were disparities based on locations of nursing homes and nursing staff shortages. For this study, I reviewed rural nursing home nursing staff shortages in comparison to urban nursing homes in the state of Minnesota and determined whether nursing homes reporting nursing staff shortages were also the ones with the most confirmed COVID-19 cases and total COVID-19 deaths from the beginning of the pandemic until July 2022. Since the beginning of the pandemic in 2020 and up to July 2022, a cumulative total of 560 million COVID-19 cases, including around 6.4 million deaths, were reported from all six WHO regions (Pan American Health Organization [PAHO], 2022). The state of Minnesota was among the highest-ranked for staffing shortages in the nation (Xu et al., 2021). The social and healthcare administration problem that prompted the search of the literature was resident safety in nursing homes during the COVID-19 pandemic due to shortages of staff.

Recent studies identified rural nursing homes as having a more difficult time with nursing staff shortages than urban nursing homes in the United States. In Minnesota, the average time spent with a nursing home resident by nursing staff is 3.02 hours a day. Staffing shortages due to COVID-19 put nursing home residents at a greater health risk (Minnesota Department of Health, 2021). Nursing home residents need a certain amount of time daily to get the proper care from their nurses. Nursing staff shortages put resident care at risk and create financial problems for nursing home facilities. Fewer nursing staff make it difficult for nursing homes to accommodate more residents. The quality of care also decreases in nursing homes with fewer nursing staff. The Centers for Medicare and Medicaid Services (CMS) have data that must be adjusted to fill gaps and understand difficulties based on urban and rural locations. I used secondary data from CMS and data analysis tools to find statistical significance when comparing urban and rural nursing homes and nursing staff shortages.

Purpose of the Study

Through this quantitative retrospective quasi-experimental study, I aimed to evaluate the relationship between nursing staff shortages and COVID-19 mortality and infection among nursing home residents in the state of Minnesota based on the CMS public database, adjusting for rural and urban locations. The independent variables were shortages of nursing staff in rural and urban nursing homes in the state of Minnesota; the dependent variable was COVID-19 total deaths and COVID-19 total infections in rural and urban nursing homes in the state of Minnesota from the beginning of the pandemic until July 2022. The results from this study can be used to determine if nursing staff shortages affect patient care quality in nursing homes, especially during emergencies.

Findings from this study may contribute to positive social change by enabling healthcare administrators to make effective and efficient decisions during medical emergencies, improve their disaster management plan, improve human resource management retention of employees, and improve the quality of patient care for healthcare organizations.

Research Questions and Hypotheses

The following research questions and hypotheses guided this study:

Research Question 1: Is there an association between nursing staff shortages and total confirmed COVID-19 resident deaths in Minnesota state nursing homes based on the data obtained from the CMS public nursing home database, adjusting for rural and urban locations?

H01: Nursing staff shortages have no statistically significant relationship with COVID-19 total resident deaths in Minnesota state nursing homes.

H11: Nursing staff shortages have a statistically significant relationship with COVID-19 total resident deaths in Minnesota state nursing homes.

Research Question 2: Is there an association between nursing staff shortages and total confirmed COVID-19 infections among residents in Minnesota state nursing homes based on the data obtained from the CMS public nursing home database, adjusting for rural and urban locations?

H02: Nursing staff shortages have no statistically significant relationship with total confirmed COVID-19 infections in Minnesota state nursing homes.

H12: Nursing staff shortages have a statistically significant relationship with total confirmed COVID-19 infections in Minnesota state nursing homes.

Theoretical and Conceptual Framework

This study's theoretical framework was built on Donabedian's structure process-outcome towards health care quality. The Donabedian model uses a method that measures structure, process, and outcome to evaluate the quality of care (Agency for Healthcare Research and Quality [AHRQ], 2015). Donabedian (2005) believed that structure measures influence process measures, which affect outcome measures. Nursing staff and locations are structural measures; patient infection with COVID-19 is a process measure, and patient mortality with COVID-19 is an outcome measure. Lack of staffing levels in nursing homes affects the care residents receive in nursing homes, especially during emergencies, when the outcomes of resident care can become worse based on my assumptions and recent research.

Structural measures in the Donabedian model stand for organizational delivery of care (AHRQ, 2015). Structural measures include organization staff, equipment, space, time, and money. Structural measures can be seen in the number of nursing staff and the location of nursing homes. Process measures in the Donabedian model show providers methods to maintain or improve health for healthy or diagnosed patients (AHRQ, 2015). Process measures are actions for diagnosis, treatment, and other services. Process measures can be seen when patients wait before seeing their nurse. Outcome measures show the impact of healthcare services or their intervention on patient health status (AHRQ, 2015). Examples of outcome measures are results and objectives, which are

subjective at an individual or group level. In other words, outcome measures can be seen in reduced mortality, reduced infections, and improved patient care. This study classified nursing staff shortages and rural and urban nursing home locations as structure factors. Nursing homes with an increased number of COVID-19 infections compared to other nursing homes relate to a process indicator that reflects a lack of resident care. Furthermore, increased mortality because of COVID-19 relates to an outcome showing lack of quality care.

Nature of the Study

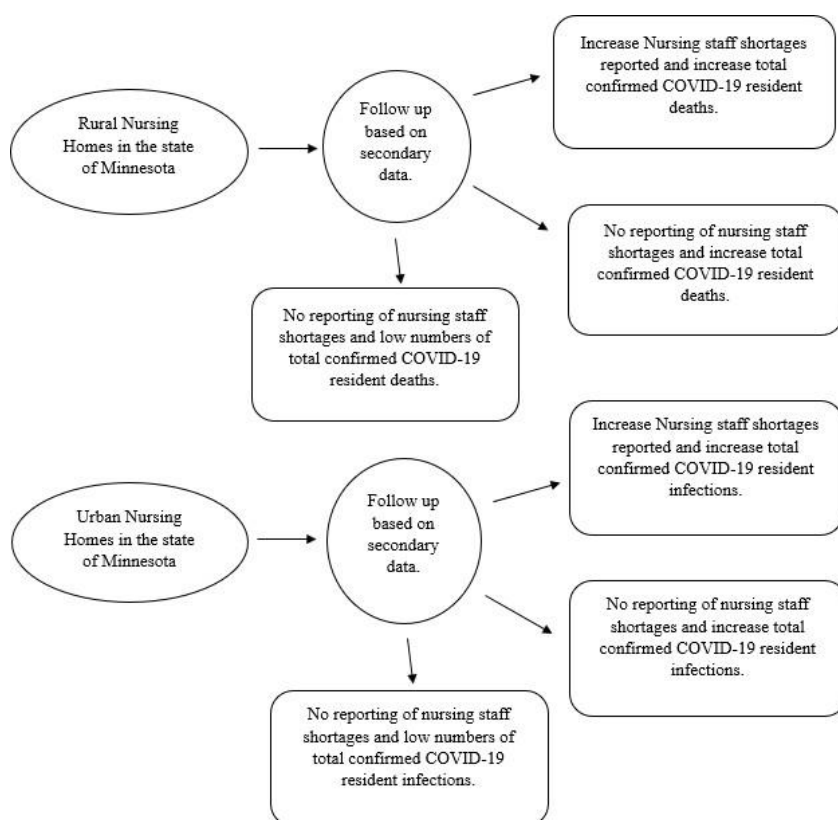
To answer the research question in this quantitative study, I used a retrospective cohort quasi-experimental research design, with the data analyzed using a multivariable linear regression analysis design. A cohort design is a type of nonexperimental or observational research design that is selected based on individuals' exposure status and followed over time to search for the occurrence of an outcome of interest (Setia, 2016). A retrospective cohort study uses preexisting secondary research data to study relationships between exposure and outcome (Setia, 2016).

Quasi-experimental study designs are non-randomized, pre- and post-intervention studies commonly used in medical informatics literature to evaluate the benefits of specific interventions (Harris et al., 2006). This research design was retrospective cohort because the data were collected from previous records on the CMS website, and the participants did not have the outcome of interest. They were selected based on their exposure to their specific nursing home location and staffing shortages. As seen in Figure 3, at baseline, two groups selected are from rural locations and urban locations; throughout selected dates for follow-up, some nursing homes would show an increase in

infections and deaths from COVID-19, with increased staffing shortages; some would show no staffing shortages but would still have high numbers of deaths and infections; and some would have low numbers of deaths and infections from COVID-19 with no reporting of nursing staff shortages. This study compared the outcomes of these two groups.

Figure 3

Retrospective Cohort Study Design



Regression analysis helps identify whether the selected independent variables impact the dependent variable (Gallo, 2015). Dependent variables are the main factors that a researcher conducting a study is trying to understand. In this study, the dependent

variables were COVID-19 total deaths and COVID-19 total infections in rural and urban nursing homes in Minnesota, and the independent variable was the shortage of nursing staff reported in rural and urban nursing homes in Minnesota. Regression analysis can help test if there is statistical significance to the study variables or if there is no relationship between the variables. Before running the regression analysis in this study, multicollinearity was tested. Multicollinearity is a statistical phenomenon in which two or more predictor variables in multiple regression models are highly correlated; if they are correlated, the standard of error of the coefficients will increase, thus making some variables statistically insignificant (Daoud, 2017). A multicollinearity test can check for the reliability of the regression model. Another test used was bivariate Pearson correlation; this test produces a sample correlation coefficient r that can measure the strength and direction of linear relationships of variables (Kent State University, 2023). This test identified how a shortage of nursing staff can influence COVID-19 infections and deaths among nursing home residents.

Literature Search Strategy

Many scholarly journal articles, previous study reports, and textbooks were studied to create the literature review. The keywords used for searching data online included *COVID-19 nursing home, staffing shortage during COVID-19 pandemic in nursing homes, rural and urban nursing home differences, rural Minnesota nursing homes, patient care at nursing homes during COVID-19 pandemic, challenges faced by nursing homes during a pandemic, and staff challenges during the pandemic in nursing homes*. The Databases used to search for keywords were NCBI/Pub Med Center, PubMed, Google Scholar, CMS, and Walden Library. Almost all the literature used for

this research study was recent, with publication dates falling primarily in the 2020–2023 range. Because this pandemic happened recently, there have not been many studies done on it, which is the reason for studying this knowledge gap. The literature review in the study was framed based on the critical variables researched. Key variables were nursing staff shortages in rural and urban nursing homes in Minnesota and total COVID-19 infections and deaths among residents in rural and urban nursing homes in Minnesota. The following section discusses the literature that justified the study and supported the conceptual framework.

Literature Review

Nursing homes have been experiencing staffing challenges; according to a recent report by the American Health Care Association and National Center for Assisted Living (AHCA & NCAL, 2023), nursing homes lost 210,000 jobs during the COVID-19 pandemic. It has also been reported that between February 2020 and December 2022, the number of nursing home employees dropped from over 1.5 million to 1.3 million (Bailey, 2023). The report also stated that staffing shortages have caused nursing homes to limit resident admissions, causing hospitals to have significant backlogs with patients waiting to find available nursing home beds (AHCA & NCAL, 2023). According to the AHCA and accounting and consulting firm CLA (CliftonLarsonAllen LLP), nursing homes would have to spend up to \$10 billion per year and hire close to 188,000 nurses to comply with increased minimum staffing requirements (AHCA & CLA, 2022).

A recent study reported that the states of Georgia and Minnesota reported the highest nurse staffing shortages during the pandemic (Xu et al., 2020). To back this study with more recent data, the KFF website (Ochieng et al., 2022) mentioned that Minnesota,

as of March 20, 2022, reported 64% staffing shortages in nursing facilities and that Alaska reported the highest staffing shortages, at 80% in facilities. In 2022, Minnesota nursing homes reported staffing shortages worse than anywhere else in the country (Shockman, 2022). In another news article, it was reported that many nursing homes in Minnesota were not taking new patients due to staffing shortages, and many nursing homes were closing due to a lack of financial resources (Hoff, 2023). Lawmakers have increased wages from \$16 to \$25 per hour, but statistics have indicated that 97% of candidates are not interested in working at nursing homes (Hoff, 2023). Again, these statistics place the senior residents of Minnesota at risk due to this dilemma.

Rural nursing homes reported staffing shortages and increased turnover compared to urban nursing homes before the pandemic (Yang et al., 2021). On average, rural populations are older and more susceptible to coronavirus infections than urban populations (Yang et al., 2021). I assumed that rural nursing homes in Minnesota were at greater risk; thus, there is a need to study this problem further. This study helped identify statistically significant relationships between rural and urban counties in Minnesota that suffered the highest nursing staff shortages that impacted nursing home residents' health. The results of this study can help specific rural nursing homes find solutions to better prepare for future disastrous emergencies. For healthcare administrators, it is essential to prepare healthcare organizations for future disaster response ahead of time. Identifying patterns of nursing homes with the most significant difficulty can help identify challenges to address this issue for future emergencies in nursing homes.

The specific research problem addressed throughout this study was whether rural nursing homes experienced higher nursing staff shortages and more coronavirus

outbreaks and deaths compared to urban nursing homes in Minnesota from the beginning of the pandemic until July 2022. This study aimed to examine nursing staff shortages impacting resident quality of care in rural and urban nursing homes in Minnesota and to compare trends. The independent variable was the shortage of nursing staff, and the dependent variables were COVID-19 total deaths and COVID-19 total infections in rural and urban nursing homes in Minnesota from the beginning of the pandemic until July 2022. Regression analysis showed the relationship and the extent to which the independent variable affects the dependent variable, and the Pearson correlation helped see how nursing staff shortages influenced COVID-19 infections and deaths.

Literature Review Related to Study Variables

Recent research and data gathered from nursing homes during the COVID-19 pandemic in the state of Minnesota suggest that there are nursing staff shortages. However, very little research has been done on specific rural locations in comparison to urban locations in the state of Minnesota. Perhaps staffing shortages had little to do with COVID-19 infections and deaths among residents based on rural or urban locations. It is crucial to study further the pandemic's impact on Minnesota nursing homes, which reported high staffing shortages.

Challenges Faced by Rural Nursing Homes

Rural community residents, on average, are older compared to urban community residents and have more underlying health conditions and higher rates of disability (Smith et al., 2021). Handling patients with complex health conditions creates challenges for nursing homes with limited resources. Coordinating care due to geographical distance between rural and urban areas can also affect patient care. Taking care of patients placed

in facilities requires robust communication and coordination and meeting patients' clinical, social, and emotional needs upon arrival (Smith et al., 2021). Admission of patients with dementia and other mental or behavioral health conditions requires advanced preparation by nursing homes. Patients who need specialized equipment and space for treating certain medical conditions create additional challenges for nursing homes.

