Geographic Inequities in Nursing Home Inspections: A Comparative Analysis of Rural and Urban Facilities

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Abstract

Objective: To investigate the differences in nursing home inspection times between rural and urban facilities and examine factors that contribute to these differences.

Data Source: Quality, Certification, and Oversight Reports (QCOR) from the Centers for Medicare and Medicaid Services, and control variables obtained from the U.S. Census.

Study Design: Panel regression with fixed effects was used to analyze the relationship between inspection times and rural or urban location of nursing homes, controlling for the size of each facility and other relevant characteristics.

Data Collection/Extraction Methods: The analysis used 163,561 workload reports from health-related inspections conducted between 2010 and 2022. These inspections were conducted as part of standard surveys with a health focus.

Principal Findings: The amount of time allocated to inspections was significantly different in rural nursing homes compared to urban facilities. For each additional violation uncovered by inspectors, inspectors spent 2.514 hours in rural nursing homes , compared to 2.901 hours in urban nursing homes ($p < 0.01$).

Conclusion: The allocation of inspection time in nursing homes is influenced by facility location, rural or urban, as well as other characteristics. Further research is needed to understand the underlying causes of these differences and to develop strategies to address potential inequities in nursing home inspections.

Keywords: nursing homes, inspection time, CMS survey process, rural, urban, quality of care

Introduction

The Centers for Medicare and Medicaid Services (CMS) oversees regular inspections of nursing homes that participate in the Medicare and Medicaid programs. These inspections are conducted by state survey agencies, and they are designed to ensure that facilities are in compliance with health and safety regulations and that residents are receiving adequate care (Castle & Ferguson, 2010). Given the importance of these inspections, it is imperative to understand the factors that may influence the amount of time spent on-site by regulators during inspections.

This study is motivated by a concern about potential disparities in inspection times between rural and urban nursing homes and the impact of these disparities on the quality of care received by residents. Rural nursing homes face unique challenges compared to their urban counterparts, including limited access to healthcare resources, a shortage of healthcare professionals, and a population with greater health needs (Quigley et al., 2021). These challenges were further compounded by the COVID-19 pandemic (Yang et al., 2021), which highlighted longstanding disparities in healthcare access and quality between rural and urban facilities.

In response to these concerns, this research aims to investigate possible variations in the duration of inspections between rural and urban nursing homes and identify factors contributing to these disparities. Utilizing an extensive dataset comprising 163,531 inspection records, the study employs panel regression analysis to investigate the relationship between rurality and inspection duration. The analysis controls for facility size, resident acuity, and the extent of violations discovered during the survey.

The findings of this research hold implications for policymakers and nursing home administrators. The results reveal inequalities in the inspection process between rural and urban facilities, underscoring the need for consistent and equitable oversight across all nursing homes, regardless of their location. By shedding light on factors leading to differences in inspection durations, this research can contribute to the development of policies and practices aimed at enhancing the quality of care for nursing home residents.

Methods

Study Population

This study used data from every U.S. nursing home certified to participate in the Medicare and Medicaid Program, which represents approximately 97% of all nursing homes in the

U.S. (National Center for Health Statistics, 2022). Data for each inspection[1] was obtained from the Quality, Certification, and Oversight Reports (QCOR) provided by the Centers for Medicare & Medicaid Services(CMS, 2022). The dataset comprises over 1.5 million inspection reports, including complaint surveys, standard surveys, and revisits. The analysis focuses on health-related standard surveys (n = 163,531) as they are comprehensive and conducted every 9-15 months. Given that they are conducted approximately annually, these surveys are more appropriate for panel analysis than the other survey types. Repeat surveys within the same calendar year were excluded to create regular intervals for analysis. See **Appendix A** for more information on the intervals between surveys.

Dependent variable

The dependent variable in this study is the time spent onsite at the nursing home by the inspection team, measured in hours **(Table 1)**. A longer inspection time may indicate a more comprehensive evaluation of the nursing home, potentially leading to the identification of a higher number of deficiencies or issues. Conversely, shorter inspection times could suggest a more superficial examination, potentially overlooking critical concerns.

