A Statistical Analysis of Rural-Urban Mean Emergency Medical Service Response Time Disparities in Connecticut

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Introduction

Staff shortages, underfunded EMS departments, changes in demographic makeup have left rural areas nationwide struggling to provide timely pre-hospital care to their residents: Rural response times are almost double those in urban areas[1]. However, rural areas are more likely to contain pockets of poverty, which may confound the relationship between response time and rurality.

Connecticut has the highest median income and the lowest poverty rates for rural areas in the country[2]. This fact makes it an ideal state in which to examine the rural-urban prehospital care disparity as it removes the possible confounding factor. This research aims to analyze EMS mean response time to confirm the existence of the nationwide trend in the state.

Results

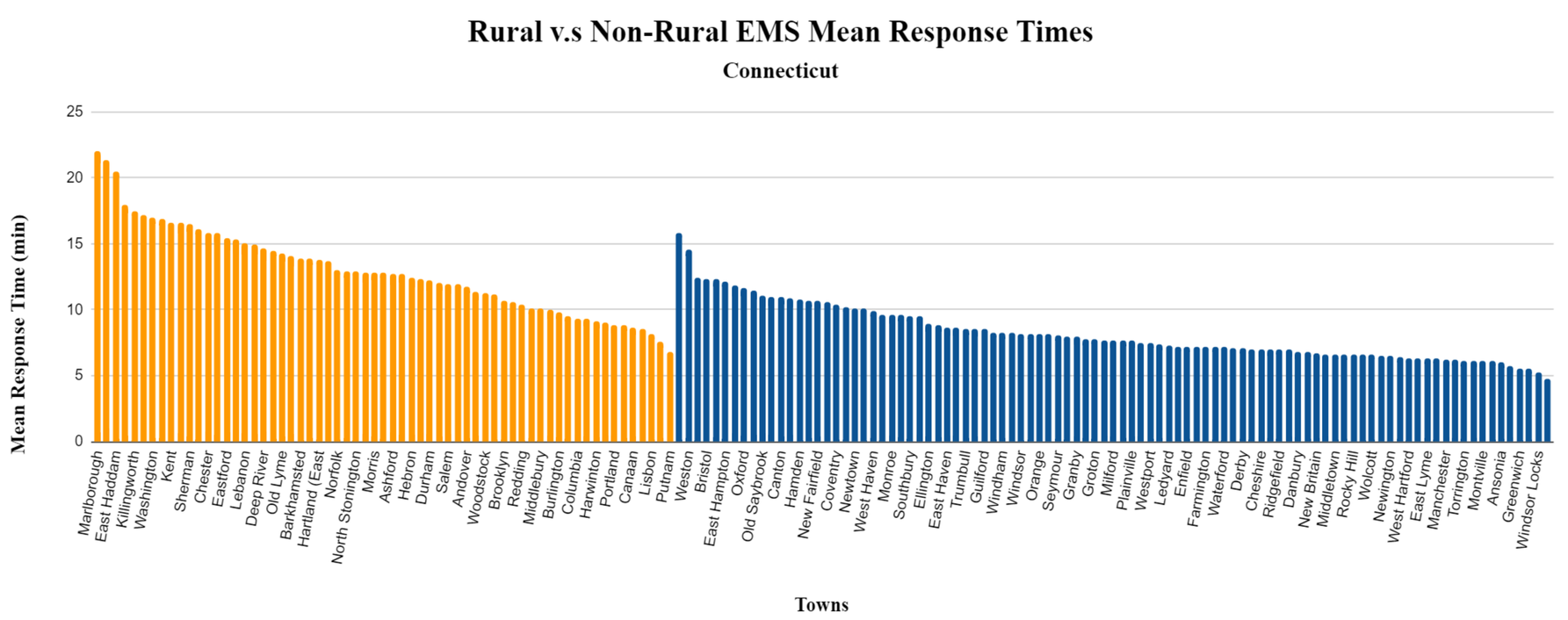

Figure 1. A graph with mean EMS response times for every town in Connecticut. Orange bars represent rural towns, blue bars represent non-rural towns

	Rural	Non-Rural
Mean Response Time (MRT)	12.97	8.25
Median Response Time	12.8	7.7
Standard Deviation	3.33	2.10
Data Points	63	95
Outliers	None	14.6 (Weston), 15.8 (Simsbury)
Z Statistic	8.3464	
U Value	642	
P Value	<0.0001	

Table 1. A summary of the statistical results of the Mann-Whitney test. The P value is significantly lower than α=0.05, demonstrating that the null hypothesis ($MRT_{Rural} = MRT_{Urban}$) is false