The Donabedian structure-process-outcome model highlights the importance of structural considerations, including facility location and staffing (Smith et al., 2021). Rural residents have fewer economic resources, high poverty rates, and lower health insurance rates (Smith et al., 2021). Not only that, as mentioned previously, many rural nursing homes have no choice but to close due to financial strain and lack of staffing. It has been reported that many nursing homes in Minnesota are not taking on new patients due to staffing shortages, and many nursing homes are closing due to a lack of financial resources (Hoff, 2023). Also, lawmakers' efforts towards increasing wages have shown no results because 97% of candidates are not interested in working at nursing homes (Hoff, 2023). Another difference between rural and urban residents is that rural residents live twice as far from hospitals on average compared to urban residents (Smith et al., 2021). It is vital to understand the struggles rural nursing homes face because they impact the quality of care for residents.

COVID-19 Pandemic and Nursing Home Residents

Nursing homes are vital healthcare facilities that provide care to older adults. The COVID-19 pandemic highlighted the vulnerability of nursing homes and how it affected the health of nursing home residents (Xuemei et al., 2022). With the aging population of

the United States, the need for high-quality nursing homes will continue to rise, and the cost of nursing home care will be a significant portion of national health expenditures (Xuemei et al., 2022). Xuemei et al. (2022) mentioned that one of nursing homes' most critical safety concerns is the risk of infectious outbreaks, especially with the COVID-19 pandemic, because of the congregated living conditions and vulnerable resident populations. Research has shown that more than 200,000 COVID-19 deaths occurred in long-term facilities, with 150,000 of these deaths occurring in nursing facilities that were receiving Medicare or Medicaid payments (Ochieng et al., 2022). Older adults in nursing homes are at greater risk of infection with COVID-19 because they have complex medical conditions, multimorbidity, frailty, cognitive impairment, dementia, and disability (Dyer et al., 2022). Many nursing home residents need assistance with personal care and medical care, which requires nursing home staff to be onsite.

Nursing home residents infected with the COVID-19 virus showed more symptoms than regular symptoms. Regular symptoms of the virus include headache, fatigue, dyspnea, cough, pyrexia, and myalgia, but nursing home residents presented with additional symptoms that included delirium, diarrhea, falls, behavioral changes, seizures, reduced mobility, and other atypical symptoms (Dyer et al., 2022). For this reason, it is essential to create safety guidelines to prevent another outbreak in nursing homes.

Nursing Staff Shortage During COVID-19 Pandemic

The Minnesota Nurse Association (2022) published a report of a survey of 748 nurses on why nurses left their healthcare jobs and if they planned on returning to their jobs. Some of the things shared in this survey by nurses were bad COVID-19 management, lack of support, short staffing, risk of losing the license, lack of respect by

supervisors, being overworked, understaffing, feeling demoralized about the quality of patient care, and inadequate action from hospital management on shortage of staffing. The two most popular reasons for leaving were hospital management and chronic short staffing (Minnesota Nurse Association, 2022). The COVID-19 pandemic has increased attention to the longstanding workforce issues affecting patient care and safety in nursing facilities (Ochieng et al., 2022). A recent study showed that an inadequate supply of equipment and human resources and ineffective managerial approaches lead to mental and emotional exhaustion, negative attitudes toward careers, employee turnover, and early retirement of nurses (Ghavidel et al., 2019). Researchers suggested that adopting policies in the program, paying attention to nurses' physical and mental health, and addressing problems can help healthcare administrators retain nursing staff and prevent burnout.

A shortage of nursing staff can negatively impact all residents in a nursing home and put their health at risk. According to Harrington et al. (2020), many studies show a strong positive relationship between the number of nursing staff who provide direct care to residents daily and resident quality of life and quality of care received. From 2017 to 2018, 75% of nursing homes did not meet the CMS's expected nursing staffing levels (Harrington et al., 2020). Because of the COVID-19 pandemic, the nursing staff shortage problem is critical to address to protect the health and safety of nursing home residents.

Justification Literature

In a recent study, Xu et al. (2020) discussed the nursing home staff shortage during the COVID-19 pandemic and the driving factors. Xu et al. discovered that the District of Columbia, Georgia, Minnesota, and Rhode Island had the highest rates of

staffing shortages during the pandemic. The authors used information from CMS to run multivariate logistic regression of staffing shortages with state-fixed effects to examine nursing homes during the pandemic. The study used self-reported shortages of licensed nurse staff, nurse aides, clinical staff, and other staff. The researchers discovered, based on multivariate regression, that the highest staff shortages were reported in nursing homes that had residents or staff infected with COVID-19 (Xu et al., 2020). The study also mentioned that nursing homes with a 1-week supply of personal protective equipment (PPE) had a lower chance of staffing shortages. This study mentioned Minnesota as one of the states with the highest level of staffing shortages, thus the reason for this study is to investigate the nursing homes in that state further. The researchers mentioned an interesting factor regarding staffing shortages related to residents and staff having to quarantine in case of exposure. Limitations of this study were that 20% of nursing homes did not pass the data quality check of CMS, and information provided by some nursing homes could have been inaccurate.

Xu et al. (2021) reported that 1 in 6 nursing homes self-reported a shortage in nursing staff during the COVID-19 pandemic. The shortage of nursing staff is not equally distributed across states; some states have worse experiences with staffing shortages than others. Xu et al., as a solution, suggested having more funds available by states to hire and retain staff, as well as enough PPE for residents and staff to prevent the spread of infection. Yang et al. (2021) reported that COVID-19 negatively impacted areas that were disadvantaged and low-quality nursing homes in rural locations. Because Minnesota was one of the states with the most reported staffing shortages, it is vital to study the trends in urban and rural areas of the state.

In another recent study, Yang et al. (2021) discussed the trends in COVID-19 cases, deaths, and staffing shortages in rural and urban nursing homes in the United States. This study used a linear mixed model with a state-fixed effect to estimate the interaction effect of rural and urban nursing home COVID-19 cases, death, and staffing shortages. The finding of this study revealed that rural nursing homes had increased staffing shortages overtime during the pandemic compared to urban nursing homes (Yang et al., 2021). The study identified urban nursing home staffing shortages to be relatively stable over the same time as rural nursing home staffing shortages got worse. Yang et al. study highlights the need to find strategies to prevent rural nursing homes from encountering the same staffing problems in case of future pandemics. This study's authors suggested creating effective strategies to improve the workforce to prepare it for future disasters such as COVID-19 (Yang et al., 2021).

Grinspun et al. (2023) mention the systemic failings of long-term care facilities in four high-income countries (Australia, Canada, Spain, and the United States of America) during the COVID-19 pandemic. This research study emphasizes heavily mandating recommended staffing levels, providing training in infection prevention and control, focusing on mental health for residents and staff, and building an evidence-based practice culture that ensures ongoing education for staff and nursing staff to help improve resident safety and quality of life, staff retention and work satisfaction (Grinspun et al., 2023). Grinspun et al.'s study addressed a crucial key variable: the comparison of rural versus urban long-term care facility settings. The researchers said rural areas suffered more from COVID-19 cases and had higher hospital mortality, but this disparity existed between rural and urban settlements before the pandemic (Grinspun et al., 2023). The study's

authors mentioned that at the onset of the pandemic, weekly rural deaths for the four countries selected were twice as high as urban rates (Grinspun et al., 2023). Grinspun et al. provided information on rural America having 37% more deaths from COVID-19 compared to urban Americans adjusted for population size. The authors of this study explained that rural facilities are vulnerable to COVID-19 infection because of limited resources (Grinspun et al., 2023). The limitation of this study is that it is cultivated and not specific to localized locations. This study encourages further investigation to see if all rural locations experienced similar outcomes or if some managed to handle the pandemic, like urban locations in Minnesota (Grinspun et al., 2023).

Supporting Literature

Nursing homes serve a vulnerable population that is susceptible to infectious diseases. Xuemei et al. (2022) called nursing homes the hotspot for COVID-19 infections and provided recommendations such as increasing private rooms, larger living areas per bed, and the presence of a ventilator-dependent unit to lower cases of COVID-19 death and transmissibility. Xuemei et al. (2022) used a cross-sectional research design and multiple national data sets from nursing homes. The authors used zero-inflated negative binomial models to predict the number of COVID-19 cases and deaths separately among residents (Xuemei et al., 2022). The study results concluded that the increasing number of certified beds was related to reduced infections and deaths among residents. Xuemei et al. also mentioned that it decreased transmissibility among residents when other factors, such as staff-infected cases, are controlled. Design of nursing facilities by adding more private rooms and living areas can prevent outbreaks in the future. The results of this study can help address specific trends in nursing home facilities, especially with those

with more private rooms and larger living areas showing less transmissibility of the virus. This study shows that the physical environment significantly impacted COVID-19-related outcomes in nursing homes. However, to meet the demand for more beds, nursing staff must be adequately available to tend to those residents.

In a study, Inzitari et al. (2020) addressed many critical errors replicated by many countries in long-term care facilities, including a lack of protective measures and delays in testing workers, patients, and support staff. The authors mentioned nursing home residents as the most affected by the Coronavirus in many countries; half of all deaths from COVID-19 in European countries, Canada, and 40% in the USA were nursing home residents (Inzitari et al., 2020). The study also mentioned that nursing homes share many common threads in infrastructure, organization, and workforce, including low staff-to-resident ratios, low-paid staff, low skill mix, and high staff turnover, thus creating an environment with minimal resilience to adverse events (Inzitari et al., 2020). The study emphasized that nursing homes had delays in testing workers and patients and support staff shortages that caused the spread of infection and prevented proper infection control and care (Inzitari et al., 2020). This study also discusses the importance of preventive measures to be taken before another pandemic occurs in the future. The authors have discovered that coronavirus pandemics show the need for long-term care facilities to have adequate PPE (and training in its use), quick diagnostic testing, and measures to help with staff shortage, and additional demands and provision of reinforcement teams (Inzitari et al., 2020). Inzitari et al. stated that the pandemic has increased the awareness of quality of care, workforce, and living conditions. The study by Inzitari et al. (2020) showed the importance of seeking assistance as an intervention for future pandemics. Every nursing

home needs to collaborate with local officials to create plans in case of another pandemic to prevent the chaos we recently saw with COVID-19. The study's authors feel strongly about creating a sustainable model for long-term care facilities in case of another pandemic (Inzitari et al., 2020). The pandemic has revealed the flaws in the original nursing home models and how it presents itself as an unsafe place for residents (Inzitari et al., 2020).

Inzitari et al. (2020) suggested adding new policies, models, and investments to improve nursing homes. The recommendation requires changing policy to ensure patients get optimal care and using telemedicine to ensure timely care for residents' needs (Inzitari et al., 2020). This study shows hope for rural nursing homes by trying telemedicine technology to provide on-site virtual care for residents; however, rural nursing homes lack resources, making this solution challenging to adopt (Inzitari et al., 2020).

Yang et al. (2021) reported more significant staffing shortages in rural nursing homes than in urban locations. The study addressed a critical key variable, studying the need for assistance in different nursing homes. CMS, in their data set, asked nursing homes if they needed assistance with staffing shortages. Comparing data to see which nursing homes asked for assistance can show the nursing homes struggling with staffing shortages. Yang et al. noted how the trends from 2020 changed in 2021, and rural nursing homes showed a need for a shortage of nursing staff compared to urban nursing homes. Inadequate nursing home staff can lead to poor quality of resident care, thus increasing COVID-19 cases and other health and safety concerns. Another concern mentioned in a study conducted by Radcliff et al. (2020) was communication challenges in rural nursing homes. The study conducted interviews and site visits to gather information on long-term

care staff and emergency planning (Yang et al., 2021). Rural nursing homes need vital leadership to address future pandemics with more accessible communication and coordination (Radcliff et al., 2020). Nursing homes facing communication challenges make it difficult for providers to care for residents during disasters. Radcliff et al. (2020) mentioned that limited coordination among local leadership and long-term care providers caused trouble sending information, seeking assistance, resources, and services, and slowed the recovery time. The authors encouraged readers to have rural long-term care stakeholders address the gaps in communication and coordination to improve their disaster resilience in the future (Radcliff et al., 2020).

The Future of Nursing 2020-2030: Charting a Path to Achieve Health Equity explores how to keep costs lower, utilize more technology, and maintain patient and family-focused care while reducing health disparities and promoting equity among nurses. Due to Minnesota's lack of resources and extreme staffing shortage, these suggestions can be complicated to adopt in rural locations. Shortages of nursing staff is a current crisis in rural Minnesota. Nurses are a vital part of our healthcare system, and fixing this dilemma should be a top priority for the United States government. Some scholars have suggested providing robust education, a supportive work environment, and autonomy to nursing staff for retention (National Academies of Sciences, Engineering, and Medicine, 2021). Some disparities cause unfair conditions for nursing home residents. People of lower socioeconomic backgrounds, rural residents, and communities of color experience poor health compared to those of higher socioeconomic status, urban residents, and individuals not from color communities (National Academies of Sciences, Engineering, and Medicine, 2021). Nurse foundations for quality care were poor in large,

small, and isolated rural areas, based on a study done in 2019 before the pandemic (Smith et al., 2019). Smith et al. (2019) did a cross-section, comparative, and descriptive study using a sample of 566 urban, 49 large, 18 small, and nine isolated hospitals from California, Florida, and Pennsylvania. The study discovered that nursing foundations for quality care were poor in large, small, and isolated rural hospitals in each State (Smith et al., 2019).

In their study, Yang et al. (2021) mentioned that rural nursing homes already suffered from staff shortages before the pandemic. Additionally, there are lower numbers of Bachelor of Science in Nursing (BSN) graduates among registered nurses (RN), and there is a lack of well-trained rural nursing personnel (Yang et al., 2021). Problems were reported with the quality of nursing care, especially with staffing shortages and training before the pandemic; hence, the pandemic caused terrible patient care for nursing home residents. Yang et al. (2021) mentioned that increasing the opportunities for more education and afterschool programs, such as daycares, can help prospective employees move to rural locations and meet the need for staffing shortages.