Main explanatory variables

Rurality was primarily operationalized using the binary classification of the county as either rural or urban, according to the 2013 rural-urban continuum codes from the USDA. This classification served as the basis for the main analysis. To assess the robustness of the findings, two additional approaches were used as sensitivity analyses.

The first sensitivity analysis involved creating a binary variable to indicate whether the nursing home is located more than 20 miles from the nearest urban center.[2] This threshold of 20 miles for "remote" locations was chosen based on an examination of the distribution of distances in the dataset, as it is approximately 2 standard deviations above the mean distance of 7 miles. The distance between each nursing home and the nearest urban center was calculated using the Haversine formula, which computes the "as the crow flies" distance between two points on the Earth's surface. A dummy variable was coded to capture nursing homes located more than 20 miles from the nearest urban center.

[1] The Centers for Medicare & Medicaid Services (CMS) refers to inspections as “surveys”.
[2] I download shapefiles from the U.S., containing each urban center in the United States. I then calculated the distance between the “center” of each urban center and the nursing homes in my dataset. https://www.census.gov/geographies/mapping-files/time-series/geo/tiger-line-file.html

The second sensitivity analysis employed the log of the county population as a proxy for the level of urbanization. This approach allowed for a continuous measure of rurality, further testing the robustness of the main results. By comparing the outcomes of the main analysis and sensitivity analyses, the study aims to ensure that the conclusions drawn are reliable and not overly sensitive to the choice of rurality operationalization.

Other explanatory variables and controls

Several control variables are included in the analysis to account for the potential influence of various factors on the time spent onsite by the inspection team. Key control variables are the size of the facility and the acuity of the residents. The average daily census serves as a proxy for facility size, while the acuity index represents the complexity of care required by the residents. Controlling for acuity is essential, as patients with more complex needs may necessitate more inspection time to evaluate the quality of care effectively.

Further, the analysis controls for the number of violations identified during the survey and the severity of these violations. These variables help account for the potential relationship between inspection time and the extent of issues discovered at the facility. Other important variables considered in the study include pre-survey hours and travel hours to the nursing home. Accounting for these factors helps to ensure that the analysis captures the true impact of rurality on inspection time, independent of other potentially confounding influences.

Analysis

The main analysis in this study involves regressing the explanatory variables on onsite hours spent during inspections. Two-way fixed effects were employed to control for unobserved time-invariant factors at the nursing home level, as well as any potential period-specific shocks affecting all facilities. Fixed effects are crucial for isolating the impact of the explanatory variables of interest, while accounting for any unobserved factors that may be correlated with both the dependent and independent variables. Panel regression was performed in R (version 4.1), using the plm package (Croissant & Millo, 2008). Equation 1 presents the general form of the regression equation.

Equation 1

$$Y_{it} = \beta_0 + \beta_1 \cdot X_{1it} + \beta_2 \cdot X_{2it} + \cdots + \beta_k \cdot X_{kit} + \gamma_i + \lambda_t + \epsilon_{it}$$

Interaction terms between rurality and the number of violations were incorporated into the model to account for the time-invariant nature of rurality, which makes it challenging

to directly estimate a coefficient using fixed effects. The inclusion of these interaction terms allows for the examination of whether the effect of violations on onsite time differs between rural and urban areas. To address potential autocorrelation and heteroskedasticity within nursing homes over time, clustered standard errors at the nursing home level were employed, ensuring that the estimates are robust to any deviations from the standard assumptions of the linear regression model.

Limitations

While this empirical strategy has several strengths, there are several limitations. One major limitation is the potential endogeneity in the relationship between inspection time and the number of violations. Longer inspection times could lead to the identification of more violations, but more violations might also increase the time spent onsite by inspectors. It is challenging to establish causality between these two variables, and it is possible that unobserved factors could be driving both inspection time and the number of violations identified.

In addition, the fixed-effects regression model employed in this study assumes that unobserved, time-invariant factors at the nursing home level are constant over time. However, nursing homes may experience changes in management, staffing, or other factors that could affect inspection time and are not captured in the model. The use of fixed effects may not fully account for such time-varying unobserved factors.