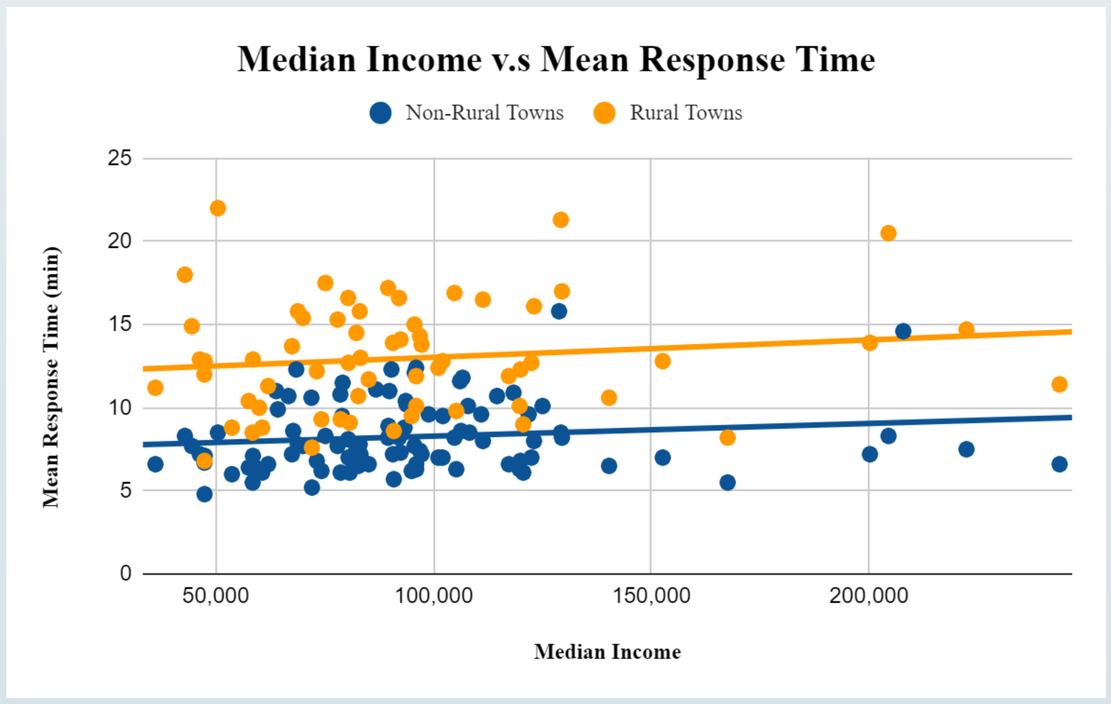

Figure 2. A clear graphical representation of the fact that median income is not a mediating factor in the rural-urban EMS response disparity

Rural Median Income – Response Time Correlation: -0.148, p=0.247, no significant relation
Urban Median Income – Response Time Correlation: 0.137, p=0.186, no significant relation
Rural-Urban Median Income T-Test Results: p=0.299, no significant difference between median incomes in the two datasets

Methodology

To answer the primary question of this research study, a two-sample right tailed **Mann Whitney Wilcoxon test** was performed comparing the mean response times of 63 rural towns and 95 non-rural (urban and suburban) towns, excluding 8 towns that lacked data. The null hypothesis was that the mean response times of both datasets would be equal, whereas the alternative was that the rural dataset would have a higher mean response time than the non-rural counterpart. Tests for measures of central tendency and the Tukey Fence test for outliers were performed.

To discover whether a difference in median income exists between rural and non-rural areas, and thus whether this difference could affect the result of the Mann Whitney test, two approaches were used. First, **Pearson coefficients of correlation** were calculated were calculated for the strength of the association between median income and response time for the rural and non-rural datasets separately. Second, a **heteroscedastic two-sample t-test** was performed to test for a difference in median income between the two datasets.

All data was drawn from the Connecticut Department of Public 2017 EMS report[3] and the CT Data Initiative[4]. Towns were classified as rural according to CT Office of Rural Health standards: a population of fewer than ten thousand and a population density of less than five hundred residents per square mile[5].

Conclusion

A statistically significant disparity exists in response times between rural and non-rural towns in Connecticut; in other words, the average mean EMS response time is longer in the former. Furthermore, this fact does not seem to be influenced by median income.

Sources

(1) Mell HK, Mumma SN, Hiestand B, Carr BG, Holland T, Stopyra J. Emergency Medical Services Response Times in Rural, Suburban, and Urban Areas. JAMA Surg. 2017;152(10):983-984. doi:10.1001/jamasurg.2017.2230
(2) New Census Data Show Differences Between Urban and Rural Populations. The United States Census Bureau. Published December 30, 2016.
(3) Kloter A. Office of Emergency Medical Services Data Report. (Pino R, ed.). Department of Public Health; 2017.
(4) CT Data Initiative, 2016-2020
(5) *An Assessment of Connecticut Rural Health: Overview, Obstacles, and Opportunities*. Connecticut Office of Rural Health; 2015.
http://www.ruralhealthct.org/assets/CT_Office_of_Rural_Health_Rural%20Assessment_2015.pdf

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