The need to meet staffing shortages in rural nursing homes and improve resident care is much needed, but many barriers exist to overcome. Rural areas lack many resources because they are further away from the main cities. Telehealth is one way to address healthcare needs in rural areas, but it does not fix the problem with the lack of nursing staff on site. It also does not fix the problem of avoiding the spread of COVID-19 or future pandemics in a nursing facility. Finding ways to attract nursing staff to work in rural areas is an ideal way to help fix this dilemma for future resident care safety. There

are still many gaps in understanding preparedness for nursing home residents' safety in future pandemics.

Training staff, especially nursing staff, is critical to preparing for future outbreaks. Thus, studying trends in Minnesota's rural and urban nursing homes during the pandemic can help create solutions for future outbreaks.

Definitions

Coronavirus disease (COVID-19): Coronavirus disease is an infectious disease caused by the virus SARS-CoV-2. The virus causes respiratory illness and usually recovers without special treatment, but in some individuals, it can cause severe illness and require medical assistance (WHO, 2022).

COVID-19 infection: Number of COVID-19 infections reported by individual nursing homes among residents in Minnesota based on the public data provided by the CMS website.

COVID-19 mortality: Based on the CMS website's public data, the number of COVID-19 deaths reported by individual nursing homes among Minnesota residents.

Nursing staff: Nurses have completed the basic nursing education program and are qualified and registered to provide competent and responsible care to the sick, promote wellness, prevent illness, and provide rehabilitation (WHO, 2023).

Nursing staff shortages: Appropriate nursing staffing is critical for the delivery of safe and quality care for patients. Staffing shortages impact nurses' ability to deliver safe, quality care to patients (American Nurses Association, 2012). Nursing staff shortages will be measured using the public data on the CMS website, which has data from nursing homes that voluntarily reported nursing staff shortages.

Rural nursing home: Facilities in communities with less than 20,000 residents (Nurse Key, 2017). Nursing homes were separated into rural and urban locations.

Cohort study: This is a non-experimental or observational study design in which the participants do not have the outcome of interest to start; they are selected based on exposure (Setia, 2016).

Assumptions

This study assumes that the CMS website's data is accurate and updated. It is also assumed that nursing homes followed COVID-19 guidelines and tried their best to provide quality care despite challenges from staffing shortages and geographical locations. Another assumption is that nursing homes provided accurate information to the CMS website and did not withhold information to protect organizational structure or process flaws. The number of residents' deaths and number of infections from COVID-19 was reported accurately to the CMS website by nursing homes, which is another assumption.

Scope and Delimitations

This study will examine nursing staff shortages and COVID-19 infections and deaths among nursing home residents adjusting for rural and urban nursing homes in Minnesota. It is essential to see patterns in different areas of the state to understand better the challenges nursing homes face during the pandemic and identify similarities. There is a chance of increasing staffing shortages in Minnesota's urban and rural areas. The delimiting factor in the study is the location, which only focuses on one state. Other states also reported increased staffing shortages, but only the state of Minnesota will be the focus of this study.

Limitations

There are several limitations to be considered in this study. In the CMS data, 20% of the nursing homes did not pass the data quality check. Also, nursing homes self-reported information on staffing shortages; thus, it could be inaccurate. The data updates weekly, so information and trends are changing constantly; therefore, results in previous studies can vary based on newer data. This study will be time-sensitive because the data continues to change weekly; hence, it could cause problems with conclusions that might vary based on timelines. The study also does not consider other reasons for high mortality and infections in nursing homes due to COVID-19, such as residents already suffering from chronic diseases or with fragile immune systems to fight viral infections. Also, this study only accounts for nursing homes in Minnesota and does not speak for nursing homes in other states.

Significance

This study will help identify which locations in the state of Minnesota had the most nursing staff shortages that impacted residents' health negatively. Based on the results of this study, lawmakers can gain additional information to see the importance of this crisis with nursing staff shortages in Minnesota, especially in nursing homes. This study will bring positive social change by enabling healthcare administrators to make effective and efficient decisions during medical emergencies, improve their disaster management plan, improve human resource management retention of employees, and improve the quality of patient care for their healthcare organization. Also, as a healthcare administrator, it is imperative to prepare healthcare organizations for future disaster response ahead of time. Identifying patterns and locations of nursing homes with the most

significant difficulty can help identify trends to address the issue better for future emergencies in nursing homes in Minnesota.

Summary

Section one of this study successfully outlines several reasons to show the importance of studying nursing home residents' mortality and infection with COVID-19 and nursing staff shortages in Minnesota, adjusting for rural and urban locations. This section discussed the background, problem statement, purpose of the study, research questions and hypotheses, theoretical framework, study nature, literature review, definitions, assumptions, scope and delimitations, and significance. The next chapter will focus on the design and data analysis methodology.

Section 2: Research Design and Data Analysis Plan

The purpose of this quantitative retrospective quasi-experimental study was to evaluate the relationship between nursing staff shortages and COVID-19 mortality and infection among nursing home residents in Minnesota based on the CMS public database, adjusting for rural and urban locations. The independent variables were shortages of nursing staff in rural and urban nursing homes in the state of Minnesota; the dependent variables were COVID-19 total deaths and COVID-19 total infections in rural and urban nursing homes in the state of Minnesota from the beginning of the pandemic until July 2022. In this section, I address the rationale for the study, study variables, research design, and how I sought to evaluate the research questions while explaining any constraints linked to the design. This section also includes the study methodology, target population, instrumentation and operationalization, analysis plan, threats to validity, and ethical procedures.

Research Design and Rationale

Research design helps structure a study to show how the necessary information is acquired to answer the research question. Quantitative methodology allows a research design to have empirical observation and mathematical expression of relations (Hoy & Adams, 2016). An appropriate research design was essential to answer the research question and add to the growing literature on the COVID-19 pandemic. I used a retrospective cohort quasi-experimental research design. Cohort design is a type of research design that is nonexperimental or observational, is selected based on the exposure status of individuals, and is followed over time to search for the occurrence of the outcome of interest (Setia, 2016). A retrospective cohort study uses preexisting

secondary research data to study relationships between exposure and outcome (Setia, 2016). Quasi-experimental study designs are non-randomized, pre–and post-intervention studies commonly used in medical informatics literature to evaluate the benefits of specific interventions (Harris et al., 2006).

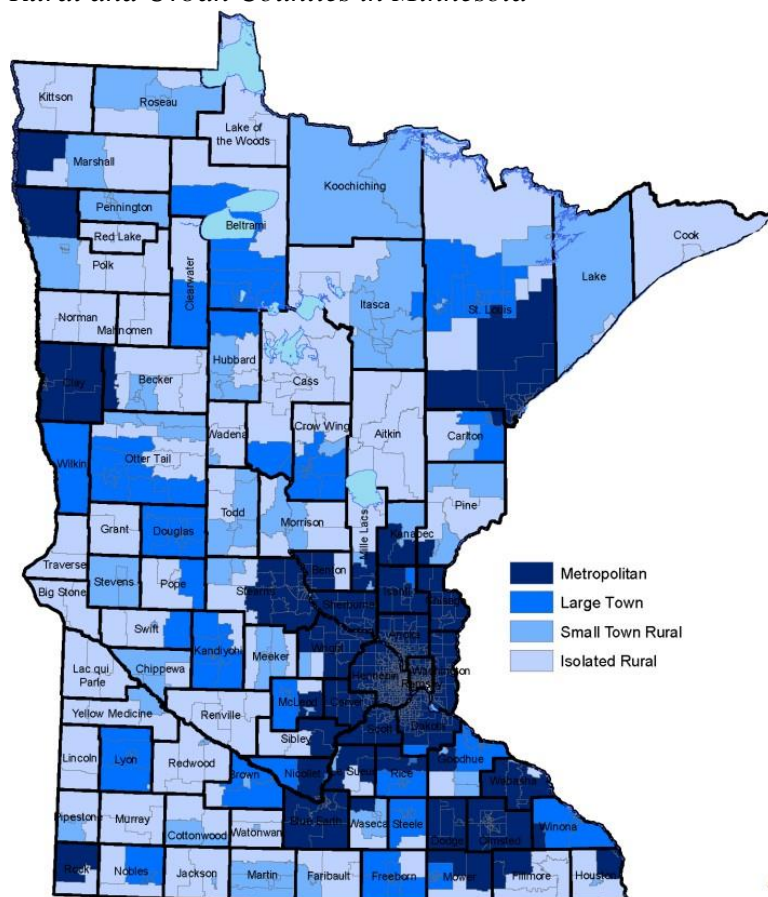
This research design was a retrospective cohort study because the data were collected from previous records on the CMS website, and the participants did not have the outcome of interest. They were selected based on their exposure to their specific nursing home location and staffing shortages. The independent variables were nursing staff shortages, and the dependent variables were COVID-19 total deaths and COVID-19 total infections in rural and urban nursing homes in Minnesota from the beginning of the pandemic until July 2022. Data were acquired from the CMS public database. The data were analyzed using a multivariate regression analysis design. Regression analysis can help test if there is statistical significance to the study variables or if there is no relationship between the variables. Before running the regression analysis in this study, multicollinearity was tested. Multicollinearity is a statistical phenomenon in which two or more predictor variables in multiple regression models are highly correlated; if they are correlated, the standard of error of the coefficients will increase, thus making some variables statistically insignificant (Daoud, 2017). Multicollinearity testing can check for the reliability of the regression model. After data cleanup in an Excel file and adjusting the data in SPSS software, I ran a regression analysis to see the relationship and the extent to which the independent variable affects the dependent variable and used Pearson correlation to see how nursing staff shortages influenced COVID-19 infections and deaths in nursing homes, adjusting for rural and urban locations.

The significant constraints in obtaining the data consisted of data cleanup, adjusting data to rural and urban locations, and analyzing the data. Because the data were public, they had information from every single nursing home in the United States; cleaning data only to have my choice of state was a time-consuming process. Data was cleaned up in an Excel file to simplify the process and then moved to SPSS software to run the analysis report.

Methodology

Population

The population studied in this experiment was from Minnesota nursing home facilities. For this study, 87 counties from the state of Minnesota were selected to study nursing home challenges during the COVID-19 pandemic. These counties were collected using the data set provided by CMS and analyzed using SPSS. Using the dummy variable technology in SPSS, 87 counties were separated into rural and urban counties. Counties were separated using the map provided by the Department of Health from Minnesota (Minnesota Department of Health, 2021). There are a total of 44 rural counties and 43 urban counties. Large and small rural counties and large and small urban counties were all combined into two data variables. The data used for this study were collected from the beginning of the pandemic until the end of July 2022. There were 364 nursing homes in rural counties and 1,056 in urban counties in Minnesota that reported data to CMS. Figure 4 is a map of Minnesota showing the breakdown of rural and urban regions. This map is from the 2021 census data from the Minnesota Department of Health. Counties are separated based on the map provided by the health department of the state of Minnesota (Minnesota Department of Health, 2021).

Figure 4*Rural and Urban Counties in Minnesota*

4

Note. From *Rural Health Care in Minnesota: Data Highlights*, by Minnesota Department of Health, 2021 (<https://www.health.state.mn.us/facilities/ruralhealth/docs/ruralhealthcb2021.pdf>).

Sampling and Sampling Procedures

Secondary data analysis is the reanalysis of data gathered by another organization (Shi, 2008). This study included all urban and rural nursing home data reported to CMS for the COVID-19 pandemic from the beginning until July 2022. To separate urban from rural counties in Minnesota, a map provided by the Minnesota Department of Health from 2021 was used to create dummy variables in SPSS for data analysis. Urban counties

have more nursing homes and thus have more extensive data provided to CMS than rural counties. However, the statistical analysis yielded results that could accept or reject the null hypothesis. The data were downloaded as an Excel file from the CMS website and transferred into the SPSS software for data analysis. The nursing home COVID-19 data exist in a public file that includes data reported by nursing homes to CDC's National Healthcare Safety Network (NHSN) Long Term Care Facility (LTCF) COVID-19 Module: Surveillance Reporting Pathways and COVID-19 Vaccinations (CMS, 2022). For this research study, only Minnesota was used, and the sample was used in rural and urban counties.

Sample Size Power Analysis

Type I errors (false positive) can occur from poor sampling that can lead to an experimental sample different from the population; this error occurs when H_1 is accepted in error when it is not valid in the population being studied (Serder et al., 2021). Type II error occurs when H_1 is rejected and H_0 is accepted incorrectly; this error occurs due to a small sample size combined with a small effect size, thus reducing the power of the study (Serder et al., 2021). Power is the probability of rejecting a false null hypothesis and is calculated as $1-\beta$ for Type II error (Serder et al., 2021). The ideal power of a study is 0.8, specified as 80%; a good sample size should obtain a Type I error as low as 0.05 and a power as high as 0.8 or 0.9 (Serder et al., 2021). This study was maintained to obtain a power level of 80%. To achieve my ideal sample size, I used the desired sample equation: Necessary sample size (n) = $(Z\text{-score})^2 \times P \times (1-P) / (\text{margin of error})^2$. The margin of error for the equation was 10%, with P equal to 0.05 and a confidence level of 95%.

Based on my sample size equation results, I needed a sample of 96 nursing homes. Because I had access to most of the nursing homes' data on the CMS website, I had a huge sample size to run my experiment. Samples excluded from the study consisted of nursing homes in other states and dates of data that were not part of the study for this experiment. Samples included in this study consisted of nursing homes in Minnesota and dates of data from the beginning of the pandemic until July 2022.

Procedure for Gaining Access to the Data

The data set in this study was a public file on nursing home COVID-19 information reported by nursing homes to the CDC's NHSN LTCF COVID-19 Module: Surveillance Reporting Pathways and COVID-19 vaccinations (CMS, 2022). Data on this website can be visualized and downloaded as an Excel file. These data are made public to protect nursing home residents; thus, nursing homes are required to report vaccinations of residents and staff, infections, deaths, staff shortages, lack of proper equipment, and so forth.

Reputability of the Sources and Justification

This data source is credible because it is on a government website; thus, nursing homes must provide accurate information to CDC and NHSN. Still, a few nursing homes in the data set have left many questions unanswered concerning the staffing shortage. The COVID-19 pandemic showed all the flaws in the healthcare system and is a significant crisis worldwide. Because of this reason, many nursing homes and hospitals refuse to share information or refuse to answer all or some questions. However, there are still many nursing homes that do answer all the required questions. These data are sufficient for studying nursing homes and their challenges during the pandemic. Another great

thing about the website is that it regularly updates new data and maintains quality checks to ensure that datasets are as accurate as possible.