Lastly, a weakness of this study is the absence of data on the composition and experience of inspection teams, which is a crucial factor that I am missing in the analysis. The inspection time in the dataset is recorded as the aggregate of individual hours spent by each team member, rather than the actual time spent by the team as a whole. For instance, if a team of four inspectors were to spend three 8-hour days at a facility, the actual time spent by the team would amount to 24 hours. However, the dataset would indicate 96 hours (4 inspectors x 3 days x 8 hours per day) as it sums up the individual hours contributed by each team member. Consequently, it is not possible to disentangle individual hours from the total recorded time, rendering the study findings highly sensitive to the size of the inspection team.

Results

Table 2 presents the characteristics of nursing homes inspected in 2019. The average daily census for rural nursing homes was 65.65 (SD = 33.02) and 94.98 (SD = 54.31) for urban nursing homes. The Acuity Index was found to be 11.75 (SD = 1.86) for rural homes and 12.27 (SD = 1.75) for urban homes. The percentage of residents on Medicaid was 64.15 (SD

= 18.02) for rural homes and 59.36 (SD = 24.87) for urban homes. In terms of ownership type, 65% of rural nursing homes were for-profit, 11% were government-owned, and 24% were non-profit. In contrast, 73% of urban nursing homes were for-profit, 4.5% were government-owned, and 23% were non-profit.

According to **Table 3**, the average onsite hours for rural nursing homes was 101.42 (SD = 41.80) and 117.25 (SD = 51.86) for urban nursing homes. Pre-survey hours were found to be 3.85 (SD = 3.69) for rural homes and 4.55 (SD = 4.91) for urban homes. The average number of violations in rural nursing homes was 5.65 (SD = 4.88) and 6.38 (SD = 5.49) in urban nursing homes. Severe violations were found in 2.8% of rural inspections and 2.7% of urban inspections (Table 3). **Appendix B** provides information on the proportion of total hours allocated to onsite hours and travel.

Figure 1 shows the mean onsite time in hours per bed for rural and urban nursing homes over time. The data was adjusted for facility size by multiplying the number of certified beds in each facility with the on-site hours and then dividing the sum of these products by the total number of certified beds. This computation was performed across all facilities in each time period and location. The plot demonstrates a consistently lower onsite time in rural facilities compared to urban facilities. **Figure 2** shows a scatter plot with a linear regression line to visualize the relationship between mean onsite inspection times and the number of violations, grouped by location.

In my analysis of the differences in inspection time between rural and urban nursing home facilities, the regression results presented in **Table 4** provide valuable insights into the key factors driving these differences. Focusing on the coefficients of interest, the number of deficiencies is positively associated with inspection time across all three models, with coefficients ranging from 2.796 to 2.901, all statistically significant at the 1% level. This finding suggests that, on average, the inspection time increases as the number of deficiencies identified during the survey increases, regardless of the nursing home's location.

When examining the interaction term between the number of deficiencies and rural nursing homes (no. violations * rural), I observe a statistically significant negative coefficient of -0.387 ($p < 0.01$). Specifically, the effect of each additional deficiency on on-site hours is 2.514 hours for rural nursing homes, while it is 2.901 hours for urban nursing homes. I also found that the interaction term between the number of deficiencies and remote location was also negative and statistically significant (-1.800, $p < 0.001$). This indicates that the effect of each additional deficiency on onsite inspection hours is 0.998 hours for nursing homes located 20 miles or more from the nearest urban center, while it is 2.798 hours for nursing homes located less than 2 miles from the nearest urban center.

These results indicates that the positive relationship between the number of deficiencies and inspection time is weaker for rural nursing homes compared to their urban counterparts.

Among the control variables, the presence of a severe violation is found to have a strong positive and statistically significant impact on inspection time, with a coefficient of 29.507 ($p < 0.01$) in Model 3. This finding underscores the importance of addressing severe violations during inspections, as they significantly contribute to the overall inspection time.

Other control variables, such as the average daily census and pre-survey hours, also exhibit positive and statistically significant relationships with inspection time across all models, with coefficients ranging from 0.264 to 0.265 ($p < 0.01$) and 1.206 to 1.207 ($p < 0.01$), respectively. These findings suggest that the inspection time increases with a higher average daily census and more time spent on pre-survey activities.