Operationalization of Constructs

Operationalization is the process of turning theoretical constructs into measurable laboratory quantities to be studied via empirical observations (Haucke et al., 2021). The independent variables were nursing staff shortages, and the dependent variables were COVID-19 total deaths and COVID-19 total infections in rural and urban nursing homes in Minnesota from the beginning of the pandemic until July 2022. These variables cannot be observed or measured; thus, I used secondary data to run a retrospective cohort quasi-experimental research design. Table 1 shows the operationalization of the variables for this study.

Table 1*Variable Operationalization*

Variable	Description	Measure
COVID-19 infections of residents adjusted for rural and urban locations in the state of Minnesota	Total number of COVID-19 infections reported by nursing home residents	Numerical discrete data for total numbers of COVID-19 infections in each nursing home in the state of Minnesota
COVID-19 deaths of residents adjusted for rural and urban locations in the state of Minnesota	Total number of COVID-19 deaths reported by nursing home residents	Numerical discrete data for total numbers of COVID-19 infections in each nursing home in the state of Minnesota
Nursing homes adjusted for rural and urban locations in the state of Minnesota reported a shortage of nursing staff.	Yes or no for nursing staff shortage reported by nursing homes in the state of Minnesota	Numerical discrete data for nursing staff shortage Yes = 1 No = 2

Restating the Research Questions and Hypotheses

Research Question 1: Is there an association between nursing staff shortages and total confirmed COVID-19 resident deaths in Minnesota state nursing homes based on the data obtained from the CMS public nursing home database, adjusting for rural and urban locations?

H01: Nursing staff shortages have no statistically significant relationship with COVID-19 total resident deaths in Minnesota state nursing homes.

H11: Nursing staff shortages have a statistically significant relationship with COVID-19 total resident deaths in Minnesota state nursing homes.

Research Question 2: Is there an association between nursing staff shortages and total confirmed COVID-19 infections among residents in Minnesota state nursing homes based on the data obtained from the CMS public nursing home database, adjusting for rural and urban locations?

H02: Nursing staff shortages have no statistically significant relationship with total confirmed COVID-19 infections in Minnesota state nursing homes.

H12: Nursing staff shortages have a statistically significant relationship with total confirmed COVID-19 infections in Minnesota state nursing homes.

Data Analysis Plan

This section of the study explains the methods used to obtain the data, perform data cleanup, and analyze the data to answer the research questions. The data set in this study was a public file on nursing home COVID-19 information reported by nursing homes to the CDC's NHSN LTCF COVID-19 Module: Surveillance Reporting Pathways and COVID-19 vaccinations (CMS, 2022). Data on this website was downloaded as an Excel file to answer the research questions in this study. Once the Excel data were downloaded, they were cleaned using Excel software on a Microsoft desktop computer. This data source is credible because it is on a government website; thus, nursing homes must provide accurate information to the CDC and NHSN. Nursing homes that left the

shortage of nursing staff questions blank were accounted for in data analysis. The data on the CMS website were updated and needed no additional cleanup regarding removing any duplicate entries. The only time-consuming process was separating Minnesota data from other states because the file download was huge. Once the data were ready and saved with just the information from the state of Minnesota, it was opened in the SPSS software.

SPSS allows for extensive data sets to be analyzed; thus, it was used to answer the research questions for this study. This study used descriptive data analysis for the three variables: COVID-19 infections among nursing home residents, COVID-19 deaths among nursing home residents, and shortage of nursing staff reported by nursing homes, all adjusted for rural and urban locations. Descriptive statistics allow readers to see short summaries of what to expect before moving into multiple linear regression analysis. The study design for this research study had a significance level of 0.05; thus, if the *p-value* is less than or equal to 0.05, the null hypothesis will be rejected.

The analysis for both research questions followed similar methods. The test that was used to check for statistical significance was multiple linear regression. Multiple linear regression is a model that uses several independent variables to help identify a quantitative outcome (Schober & Vetter, 2020). The regression model estimates the effect of each independent variable while keeping other independent variables' values constant (Schober & Vetter, 2020). For my first question, my two independent variables were a shortage of nursing staff in rural nursing homes and the shortage of nursing staff in urban nursing homes, and the dependent variable was the total COVID-19 resident deaths reported in nursing homes, adjusting for rural and urban locations. For my second

question, my two independent variables were a shortage of nursing staff in rural nursing homes and the shortage of nursing staff in urban nursing homes, and the dependent variable was the total COVID-19 infections reported in nursing homes, adjusting for rural and urban locations. Multiple regression will explain how the independent variables influence the dependent variables.

Total COVID-19 deaths = $\beta_0 + \beta_1$ Shortage of nursing staff in rural nursing homes in Minnesota + β_2 Shortage of nursing staff in urban nursing homes in Minnesota
 β_1 and β_2 are the coefficients of Shortage of nursing staff in rural and urban nursing homes in Minnesota.

Total COVID-19 infections = $\beta_0 + \beta_1$ Shortage of nursing staff in rural nursing homes in Minnesota + β_2 Shortage of nursing staff in urban nursing homes in Minnesota
 β_1 and β_2 are the coefficients of Shortage of nursing staff in rural and urban nursing homes in Minnesota.

This study will use a multicollinearity test to check the regression model's reliability. Multicollinearity is a statistical phenomenon in which two or more predictors' variables in multiple regression models are highly correlated; if they are correlated, the standard of error of the coefficients will increase, thus making some variables statistically insignificant (Daoud, 2017).

Threats to External and Internal Validity

The goal of any research scientist is to design a study that is free from bias and other limitations to preserve the research integrity. The research studies must show the highest validity to readers for valid results. External and internal validity are essential concepts when designing a research study. External validity cannot exist without internal

validity (Cottrell & McKenzie, 2011). In other words, internal validity is more critical when generalizing research findings. This study used government data sources to answer the research questions. The data used in this study is from a government agency; thus, the validity and reliability of the data are acceptable for addressing internal validity.

However, one threat to the internal validity of this study is that nursing homes self-reported to the government agency. Self-report weaknesses are that many respondents do not tell the truth or remember to repeat accurate information (Cottrell & McKenzie, 2011). However, with many healthcare organizations using electronic health records, information is usually electronically transferred between organizations. So, for this study, it can be assumed that nursing homes provided accurate information to the government agency. External validity concerns the ability to generalize study results to other groups and settings beyond those in the current experiment (Cottrell & McKenzie, 2011).

Location interaction can threaten external validity since different states can show alternating results for their urban and rural nursing home challenges during the COVID-19 pandemic. The research questions only focused on the state of Minnesota; thus, the results might be different in other states.

Threats to Statistical Conclusion Validity

A threat to statistical conclusion validity is if the experiment finds no relationship between the shortage of nursing staff and total COVID-19 infections and death numbers in the state of Minnesota, adjusting for rural and urban locations. This threat can occur if assumptions are not adequately tested or the statistically significant level of 0.05 is not a considerable margin of error for the experiment.

Ethical Procedures

This study meets ethical procedures because the data is from a public file updated by government officials and contains information provided by nursing homes. The data contains no patient or staff information. Instead, the data used for this experiment only contains yes-or-no questions and numbers for total COVID-19 infections and deaths reported in nursing homes.

Summary

The second section of this research study discussed the research design rationale and methodology. This study's research design is a retrospective cohort quasi-experimental research design. Data is collected from the CMS website and cleaned, organized, and analyzed using Excel and SPSS. The population being studied in this experiment are rural and urban regions in Minnesota. The study uses multiple regression analysis to find statistical significance between independent and dependent variables.

This section also discusses threats to validity and ethical procedures. Section three presents the results and findings.

Section 3: Presentation of the Results and Findings

This study aimed to investigate the relationship between nursing staff shortages and COVID-19 mortality and infection among nursing home residents in Minnesota based on the CMS public database, adjusting for rural and urban locations.

1. Is there an association between nursing staff shortages and total confirmed COVID-19 resident deaths in Minnesota state nursing homes based on the data obtained from the CMS public nursing home database, adjusting for rural and urban locations?
2. Is there an association between nursing staff shortages and total confirmed COVID-19 infections among residents in Minnesota state nursing homes based on the data obtained from the CMS public nursing home database, adjusting for rural and urban locations?

This section addresses the data analysis outlined in Sections 1 and 2 of this study.

Data Collection of Secondary Data Set

This quantitative retrospective quasi-experimental study evaluated the relationship between nursing staff shortages and COVID-19 mortality and infection among nursing home residents in Minnesota based on the CMS public database, adjusting for rural and urban locations. The independent variables were shortages of nursing staff in rural and urban nursing homes in the state of Minnesota; the dependent variables were COVID-19 total deaths and COVID-19 total infections in rural and urban nursing homes in the state of Minnesota from the beginning of the pandemic until July 2022. The results from this study can be used to determine if nursing staff shortages affect patient care quality in nursing homes, especially during emergencies. Findings from this study will

contribute to positive social change by enabling healthcare administrators to make effective and efficient decisions during medical emergencies, improve their disaster management plan, improve human resource management retention of employees, and improve the quality of patient care for their healthcare organization.

This study used a data set from the CMS public nursing home database of COVID-19 records. The data were collected by nursing homes throughout the United States and submitted to CMS services. This study included a total of 87 counties from the state of Minnesota, with 44 rural counties and 43 urban counties. Large and small rural counties and large and small urban counties were all combined into two data variables. The data used for this study were collected from the beginning of the pandemic until the end of July 2022. There were a total of 364 nursing homes in rural counties and 1,056 nursing homes in urban counties in the state of Minnesota that reported data to CMS. Data from the CMS website show that out of 1,428 nursing homes in Minnesota between May 2020 and July 2022, 738 reported a lack of nursing staff, while 690 did not report or answer the question. In the statistical analysis, all responses were included, even those that were left unanswered.

Descriptive Statistics

Descriptive statistics allow readers to see a summary of the studied sample without drawing any conclusions about the probability theory (Kaliyadan & Kulkarni, 2019). This section shows quantitative descriptions of the data for comparison between variables. Skewness and kurtosis help assess normality for data distribution in small and large sample sizes (Kim, 2013). Kurtosis helps measure the peakedness of distribution, and skewness measures the asymmetry of data (Kim, 2013). SPSS not only allows

researchers to check skewness and kurtosis, but it also shows standard error in the sample. A normal distribution's skew value is zero, representing a symmetric distribution (Kim, 2013).

A positive skew value means that the tail on the right side of a distribution is longer than the left side, and the majority of the values lie to the left of the mean; in contrast, a negative skew value means that the tail on the left side of the distribution is longer than the right side and the majority of the value lies on the right of the mean (Kim, 2013). For a normal distribution, the excess kurtosis should be zero; positive kurtosis (leptokurtic distribution) means a high peak value and negative excess kurtosis (platykurtic distribution) means a flat-topped curve (Kim, 2013). The skewness in the figures below allows readers to see the asymmetry of the data distribution, and kurtosis shows the peakedness of data distribution (Kaliyadan & Kulkarni, 2019). Both skewness and kurtosis together allow readers to see the shape of the data to help understand its distribution. Table 2 shows the descriptive statistics for variables with skewness and kurtosis of the data in a table format.

Table 2*Descriptive Statistics for Variables With Skewness and Kurtosis (May 2020–July 2022)*

Variables	<i>N</i> statistic	Range statistic	Minimum statistic	Maximum statistic	Mean statistic	Std. deviation statistic	Skewness statistic	Std. error	Kurtosis statistic	Std. error
Urban	1428	1.00	0.00	1.00	0.7395	0.43906	-1.092	0.065	-0.808	0.129
Rural	1428	1.00	0.00	1.00	0.2549	0.43596	1.126	0.065	-0.733	0.129
Lack of nursing staff	1428	1.00	0.00	1.00	0.5168	0.49989	-0.067	0.065	-1.998	0.129
No lack of nursing staff	1428	1.00	0.00	1.00	0.0518	0.22174	4.048	0.065	14.407	0.129
Residents total confirmed COVID-19	1424	234	0	234	43.58	36.393	1.972	0.065	5.553	0.130
Residents total COVID-19 deaths	1424	62	0	62	7.88	8.941	2.145	0.065	6.796	0.130
Resident total all deaths	1424	317	0	317	51.95	43.138	1.870	0.065	5.064	0.130
Valid <i>N</i> (listwise)	1424									

Before the data analysis, it is essential to see the data distribution to check for normality. Figure 5 shows a positive skewed histogram for residents' total confirmed COVID-19 infections in Minnesota from May 2020 until July 2022. A positively skewed histogram means the mean of the data is greater than the median and mode (Kim, 2013). Figure 6 also shows a positive skewed histogram for residents' total confirmed COVID-19 deaths in Minnesota from May 2020 until July 2022. Figure 7 also shows a positive skewed histogram for residents' total deaths in Minnesota from May 2020 until July 2022.

Figure 5

Skewness for Residents' Total Confirmed COVID-19 Infections From May 2020–July

2022

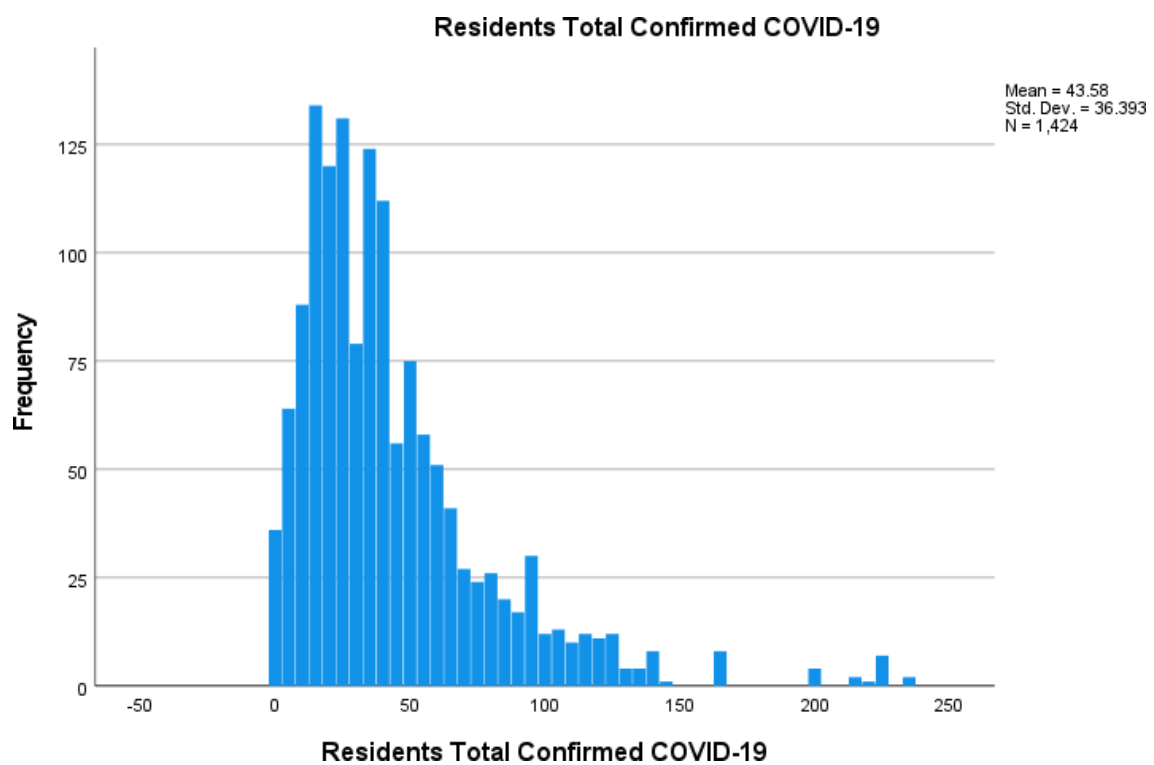


Figure 6

Skewness for Residents' Total COVID-19 Deaths From May 2020–July 2022

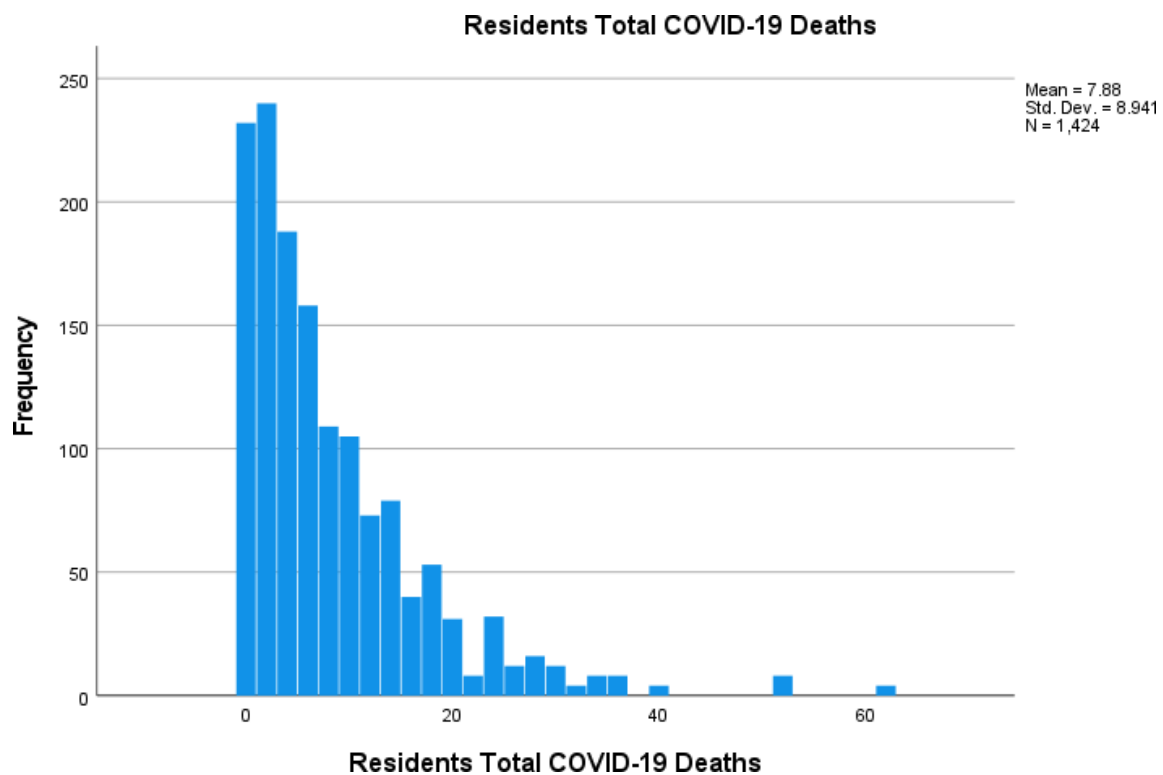


Figure 7

Skewness for Resident Total All Deaths From May 2020–July 2022

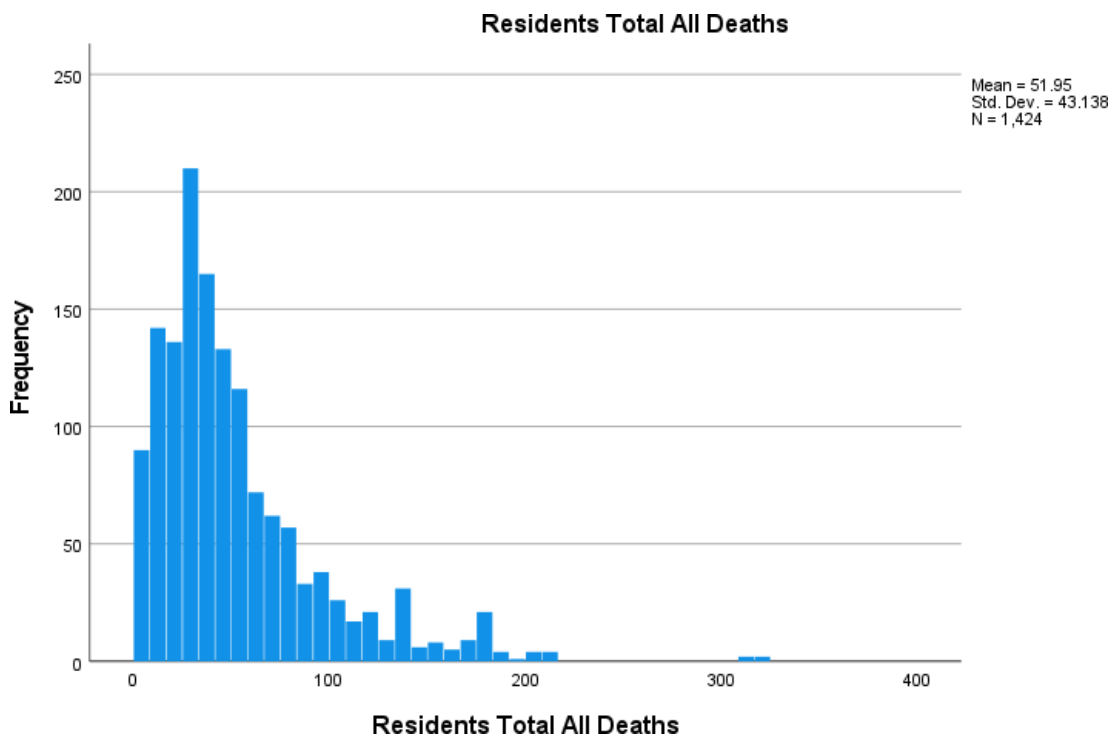


Table 3 shows the frequency of rural and urban nursing home numbers and the lack of nursing staff in Minnesota nursing homes from May 2020 until July 2022. Skewness for rural nursing homes is 1.126, which means that data are positively skewed. For urban nursing homes, the skewness is -1.092, which means the data are negatively skewed. The standard of error for skewness for rural and urban nursing homes, lack of nursing staff, and lack of nursing staff is 0.065, which means the data are very close to being symmetrical and normally distributed. For lack of nursing staff, reported data show -0.067 skewness, which means the data are negatively skewed compared to reporting no lack of staffing shortage, which is 4.048, which is positively skewed. The standard of

error for rural and urban nursing homes, lack of staffing, and lack of staffing is 0.129, which means the data are symmetrical and normally distributed.

Table 3

*Frequency Table for Rural and Urban Lack of Staffing in Minnesota Nursing Homes
From May 2020–July 2022*

		Rural	Urban	Lack of nursing staff	Reported no lack of nursing staff
<i>N</i>	Valid	1,428	1,428	1,428	1,428
	Missing	0	0	0	0
Skewness		1.126	-1.092	-0.067	4.048
Std. error of skewness		0.065	0.065	0.065	0.065
Kurtosis		-0.733	-0.808	-1.998	14.407
Std. error of kurtosis		0.129	0.129	0.129	0.129

Table 4 shows that 364 of the 1,428 nursing homes in the state of Minnesota were in rural locations.

Table 4

Frequency Table for Rural Nursing Homes in Minnesota From May 2020–July 2022

		Frequency	Percent	Valid percent	Cumulative percent
Valid	Urban	1,064	74.5	74.5	74.5
	Rural	364	25.5	25.5	100.0
	Total	1,428	100.0	100.0	

Table 5 shows that 1,056 of the 1,428 nursing homes in the state of Minnesota were in urban locations.

Table 5

Frequency Table for Urban Nursing Homes in Minnesota From May 2020–July 2022

		Frequency	Percent	Valid percent	Cumulative percent
Valid	Rural	372	26.1	26.1	26.1
	Urban	1,056	73.9	73.9	100.0
	Total	1,428	100.0	100.0	

In Table 6, data show that between May 2020 and July 2022, 738 of the 1,428 nursing homes in the state of Minnesota reported a lack of nursing staff, while 690 did not report or did not answer the question on the CDC website.

Table 6

Frequency table for lack of nursing staff in Minnesota nursing homes from May 2020–July 2022

Valid	Did not answer or report none	690	48.3	48.3	48.3
	Reported lack of nursing staff	738	51.7	51.7	100.0
	Total	1,428	100.0	100.0	

In Table 7, data show that out of 1,428 nursing homes in the state of Minnesota between May 2020 and July 2022, 74 reported no shortage of nursing staff, while 1,354 did not report or report a shortage of staffing on the CDC website.

Table 7

*Frequency Table for No Report of Nursing Staff Shortage in Minnesota Nursing Homes
From May 2020–July 2022*

	Frequency	Percent	Valid percent	Cumulative percent
Reported or did not reply to lack of nursing staff	1,354	94.8	94.8	94.8
Did not report lack of nursing staff	74	5.2	5.2	100.0
Total nursing homes	1,428	100.0	100.0	

Multiple Linear Regression Analysis for Research Question 1

Below is the summary of multiple linear regression analysis to check the research questions in this study. The first research question was: Is there an association between nursing staff shortages and total confirmed COVID-19 resident deaths in Minnesota state nursing homes based on the data obtained from the CMS public nursing home database, adjusting for rural and urban locations?

Tables 8 through 13 show multiple linear regression analyses for rural nursing homes, with the dependent variable being the total confirmed COVID-19 resident deaths in Minnesota and the independent variable being the lack of nursing staff and rural locations from May 2020 until July 2022.

Tables 10 through 19 show the summary of the urban nursing home multiple linear regression analysis, with the dependent variable being the total confirmed COVID-19 resident deaths in Minnesota and the independent variable being the lack of nursing staff and urban locations.

Table 8 shows that the mean number of residents with COVID-19 deaths is 7.88, and the standard deviation is 8.91 from 1,424 nursing homes. The lack of nursing staff means 0.5183, and the standard deviation is 0.49984 from 1,424 nursing homes. And no lack of nursing staff variable mean is 0.0520, and the standard deviation is 0.22204 from 1424 nursing homes in Minnesota from May 2020 to July 2022. The rural nursing home mean is 0.2556, and the standard deviation is 0.43636 from 1,424 nursing homes in Minnesota from May 2020 until July 2022.

Table 8

Descriptive Statistics for Rural Nursing Homes' COVID-19 Deaths From May 2020–July 2022

	Mean	Std. deviation	N
Residents total COVID-19 deaths	7.88	8.941	1,424
Lack of nursing staff	0.5183	0.49984	1,424
No lack of nursing staff	0.0520	0.22204	1,424
Rural	0.2556	0.43636	1,424

In Table 9, the correlation model shows that total resident COVID-19 deaths correlated the highest with rural locations, with -0.142, as compared to lack of nursing staff at -0.04 and no lack of nursing staff at -0.032. The model also shows a high correlation between a lack of nursing staff and no lack of nursing staff -0.243. Pearson correlation measures the strength and direction of the linear relationship between two variables (Kent University, 2023).

The coefficient can range from +1 to -1, with +1 indicating a positive correlation and -1 indicating a negative correlation (Kent University, 2023). Again, these correlations are not as high, but based on this model, these Pearson correlations stand out.

Table 9

Correlations for Rural Nursing Homes COVID-19 Deaths From May 2020–July 2022

		Residents Total COVID-19 Deaths	Lack of nursing staff	No lack of Nursing staff	rural
Pearson Correlation	Residents Total COVID-19 Deaths	1.000	-0.040	-0.032	-0.142
	Lack of nursing staff	-0.040	1.000	-0.243	-0.002
	No lack of nursing staff	-0.032	-0.243	1.000	0.066
	rural	-0.142	-0.002	0.066	1.000
Sig. (1- tailed)	Residents Total COVID-19 Deaths		0.066	0.112	0.000
	Lack of nursing staff	0.066		0.000	0.469
	No lack of nursing staff	0.112	0.000		0.006
	rural	0.000	0.469	0.006	
N	Residents Total COVID-19 Deaths	1424	1424	1424	1424
	Lack of nursing staff	1424	1424	1424	1424
	No lack of nursing staff	1424	1424	1424	1424
	rural	1424	1424	1424	1424

In Table 10, the adjusted R square for this model is 0.021. Thus, it is a good predictor because it has a less than 0.05 p-value. This model predicts 2% of the variance for the dependent variable, as explained by the independent variables.

Table 10

Model Summary for Variables in Comparison to Total COVID-19 Death May 2020–July 2022

Model	<i>R</i>	<i>R</i> square	Adjusted <i>R</i> square	Std. error of the estimate	Change statistics				
					<i>R</i> square change	<i>F</i> change	df1	df2	Sig. <i>F</i> change
1	.151 ^a	0.023	0.021	8.848	0.023	11.041	3	1,420	0.000

In Table 11, the ANOVA calculation shows a statistically significant value of less than 0.001. Table 12 shows that nursing homes that reported a lack of nursing staff in rural counties had a 0.9% less effect on total COVID-19 deaths, with a statistical significance of 0.072. Nursing homes that reported no lack of nursing staff in rural counties had a 1.40% less effect on total COVID-19 deaths, with a statistical significance of 0.198.