Discussion

My analysis revealed a substantial difference in inspection time between rural and urban nursing homes, with rural facilities exhibiting a weaker positive relationship between the number of deficiencies and inspection time compared to their urban counterparts. One potential explanation for this finding could be that rural facilities face unique challenges related to their geographical location, such as reduced access to resources, personnel, or expertise, which may impact the inspection process. Inspectors also might be under time constraints or experience logistical difficulties in reaching rural locations, potentially leading to shorter inspection durations.

Detecting a severe violation significantly increased the duration of inspections, underlining the significance of addressing these breaches during the inspection phase. This outcome aligns with the primary objectives of the CMS assessment process, which seeks to safeguard the welfare and security of residents in nursing homes. The findings of my study endorse the necessity for ongoing attentiveness in pinpointing and correcting severe breaches to uphold top-notch care standards in nursing homes.

I also found that inspection time was positively associated with the average daily census and pre-survey hours. This suggests that larger facilities and those with more extensive pre-survey activities may require more inspection time, possibly due to increased complexity or the need for a more thorough evaluation. These findings underscore the importance of allocating sufficient resources to the inspection process to ensure that all facilities, regardless of size, receive adequate oversight.

This study sheds light on the differences in inspection time between rural and urban nursing homes and highlights the importance of addressing severe violations during inspections. My findings have implications for policymakers and regulators, who should consider the unique challenges faced by rural nursing homes. Regulators should ensure that all facilities receive adequate oversight to safeguard the quality of care for residents. Further research is needed to better understand the underlying factors driving these differences and to inform targeted interventions that can improve the effectiveness of the CMS survey process.

Tables and Figures

Figure 1: Relationship between state survey agencies and nursing homes.

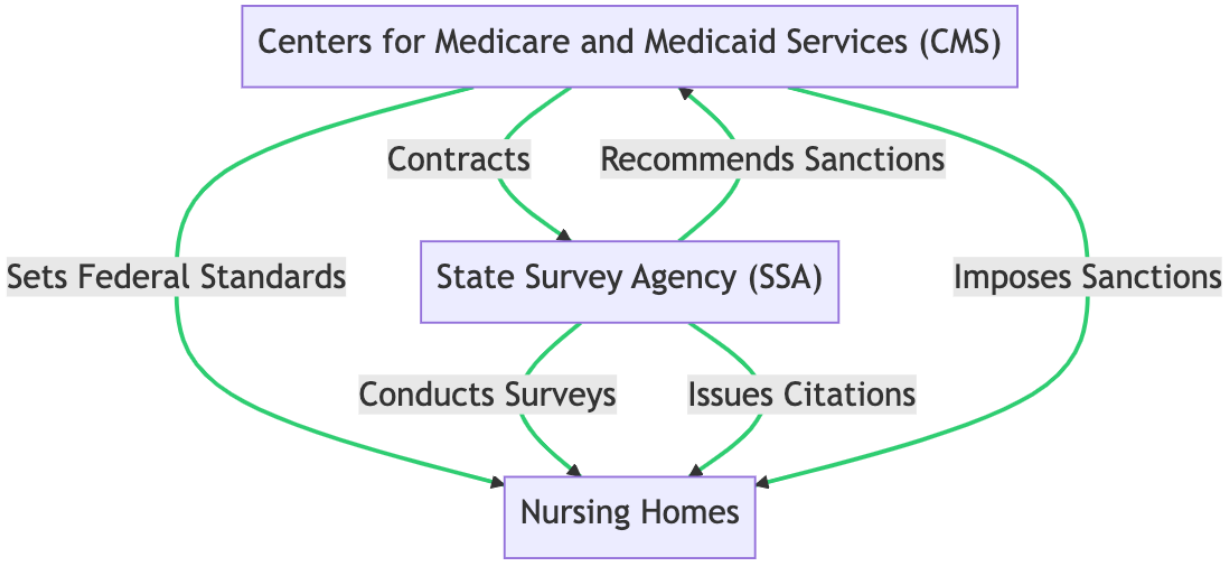

Table 1: Variables in the regression equation

Variable	Type	Description
Dependent variable		
Onsite hours	Continuous	
Key Independent variables		
Rural	Binary	1 = Rural, 0 = Urban
Population in county	Log	Log-transformed population
Remote distance	Binary	>20 miles = 1, <=20 miles = 0
Control variables		
Average daily census	Continuous	
Number of violations	Discrete	
Severe violation	Binary	1 = Severe, 0 = Non-severe
Acuity Index of residents	Continuous	