Table 11

ANOVA for Variables in Comparison to Total COVID-19 Death May 2020–July 2022

Model		Sum of squares	<i>df</i>	Mean square	<i>F</i>	Sig.
1	Regression	2593.028	3	864.343	11.041	< .001 ^a
	Residual	111168.954	1,420	78.288		
	Total	113761.982	1,423			

Table 12

*Coefficient Table for Variables in Comparison to Total COVID-19 Deaths May 2020–
July 2022*

Model	Unstandardized coefficients	Std. error	Standardized coefficients Beta	<i>t</i>	Sig.	95.0% confidence interval for B Lower bound	95.0% confidence interval for B Upper bound	Collinearity statistics Tolerance	Collinearity statistics VIF
(Constant)	9.133	0.381		23.994	0.000	8.387	9.880		
Lack of nursing staff	-0.872	0.484	-0.049	-1.803	0.072	-1.821	0.077	0.941	1.063
No lack of nursing staff	-1.404	1.091	-0.035	-1.287	0.198	-3.545	0.737	0.937	1.068
Rural	-2.855	0.539	-0.139	-5.299	0.000	-3.912	-1.798	0.995	1.005

This concludes that a lack of nursing staff in rural locations has a more significant statistical impact on total death by COVID-19 in nursing home residents than no lack of nursing staff. Looking at the overall deaths caused by COVID-19 in rural nursing homes, we find that for every death in Minnesota's rural locations, there are 2.85 fewer deaths compared to other locations, and there is a high statistical significance of less than .001. Thus, this shows statistical significance regarding locations and COVID-19 nursing home deaths in Minnesota. In Table 13, multicollinearity is shown to be not greater than 10. Thus, the model is not redundant. All VIF values for this model are more significant than one but less than 2, thus showing less collinearity. Tolerance for collinearity statistics is closer to one but not as close to zero, thus indicating less collinearity among predicted variables.

Collinearity diagnostics help identify linear dependency. In this model, the condition index is all less than 30, which indicates no linear dependency.

Table 13

Multicollinearity Table for Variables in Comparison to Total COVID-19 Deaths May 2020–July 2022

Model		Eigenvalue	Condition index	Variance proportions			
				(Constant)	Lack of nursing staff	No lack of nursing staff	Rural
1	1	2.121	1.000	0.07	0.07	0.02	0.09
	2	1.005	1.452	0.00	0.06	0.76	0.01
	3	0.641	1.819	0.03	0.11	0.09	0.83
	4	0.233	3.017	0.90	0.76	0.13	0.07

Figure 8 shows a probability plot with dots that line up very close to our diagonal line. Thus, the dots show homoscedasticity, which states that the assumptions have been met. Homoscedasticity is an assumption of similar variance in different groups being studied.

Figure 8

Probability Plot of Regression for Total COVID-19 Deaths in Rural Nursing Homes May 2020–July 2022

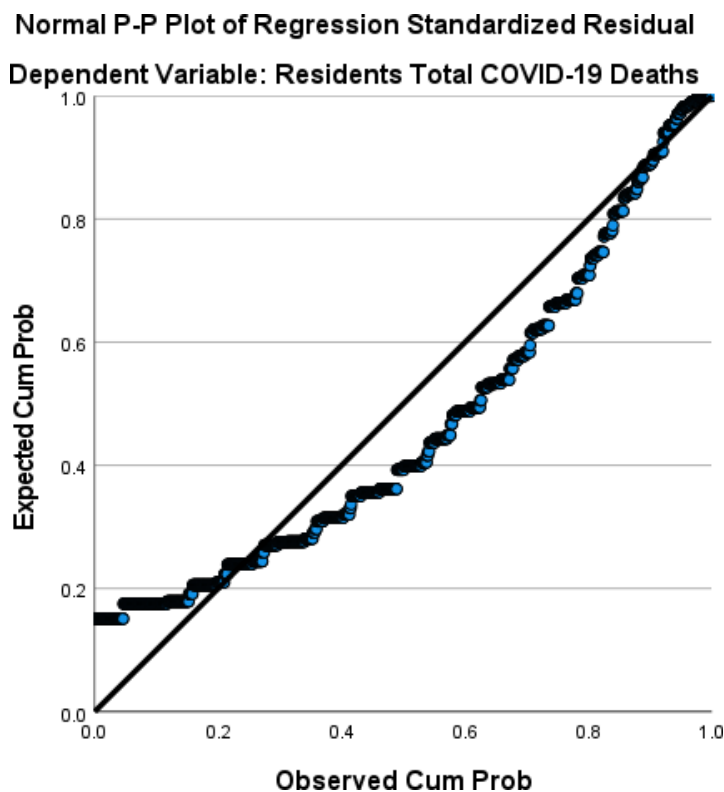


Table 14 shows that the mean of the total COVID-19 deaths is 7.88, and the standard deviation is 8.91 from 1424 nursing homes. For the variable lack of nursing staff, the mean is 0.5183, and the standard deviation is 0.49984 from 1424 nursing homes. For the variable no lack of nursing staff, the mean is 0.0520, and the standard deviation is 0.22204 from 1424 nursing homes in Minnesota from May 2020 to July 2022. Urban nursing home variable the mean is 0.7388, and the standard deviation is 0.43946 from 1424 nursing homes in Minnesota from May 2020 to July 2022.

Table 14

Descriptive Statistics for Urban Nursing Homes COVID-19 Deaths From May 2020–July 2022

	Mean	Std. Deviation	<i>N</i>
Residents Total COVID-19 Deaths	7.88	8.941	1424
Lack of nursing staff	0.5183	0.49984	1424
No lack of nursing staff	0.0520	0.22204	1424
Urban	0.7388	0.43946	1424

In Table 15, the correlation model shows that total resident COVID-19 deaths correlated the highest with urban locations, with 0.150, compared to a lack of nursing staff at -0.04 and no lack of nursing staff at -0.032. The model also shows a high correlation between a lack of nursing staff and no lack of nursing staff of -0.243. Again, these correlations are not as high, but based on this model, these Pearson correlations stand out.

Table 15

Correlations for Urban Nursing Homes COVID-19 Deaths from May 2020–July 2022

		Residents Total COVID-19 deaths	Lack.of.nursing.staff	No.lack.of.nursing.staff	Urban
Pearson Correlati on	Residents Total COVID-19 Deaths	1.000	-0.040	-0.032	0.150
	Lack.of.nursing.staf f	-0.040	1.000	-0.243	0.015
	No.lack.of.nursing.s taff	-0.032	-0.243	1.000	-0.062
	urban	0.150	0.015	-0.062	1.000
	Sig. (1- tailed)	Residents Total COVID-19 Deaths		0.066	0.112
Lack.of.nursing.staf f		0.066		0.000	0.282
No.lack.of.nursing.s taff		0.112	0.000		0.009
urban		0.000	0.282	0.009	
N		Residents Total COVID-19 Deaths	1424	1424	1424
	Lack.of.nursing.staf f	1424	1424	1424	1424
	No.lack.of.nursing.s taff	1424	1424	1424	1424
	urban	1424	1424	1424	1424

Table 16

Model Summary for Variables in Comparison to Total COVID-19 Deaths May 2020–July 2022

Model	R	R square	Adjusted R square	Std. error of the estimate	R square change	F change	df1	df2	Sig. F change
1	.159 ^a	0.025	0.023	8.836	0.025	12.314	3	1420	0.000

In Table 16, the adjusted R square is 0.023 for this model. Thus, it is a good predictor because it is less than 0.05 p-value. This model predicts 2% of the variance for

the dependent variable, as explained by the independent variables. Table 17, ANOVA shows a statistically significant value of less than 0.001. Nursing homes that reported a lack of nursing staff in urban counties show 0.9% less effect on total COVID-19 deaths with a statistical significance of 0.060. Nursing homes that reported no lack of nursing staff in urban counties show 1.42% less effect on total COVID-19 deaths with a statistical significance of 0.192.

Table 17

ANOVA for Variables in Comparison to Total COVID-19 Deaths May 2020–July 2022

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	2884.449	3	961.483	12.314	< .001 ^a
	Residual	110877.534	1420	78.083		
	Total	113761.982	1423			

This concludes that the lack of nursing staff in urban locations has a greater statistical impact on total deaths by COVID-19 in nursing home residents than no lack of nursing staff. Looking at the overall deaths by COVID-19 in urban nursing homes, we find that for every death in the state of Minnesota, urban locations have 3.016 more deaths than other locations, and there is a high statistical significance of less than .001. Thus, this shows statistical significance regarding the lack of nursing staff and COVID-19 nursing home deaths in Minnesota adjusted for urban and rural locations. Multicollinearity is not greater than 10. Thus, the model is not redundant, as seen in Table 18. All VIF values for this model are more significant than 1 but less than 2, thus showing less collinearity, as seen in Table 18. Tolerance for collinearity statistics is

closer to one but not as close to zero, thus indicating less collinearity among predicted variables, as seen in Table 18.

Table 18

Coefficient Table for Variables in Comparison to Total COVID-19 Deaths May 2020–July 2022

Model	Unstandardized coefficients		Standardized coefficients Beta	<i>t</i>	Sig.	95.0% confidence interval for B		Collinearity statistics	
	B	Std. error				Lower bound	Upper bound	Tolerance	VIF
(Constant)	6.196	0.535		11.586	0.000	5.147	7.245		
Lack of nursing staff	-0.909	0.483	-0.051	-1.882	0.060	-1.857	0.038	0.941	1.063
No lack of nursing staff	-1.422	1.090	-0.035	-1.305	0.192	-3.559	0.716	0.938	1.067
Urban	3.016	0.534	0.148	5.647	0.000	1.968	4.064	0.996	1.004

Collinearity diagnostics help identify linear dependency. In this model, the condition index is all less than 30, as seen in Table 19. This indicates that there is no linear dependency in this model.

Table 19

Multicollinearity Table for Variables in Comparison to Total COVID-19 Deaths May 2020–July 2022

Model		Eigenvalue	Condition Index	Variance Proportions			
				(Constant)	Lack of nursing staff	No lack of nursing staff	Urban
1	1	2.510	1.000	0.03	0.05	0.01	0.03
	2	1.001	1.584	0.00	0.04	0.82	0.00
	3	0.369	2.610	0.02	0.73	0.11	0.23
	4	0.121	4.558	0.95	0.18	0.06	0.74

Figure 9

Probability Plot of Regression for Total COVID-19 Deaths in Urban Nursing Homes

Normal P-P Plot of Regression Standardized Residual

Dependent Variable: Residents Total COVID-19 Deaths

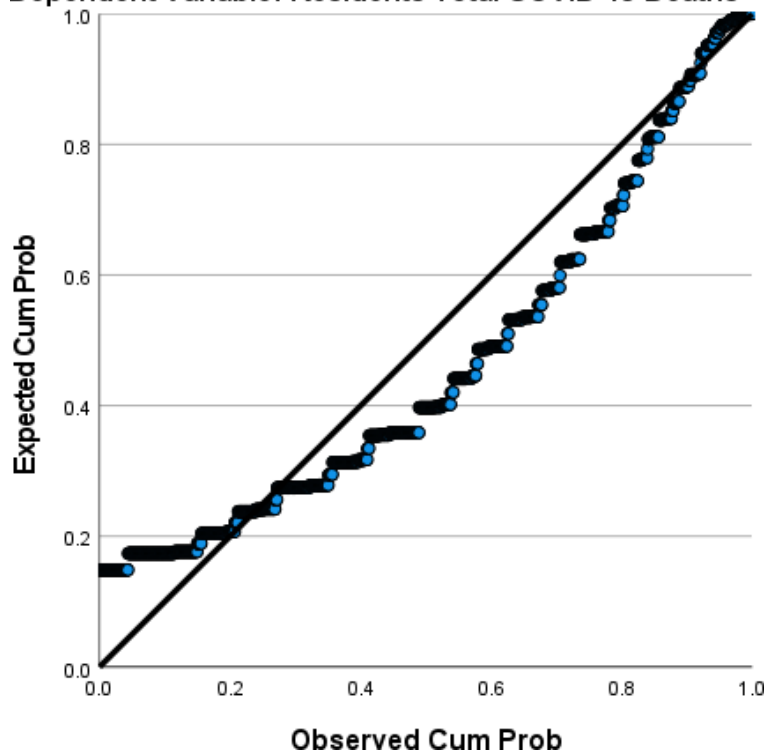


Figure 9 shows a probability plot with dots that line up very close to our diagonal line. Thus, the dots show homoscedasticity, which states that the assumptions have been met. Homoscedasticity is an assumption of similar variance in different groups being studied.

Summary of Findings for Research Question 1

Research Question 1: Is there an association between nursing staff shortages and total confirmed COVID-19 resident deaths in Minnesota state nursing homes based on the data obtained from the CMS public nursing home database adjusting for rural and urban locations?

H01: Nursing staff shortages have no statistically significant relationship with COVID-19 total resident deaths in Minnesota state nursing homes.

H11: Nursing staff shortages have a statistically significant relationship with COVID-19 total resident deaths in Minnesota state nursing homes.

Based on the results, it can be concluded that nursing staff shortage did not have a statistically significant relationship with total resident deaths from COVID-19 in the state of Minnesota. However, when adjusted for rural and urban nursing homes' locations, there is a statistically significant relationship between nursing staff shortage and total resident deaths from COVID-19 in the state of Minnesota.

Despite not seeing a significant statistical relationship between the lack of nursing staff and total COVID-19 resident deaths, the model showed a statistically significant relationship between urban and rural locations regarding COVID-19 total deaths in nursing homes. So, we can accept the hypothesis that when adjusted for rural and urban locations, there was statistical significance with COVID-19 total resident deaths in Minnesota.

Multiple Linear Regression Analysis for Research Question 2

Below is the summary of multiple linear regression analysis to check for accepting or rejecting the null hypothesis. The second research question states: Is there an association between nursing staff shortages and total confirmed COVID-19 infection among Minnesota state nursing home residents based on the data obtained from the CMS public nursing home database adjusting for rural and urban locations?

Tables 20 through 25 show the summary for a rural nursing home multiple linear regression analysis, with the dependent variable being the total confirmed COVID-19

resident infections in Minnesota and the independent variable being the lack of nursing staff and rural locations.

Tables 26 through 31 show the summary of the urban nursing home multiple linear regression analysis, with the dependent variable being the total confirmed COVID-19 resident infections in Minnesota and the independent variable being the lack of nursing staff and urban locations.