Table 2: Characteristics of nursing homes inspected in 2019

Characteristic	**Rural**, N = 3,963[1]	**Urban**, N = 10,025[1]	**p-value**[2]
Remote distance from urban center (> 20 miles)	395 (10.0%)	299 (3.0%)	<0.001
Average daily census	65.65 (33.02)	94.98 (54.31)	<0.001
Acuity Index	11.75 (1.86)	12.27 (1.75)	<0.001

Characteristic	Rural, N = 3,963[1]	Urban, N = 10,025[1]	p-value[2]
Percent of residents on Medicaid	64.15 (18.02)	59.36 (24.87)	<0.001
Ownership type			<0.001
For Profit	2,572 (65%)	7,310 (73%)	
Government	448 (11%)	454 (4.5%)	
Non-Profit	943 (24%)	2,261 (23%)	

[1]n (%); Mean (SD)

[2]Pearson's Chi-squared test; Wilcoxon rank sum test

Table 3: Characteristics of inspection reports for nursing homes (2010-2022)

Characteristic	Rural, N = 46,759[1]	Urban, N = 116,159[1]	p-value[2]
Onsite hours	101.42 (41.80)	117.25 (51.86)	<0.001
Pre-survey hours	3.85 (3.69)	4.55 (4.91)	<0.001
Number of violations	5.65 (4.88)	6.38 (5.49)	<0.001
Severe violation (yes or no)	1,327 (2.8%)	3,181 (2.7%)	0.3

[1]Mean (SD); n (%)

[2]Wilcoxon rank sum test; Pearson's Chi-squared test

Figure 1

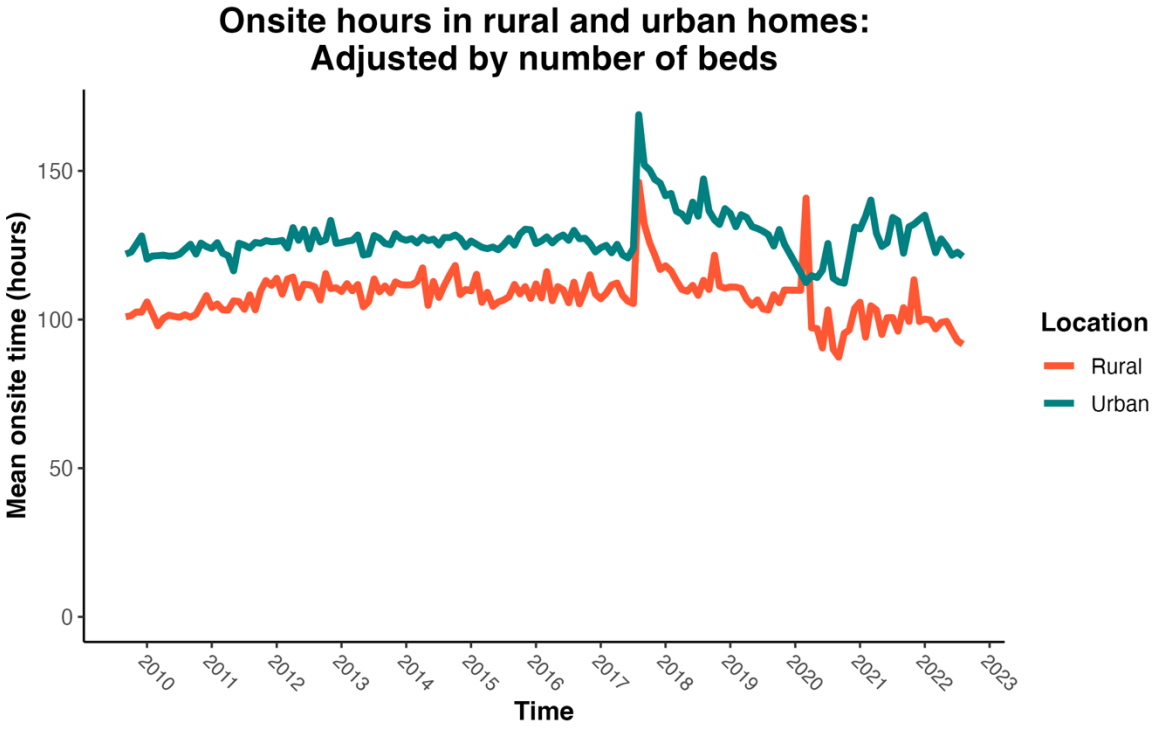

Figure 2

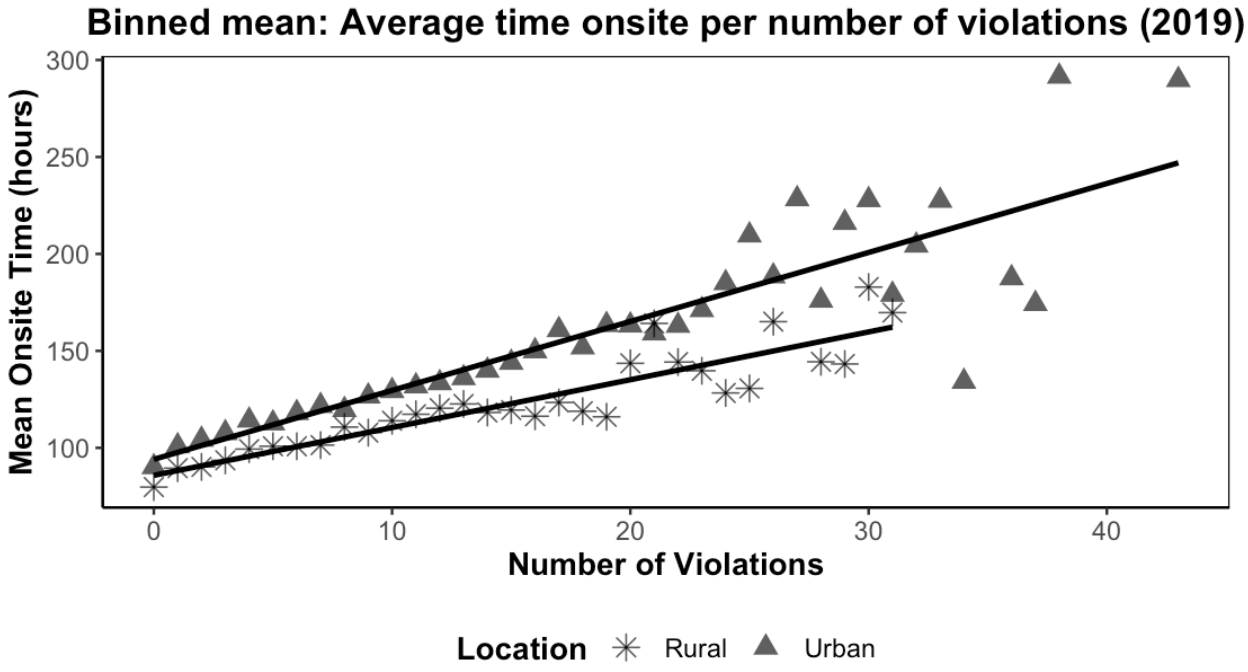

Table 4: Regression results for effect of explanatory variables on onsite hours

	Dependent variable: Onsite hours		
	(1)	(2)	(3)
No. violations	2.901***	2.798***	2.796***
	(0.046)	(0.038)	(0.038)
Average daily census	0.265***	0.265***	0.264***
	(0.019)	(0.019)	(0.019)
Pre-survey hours	1.206***	1.207***	1.207***
	(0.158)	(0.158)	(0.158)
Acuity index	-0.001	-0.003	-0.003
	(0.100)	(0.100)	(0.100)
Severe violation	29.506***	29.510***	29.507***
	(1.156)	(1.158)	(1.158)
Rural dummy * number of violations	-0.387***		
	(0.077)		
Remote dummy * number of violations		-1.800***	
		(0.318)	
Population(log)			1.767
			(5.279)
Note:		*p<0.1; **p<0.05; ***p<0.01	