In Table 20, the resident total confirmed COVID-19 infection mean is calculated to be 43.58, and the standard deviation is 36.393 from a total of 1424 nursing homes. The lack of nursing staff means 0.5183, and the standard deviation is 0.49984 from 1424 nursing homes. For the variable no lack of nursing staff, the mean is 0.0520, and the standard deviation is 0.22204 from 1424 nursing homes in Minnesota from May 2020 to July 2022. The rural nursing home mean is 0.2556, and the standard deviation is 0.43636 from 1424 nursing homes in Minnesota from May 2020 to July 2022.

Based on the correlation model, total resident COVID-19 infection correlated the highest with rural locations, at -0.214, as compared to lack of nursing staff at -0.090 and no lack of nursing staff at -0.058, as seen in Table 21. The model also shows a high correlation between a lack of nursing staff and no lack of nursing staff, at -0.243. These correlations are again not as high, but based on this model, these Pearson correlations stand out.

Table 20

Descriptive Statistics for Rural Nursing Homes COVID-19 Confirmed Cases in Minnesota May 2020–July 2022

	Mean	Std. Deviation	N
Residents Total Confirmed COVID- 19	43.58	36.393	1424
Lack of nursing staff	0.5183	0.49984	1424
No lack of nursing staff	0.0520	0.22204	1424
rural	0.2556	0.43636	1424

Table 21

Correlation for Rural Nursing Homes COVID-19 Confirmed Cases in Minnesota May 2020–July 2022

		Residents total confirmed COVID-19.	Lack of nursing staff	No lack of nursing staff	Rural
Pearson correlation	Residents total confirmed COVID-19	1.000	-0.090	-0.058	-0.214
	Lack of nursing staff	-0.090	1.000	-0.243	-0.002
	No lack of nursing staff	-0.058	-0.243	1.000	0.066
	Rural	-0.214	-0.002	0.066	1.000
Sig. (1-tailed)	Residents total confirmed COVID-19		0.000	0.014	0.000
	Lack of nursing staff	0.000		0.000	0.469
	No lack of nursing staff	0.014	0.000		0.006
N	Residents total confirmed COVID-19	1,424	1,424	1,424	1,424
	Lack of nursing staff	1,424	1,424	1,424	1,424
	No lack of nursing staff	1,424	1,424	1,424	1,424
	Rural	1,424	1,424	1,424	1,424

The adjusted R square is 0.056 for this model. Thus, it is an okay predictor because it is very close to the 0.05 p-value, as seen in Table 22. This model predicts 5.6%

of the variance for the dependent variable, as explained by the independent variables. Table 23 also shows a statistically significant value of less than 0.001 in ANOVA analysis. Nursing homes that reported a lack of nursing staff in rural counties show 7.8% less infection from COVID-19 with a statistical significance of 0.001, as seen in Table 24. Nursing homes that reported no lack of nursing staff in rural counties show 11.5% less infection from COVID-19 with a statistical significance of 0.008, as seen in Table 24.

This concludes that the lack of nursing staff in rural locations has a higher infection percentage than nursing homes that did not report staffing shortages for nurses. In the data, nursing homes in rural counties that reported staffing shortages had 7.8% less infection from COVID-19, while nursing homes that did not report a lack of staffing showed 11.5% less infection from COVID-19. In other words, nursing homes with a lack of nursing staff showed a higher infection rate than nursing homes that did not report a lack of nursing staff in rural Minnesota. Both variables are statistically significant, with a p-value of less than 0.05. The hypothesis for this question will be accepted because a statistically significant relationship exists between a lack of nursing staff and total confirmed COVID-19 infections in Minnesota state nursing homes. Looking at the overall infection of COVID-19 in rural nursing homes, we find 17.45% less infection in rural locations than in urban locations which is 18.21% less infection rate in the state of Minnesota, with a statistical significance of 0.001, as stated in Table 24 with SPSS calculation. This means that rural counties in Minnesota reported more infections with a lack of nursing staff than urban locations. Multicollinearity in Table 24 is not greater than 10. Thus, the model is not redundant. All VIF values in Table 24 for this model are more

significant than one but less than 2, thus showing less collinearity. Tolerance for collinearity statistics is closer to one but not as close to zero, thus indicating less collinearity among predicted variables; this can be found in Table 24.

Table 22

Model Summary for Variables in Comparison to Total COVID-19 Confirmed Cases in Rural Minnesota May 2020–July 2022

Model	R	R ²	Adjusted R ²	Std. error of the estimate	R ² change	F change	df1	df2	Sig. F change
1	.242 ^a	0.058	0.056	35.352	0.058	29.338	3	1420	0.000

Table 23

ANOVA for Variables in Comparison to Total COVID-19 Confirmed Cases in Rural Minnesota May 2020–July 2022

Model		Sum of squares	df	Mean square	F	Sig.
1	Regression	109997.481	3	36665.827	29.338	< .001 ^b
	Residual	1774669.710	1420	1249.767		
	Total	1884667.191	1423			

Table 24

Coefficient Table for Variables in Comparison to Total COVID-19 Confirmed Cases in Rural Minnesota May 2020–July 2022

Model	Unstandardized coefficient B	Unstandardized coefficient Std. error	Standardized coefficients Beta	t	Sig.	95.0% confidence interval for B Lower bound	95.0% confidence interval for B Upper bound	Collinearity statistics Tolerance	Collinearity statistics VIF
(Constant)	52.680	1.521		34.638	0.000	49.696	55.663		
Lack of nursing staff	-7.801	1.933	-0.107	-4.036	0.00	-11.592	-4.009	0.941	1.063
No lack of nursing staff	-11.525	4.361	-0.070	-2.643	0.00	-20.079	-2.970	0.937	1.068
Rural	-17.446	2.153	-0.209	-8.105	0.00	-21.668	-13.223	0.995	1.005

Table 25

Multicollinearity Table for Variables in Comparison to Total Confirmed COVID-19 Cases in Rural Minnesota Nursing Homes May 2020–July 2022

Model		Eigenvalue	Condition Index	Variance Proportions (Constant)	Lack of nursing staff	No lack of nursing staff	Rural
1	1	2.121	1.000	0.07	0.07	0.02	0.09
	2	1.005	1.452	0.00	0.06	0.76	0.01
	3	0.641	1.819	0.03	0.11	0.09	0.83
	4	0.233	3.017	0.90	0.76	0.13	0.07

Collinearity diagnostics help identify linear dependency. In this model, the condition index is all less than 30, as shown in Table 25. This indicates no linear dependency in this model.

Figure 10

Probability Plot of Regression for Total Confirmed COVID-19 Infection May 2020–July 2022

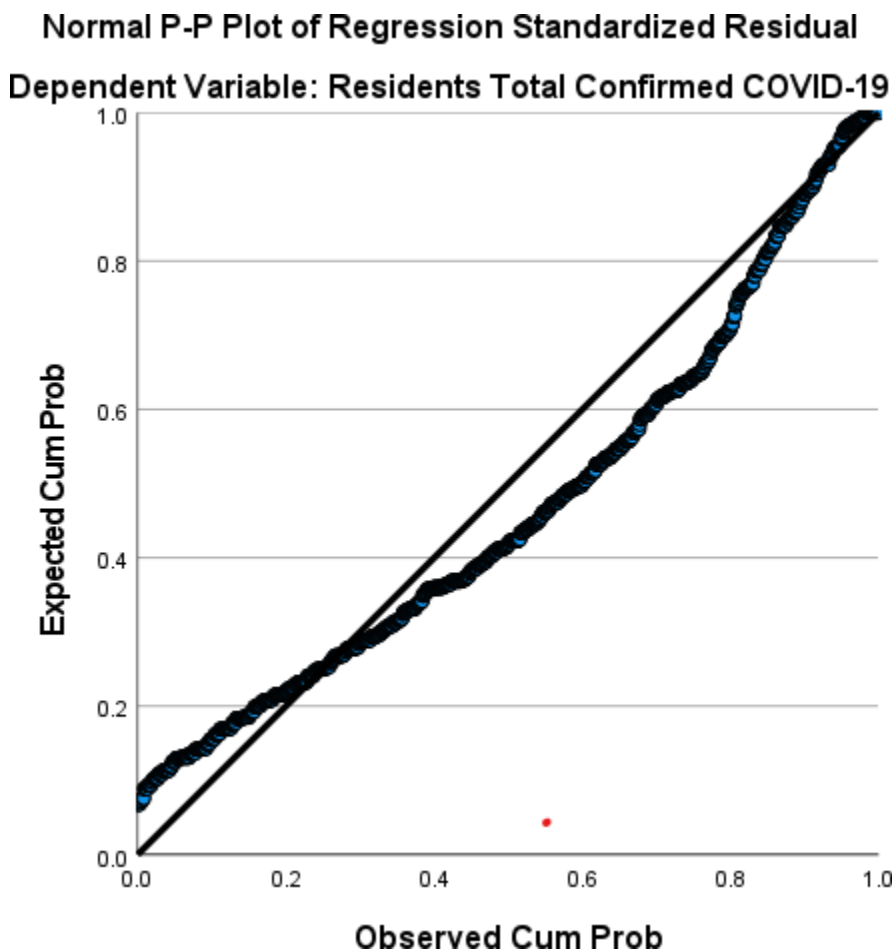


Figure 10 shows a probability plot with dots that line up very close to our diagonal line. Thus, the dots show homoscedasticity, which states that the assumptions have been met. Homoscedasticity is an assumption of similar variance in different groups being studied.

In Table 26, the resident total confirmed COVID-19 infection mean is calculated to be 43.58, and the standard deviation is 36.393 from a total of 1424 nursing homes. The

lack of nursing staff means is 0.5183, and the standard deviation is 0.49984 from 1424 nursing homes. For the variable no lack of nursing staff, the mean is 0.0520, and the standard deviation is 0.22204 from 1424 nursing homes in Minnesota from May 2020 to July 2022. For the variable urban nursing home, the mean is 0.7388, and the standard deviation is 0.43946 from 1424 nursing homes in Minnesota from May 2020 to July 2022.

Based on the correlation model, total resident COVID-19 infection correlated the highest with urban locations, at 0.223, as compared to lack of nursing staff at -0.090 and no lack of nursing staff at -0.058, as seen in Table 27. The model also shows a high correlation between a lack of nursing staff and no lack of nursing staff, at -0.243. Again, these correlations are not as high, but based on this model, these Pearson correlations stand out.

Table 26

Descriptive Statistics for Urban Nursing Homes COVID-19 Confirmed Cases in Minnesota May 2020–July 2022

	Mean	Std. Deviation	N
Residents Total Confirmed COVID- 19	43.58	36.393	1424
Lack of nursing staff	0.5183	0.49984	1424
Urban	0.7388	0.43946	1424
No lack of nursing staff	0.0520	0.22204	1424

Table 27

Correlation for Rural Nursing Homes COVID-19 Confirmed Cases in Minnesota May 2020–July 2022

		Residents total confirmed COVID-19.	Lack of nursing staff	Urban	No lack of nursing staff
Pearson correlation	Residents total confirmed COVID-19	1.000	-0.090	0.223	-0.058
	Lack of nursing staff	-0.090	1.000	0.015	-0.243
	Urban	0.223	0.015	1.000	-0.062
	No lack of nursing staff	-0.058	-0.243	-0.062	1.000
Sig. (1-tailed)	Residents total confirmed COVID-19		0.000	0.000	0.014
	Lack of nursing staff	0.000		0.282	0.000
	Urban	0.000	0.282		0.009
	No lack of nursing staff	0.014	0.000	0.009	
N	Residents total confirmed COVID-19	1,424	1,424	1,424	1,424
	Lack of nursing staff	1,424	1,424	1,424	1,424
	Urban	1,424	1,424	1,424	1,424
	No lack of nursing staff	1,424	1,424	1,424	1,424

The adjusted R square is 0.061 for this model. Thus, it is a little less than 0.05 p-value, as seen in Table 28. This model predicts 6% of the variance for the dependent variable, as explained by the independent variables. The ANOVA table shows a statistically significant value of less than 0.001 in Table 29. Nursing homes that reported a lack of nursing staff in urban counties show 8.03% less infection from COVID-19, with a statistical significance of 0.001, demonstrated in Table 30. Nursing homes that reported no lack of nursing staff in urban counties show 11.66% less infection from COVID-19, with a statistical significance of 0.007, demonstrated in Table 30.

Table 28

Model Summary for Variables in Comparison to Total COVID-19 Confirmed Cases in Urban Minnesota May 2020–July 2022

Model	<i>R</i>	<i>R</i> ²	Adjusted <i>R</i> ²	Std. error of the estimate	<i>R</i> ² change	<i>F</i> change	df1	df2	Sig. <i>F</i> change
1	.251 ^a	0.063	0.061	35.266	0.063	31.802	3	1420	0.000

Table 29

ANOVA for Variables in Comparison to Total COVID-19 Confirmed Cases in Urban Minnesota May 2020–July 2022

Model		Sum of Squares	df	Mean Square	<i>F</i>	Sig.
1	Regression	118654.555	3	39551.518	31.802	< .001 ^a
	Residual	1766012.636	1420	1243.671		
	Total	1884667.191	1423			

Table 30

Coefficient Table for Variables in Comparison to Total COVID-19 Confirmed Cases in Urban Minnesota May 2020–July 2022

Model	Unstandardized coefficients B	Unstandardized coefficients Std. error	Standardized coefficients Beta	<i>t</i>	Sig.	95.0% confidence interval for B Lower bound	95.0% confidence interval for B Upper bound	Collinearity statistics Tolerance	Collinearity statistics VIF
(Constant)	34.895	2.134		16.351	0.000	30.708	39.081		
Lack of nursing staff	-8.029	1.928	-0.110	-4.164	0.000	-11.811	-4.247	0.941	1.063
Urban	18.207	2.131	0.220	8.542	0.000	14.026	22.388	0.996	1.004
No lack of nursing staff	-11.659	4.348	-0.071	-2.681	0.007	-20.188	-3.129	0.938	1.067

This concludes that the lack of nursing staff in urban locations has a higher infection percentage than nursing homes that did not report staffing shortages for nurses.