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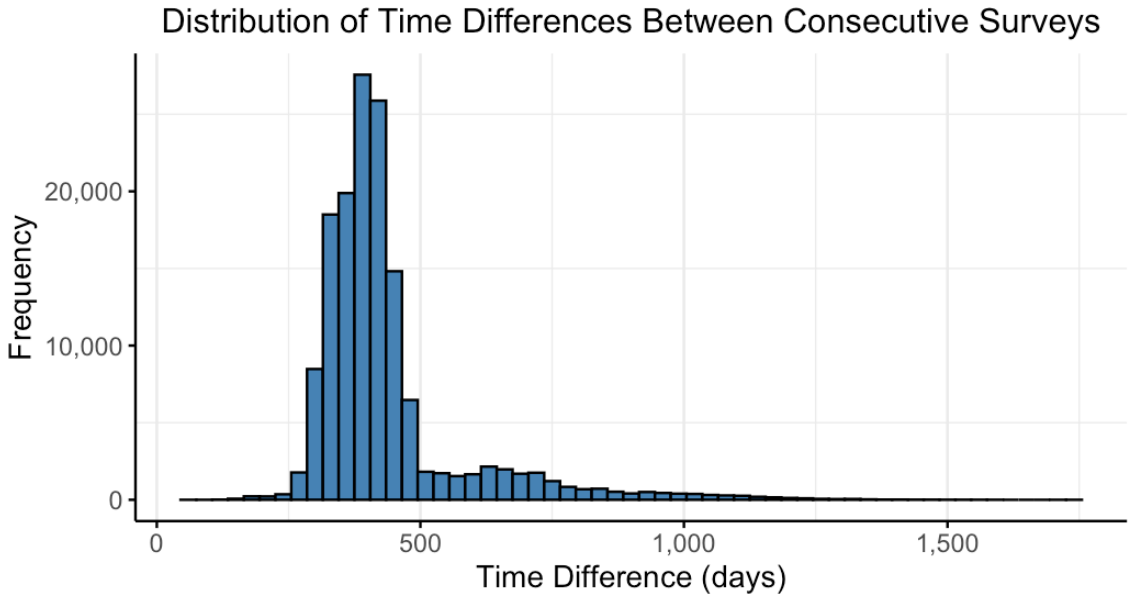
Appendix

Appendix A: Time difference between surveys

To create regular intervals for panel data analysis, I retained only the first survey for each nursing home in a given year. This approach ensures that each observation represents an approximately one-year period and allows for a consistent comparison across nursing homes and years in a panel analysis.

An analysis of the time differences between consecutive surveys reveals that the mean time between surveys is approximately 437 days, which is slightly more than a year. This finding suggests that, on average, the surveys are not perfectly spaced at one-year intervals, but they are still reasonably close to a year apart. The histogram presented below illustrates the distribution of time differences between consecutive surveys.



Appendix B

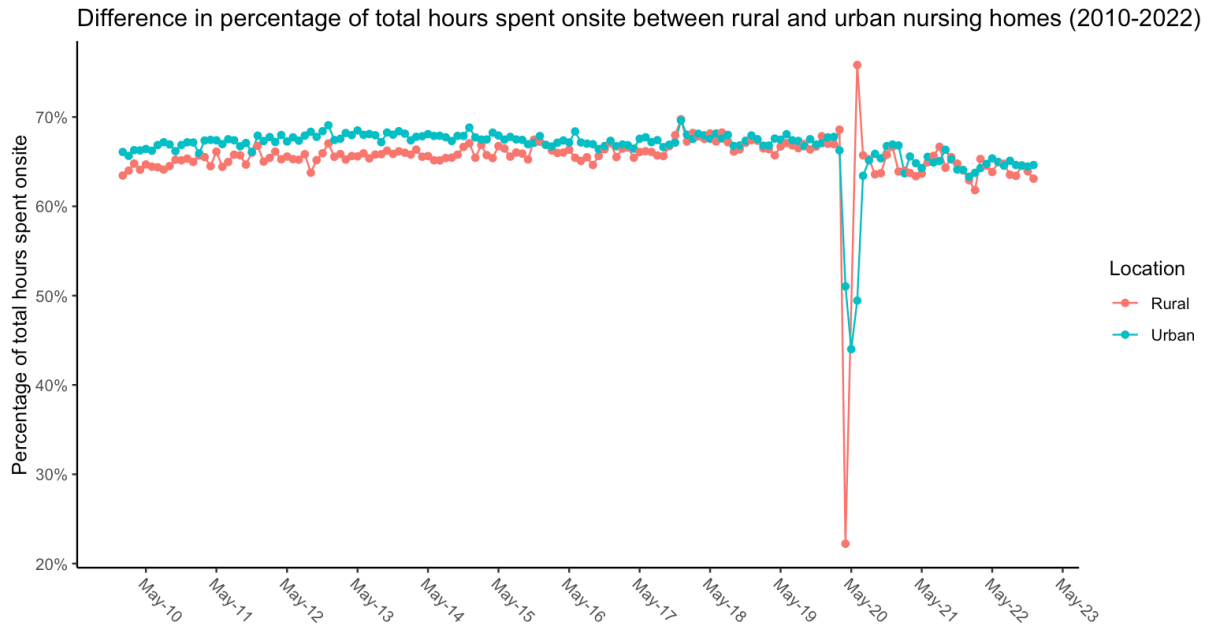


Figure 1: Line graph showing the difference in the percentage of total hours spent on-site between rural and urban nursing homes from 2010 to 2022. Over the whole period, the difference in the average percentage of on-site hours spent between rural and urban nursing homes was 1.08 percent (66.56 percent versus 65.48 percent). In 2022, the difference was less than one percent (63.9 percent versus 64.5 percent).

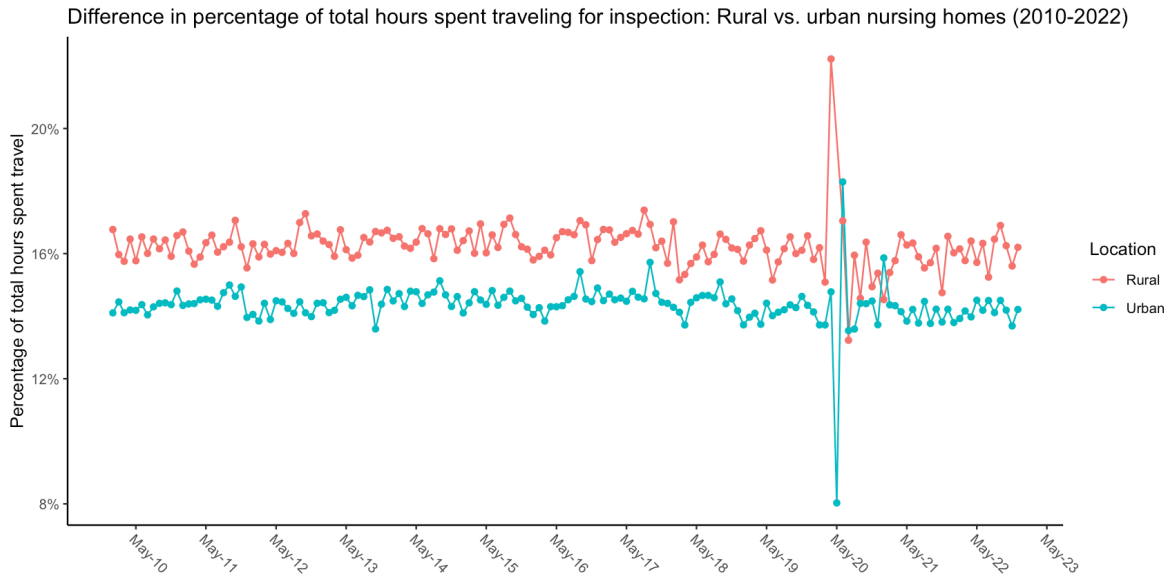


Figure 2: Line graph showing the difference in the percentage of total hours spent traveling for inspections at rural versus urban nursing homes from 2010 to 2022. Over the whole period, the difference in the average percentage of on-site hours spent was around 3 to 4 percent.