In the data, nursing homes in urban counties that reported nursing staff shortages had 8.03% less infection rate from COVID-19, while nursing homes in urban counties that did not report a lack of staffing showed 11.7% less infection from COVID-19. In other words, nursing homes with staffing shortages had higher rates of infection than nursing homes that did not report a lack of staffing shortages. Both variables are statistically significant, with a p-value of less than 0.05. Looking at the overall infection of COVID-19 in urban nursing homes, we find 18.21% less infection in urban locations than in rural Minnesota, with a statistical significance of 0.001, as seen in Table 30. The hypothesis for this question will be accepted because a statistically significant relationship exists between a lack of nursing staff and total confirmed COVID-19 infections in Minnesota state nursing homes. Looking at the overall infection of COVID-19 in rural nursing homes, we find 17.45% less infection in rural locations than in urban locations, which is 18.21% less infection rate in the state of Minnesota, with a statistical significance of 0.001, as stated in Table 30 with SPSS calculation. This means that urban counties in Minnesota reported fewer infections with a lack of nursing staff than rural locations with a difference of 0.76%. Multicollinearity is not greater than 10. Thus, the model is not redundant, as mentioned in Table 30. All VIF values for this model are equal to or greater than one but less than 2, thus showing less collinearity. The tolerance for collinearity statistics is closer to one but not as close to zero, thus indicating less collinearity among predicted variables.

Table 31

Multicollinearity Table for Variables in Comparison to Total Confirmed COVID-19 Cases in Urban Minnesota Nursing Homes May 2020–July 2022

Model		Eigenvalue	Condition index	Variance proportions			
				(Constant)	Lack of nursing staff	Urban	No lack of nursing staff
1	1	2.510	1.000	0.03	0.05	0.03	0.01
	2	1.001	1.584	0.00	0.04	0.00	0.82
	3	0.369	2.610	0.02	0.73	0.23	0.11
	4	0.121	4.558	0.95	0.18	0.74	0.06

Collinearity diagnostics help identify linear dependency. In this model, the condition index is all less than 30, as seen in Table 31. This indicates no linear dependency in this model.

Figure 11

Probability Plot of Regression for Total Confirmed COVID-19 Infections

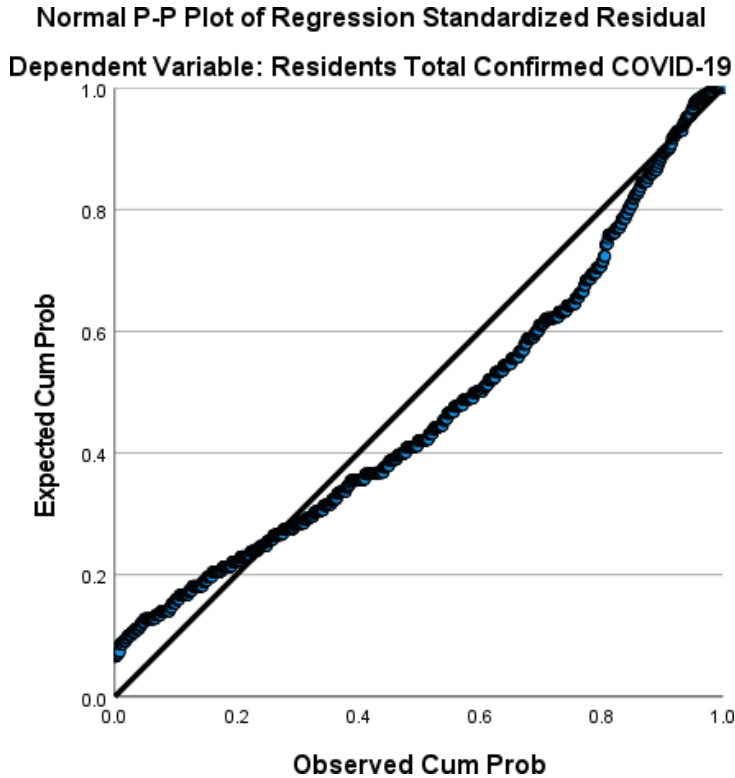


Figure 11 shows a probability plot with dots that line up very close to our diagonal line, thus showing homoscedasticity, which states that the assumptions have been met. Homoscedasticity is an assumption of similar variance in different groups being studied.

Summary of Findings for Research Question 2

Research Question 2: Is there an association between nursing staff shortages and total confirmed COVID-19 infection among Minnesota state nursing home residents based on the data obtained from the CMS public nursing home database adjusting for rural and urban locations?

H02: Nursing staff shortages have no statistically significant relationship with total confirmed COVID-19 infection in Minnesota state nursing homes.

H12: Nursing staff shortages have a statistically significant relationship with total confirmed COVID-19 infection in Minnesota state nursing homes.

Based on the results, it can be concluded that nursing staff shortages have a statistically significant relationship with total confirmed COVID-19 infection in Minnesota state nursing homes. The null hypothesis is rejected in this research question because a statistically significant relationship exists between total confirmed COVID-19 infection and nursing staff shortages in Minnesota adjusted for rural and urban locations.

Section 4: Application to Professional Practice and Implications for Social Change

This study aimed to investigate the relationship between nursing staff shortages and COVID-19 mortality and infection among nursing home residents in Minnesota based on the CMS public database, adjusting for rural and urban locations. This study used a data set from the CMS public nursing home database of COVID-19 records. The data were collected by nursing homes throughout the United States and submitted to the CMS services. This study includes a total of 87 counties from the state of Minnesota, with 44 rural counties and 43 urban counties. Large and small rural counties and large and small urban counties were all combined into two data variables. The data used for this study were collected from the beginning of the pandemic until the end of July 2022. There were a total of 1,428 nursing homes in the state of Minnesota, out of which 1,056 were in urban locations and 364 were in rural areas. Data from the CMS website show that out of 1,428 nursing homes in Minnesota between May 2020 and July 2022, 738 reported a lack of nursing staff, while 690 did not report or answer the CDC website question. In the statistical analysis, all responses were included, even those that were left unanswered. For the first research question, this study found that nursing staff shortage did not have a statistically significant relationship with COVID-19 total resident deaths in Minnesota. However, when adjusted to rural and urban counties, the data analysis indicated a statistically significant relationship between rural and urban nursing homes and total resident deaths with COVID-19 in Minnesota. For the second research question, this study found that lack of nursing staff has a statistically significant relationship with COVID-19 confirmed infection rate in Minnesota adjusted for urban and rural counties. The hypothesis was accepted for this research question because there was a statistically

significant relationship between total confirmed COVID-19 infections and nursing staff shortage in Minnesota when adjusted for urban and rural counties. This study shows a correlation between Minnesota nursing homes' reported nursing staffing shortage crisis (Longworth, 2023). Literature findings suggested that rural nursing homes experience additional challenges with nursing home residents. This study shows a correlation between the literature findings of rural nursing homes experiencing additional challenges with nursing home resident care and nursing staff shortages.

Interpretation of First Research Question Findings

Research Question 1: Is there an association between nursing staff shortages and total confirmed COVID-19 resident deaths in Minnesota state nursing homes based on the data obtained from the CMS public nursing home database, adjusting for rural and urban locations?

H01: Nursing staff shortages have no statistically significant relationship with COVID-19 total resident deaths in Minnesota state nursing homes, adjusting for rural and urban locations.

H11: Nursing staff shortages have a statistically significant relationship with COVID-19 total resident deaths in Minnesota state nursing homes, adjusting for rural and urban locations.

For the first research question, I found that nursing homes that reported no lack of nursing staff in rural counties showed 1.40% less effect on total COVID-19 deaths with a statistical significance of 0.198. This indicates that the lack of nursing staff in rural locations has a more significant impact statistically on total deaths from COVID-19 in nursing home residents compared to the lack of nursing staff. Looking at the overall

deaths caused by COVID-19 in rural nursing homes, I found that for every death in the state of Minnesota, in rural locations, there were 2.85 fewer deaths compared to other locations. There was a high statistical significance of less than 0.001, thus showing statistical significance towards location adjustment and COVID-19 nursing home deaths in Minnesota. Nursing homes that reported a lack of nursing staff in urban counties showed 0.9% less effect on total COVID-19 deaths with a statistical significance of 0.060. Nursing homes that reported no nursing staff in rural counties showed 1.42% less effect on total COVID-19 deaths with a statistical significance of 0.192. Looking at the overall deaths from COVID-19 in urban nursing homes, I found that for every death in the state of Minnesota, urban locations had 3.016 more deaths compared to other locations. There is a high statistical significance of less than 0.001, thus showing statistical significance towards locations and COVID-19 nursing home deaths in Minnesota.

The correlation model for total resident COVID-19 deaths correlated the highest with urban locations with 0.150, compared to the lack of nursing staff at -0.04 and the lack of nursing staff at -0.032. Nursing homes that reported a lack of nursing staff in urban counties showed 0.9% less effect on total COVID-19 deaths with a statistical significance of 0.060. This indicates that the lack of nursing staff in urban locations has a more significant statistical impact on total deaths from COVID-19 in nursing home residents compared to the lack of nursing staff. Looking at the overall deaths from COVID-19 in urban nursing homes, I found that for every death in the state of Minnesota, urban locations had 3.016 more deaths compared to other locations, and there is a high statistical significance of less than .001.

Based on the findings, it can be concluded that when adjusted for rural and urban locations, there was statistical significance with COVID-19 total resident deaths in Minnesota. The alternative hypothesis was accepted for the first research question, stating that nursing staff shortages have a statistically significant relationship with COVID-19 total resident deaths in Minnesota state nursing homes, adjusting for rural and urban locations. I believe there is statistical significance between staffing shortages and total COVID-19 deaths of nursing home residents. However, because there is a lack of information provided by nursing homes on reported staffing shortages on the CMS website, the data do not show a more accurate interpretation of results. The data analysis shows no significant relationship between total COVID-19 resident deaths and nursing staff shortages. However, the results show statistical significance with rural and urban county location adjustment.

Interpretation of Second Research Question Findings

Research Question 2: Is there an association between nursing staff shortages and total confirmed COVID-19 infections among residents in Minnesota state nursing homes based on the data obtained from the CMS public nursing home database, adjusting for rural and urban locations?

H02: Nursing staff shortages have no statistically significant relationship with total confirmed COVID-19 infections in Minnesota state nursing homes.

H12: Nursing staff shortages have a statistically significant relationship with total confirmed COVID-19 infections in Minnesota state nursing homes.

Nursing homes that reported a lack of nursing staff in rural counties showed 7.8% fewer infections from COVID-19, with a statistical significance of 0.001. Nursing homes

that reported no lack of nursing staff in rural counties showed 11.5% fewer infections from COVID-19, with a statistical significance of 0.008. This indicates that the lack of nursing staff in rural locations has a higher infection rate than nursing homes that did not report staffing shortages for nurses. Both variables show statistical significance, with the *p-value* being less than 0.05. The hypothesis for this question will be accepted because a statistically significant relationship exists between a lack of nursing staff and total confirmed COVID-19 infections in Minnesota state nursing homes. In the data, nursing homes in urban counties that reported nursing staff shortages had 8.03% less infection rate from COVID-19 with a statistical significance of 0.001, while nursing homes in urban counties that did not report a lack of staffing showed 11.7% less infection from COVID-19 with a statistical significance of 0.007. In other words, nursing homes with staffing shortages had higher rates of infection than nursing homes that did not report a lack of staffing shortages. Both variables are statistically significant, with a *p-value* of less than 0.05. Looking at the overall infection of COVID-19 in urban nursing homes, we find 18.21% less infection in urban locations than in rural Minnesota, with a statistical significance of 0.001, as seen in Table 30.

Looking at the overall infection of COVID-19 in rural nursing homes, we find 17.45% less infection in rural locations than in urban locations, which is 18.21% less infection rate in the state of Minnesota, with a statistical significance of 0.001, as stated in Table 30 with SPSS calculation. This means that urban counties in Minnesota reported fewer infections with a lack of nursing staff than rural locations, with a difference of 0.76%. For this question, the hypothesis will be accepted that nursing staff shortages have

a statistically significant relationship with total confirmed COVID-19 infections in Minnesota state nursing homes adjusted for urban and rural locations.

Based on the results, it can be concluded that nursing staff shortage has a statistically significant relationship with COVID-19 confirmed infection rate in the state of Minnesota for urban and rural counties. The hypothesis is accepted for this research question because there is a statistically significant relationship between total confirmed COVID-19 infections and nursing staff shortage in Minnesota.

Limitations of the Study

Nursing homes could have misreported or not reported a lack of nursing staff shortages to the CMS website during the pandemic, thus affecting the accuracy of this study. Data from the CMS website shows that out of 1,428 total nursing homes in Minnesota between May 2020 and July 2022, 738 reported a lack of nursing staff, while 690 did not report or did not answer the question on the CMS website. This could be the reason for the low statistically significant results for the research questions in this study. I do trust the validity of the information provided on the CMS website. However, the lack of information provided by nursing homes during the COVID-19 pandemic makes it challenging to see the pandemic's impact on residents.

Recommendations

Based on the findings of this study, local health departments should focus on collecting data on residents' health in nursing homes in Minnesota based on individual counties. CMS websites should make it a priority for nursing homes to provide all information requested and not leave answers blank. Because Minnesota is currently dealing with the nursing staff shortage crisis, new programs and services should be

provided to attract nurses to work in Minnesota. Telehealth services are another great resource to start implementing in rural Minnesota to help residents get access to healthcare providers promptly.

Implications for Professional Practice and Social Change

This study will bring positive social change by enabling healthcare administrators to make effective and efficient decisions during medical emergencies, improve their disaster management plan, improve human resource management retention of employees, and improve the quality of patient care for their healthcare organization. Also, healthcare administrators need to prepare healthcare organizations for future disaster response ahead of time. Identifying patterns and locations of nursing homes with the most significant difficulty can help identify trends to address the issue better for future emergencies in nursing homes in Minnesota. Finally, this study will allow healthcare providers, local healthcare departments, and state government agencies to make it mandatory for nursing homes to provide data to help improve care for future emergencies, especially for vulnerable communities.

Conclusion

The findings from this study emphasized the value of data collection in improving the nation's healthcare system. The COVID-19 pandemic showed the weaknesses of the healthcare system. It is imperative to improve the quality of care provided to the nation. Though staffing shortages caused significant issues during the pandemic in nursing homes, seeing how so many nursing homes refuse to provide information to the government is a significant issue that needs to be addressed. There is a need for healthcare organizations, especially nursing homes, to be transparent with the country to

address the gaps that still exist in healthcare. Such gaps can only be filled if everyone works together and shares information to meet the needs of those in vulnerable populations.

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