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The Impact of the SARS-Cov-2 Pandemic in Rural Areas: A Public Health Analysis

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Abstract

During the SARS-Cov-2 pandemic, rural residents have been neglected in both research, and in formal government recommendations. Rural residents face greater health challenges (such as higher rates of obesity, diabetes, smoking, and an older population) that put them at a higher risk for worse SARS-CoV-2 outcomes. In conjunction, rural areas have strained healthcare systems before considering the SARS-CoV-2 pandemic. The aim of this study is to assess whether rural counties have had worse SARS-CoV-2 outcomes in comparison to urban areas.

In this analysis, county level data is collected from the CDC and census on rural distinction, number of cases per 100,000 people, number of SARS-CoV-2 deaths per 100,000 people, race, ethnicity, and number of licensed beds per 1000 people. Data was then analyzed and assessed using SPSS (version 27) in a T test and chi square analysis. Results show that rural areas, after adjusting for population size, do not have more cases but do have more SARS-CoV-2 deaths, and a higher case fatality rate. This is likely due to the decreased health care capacity, lack of health care access and knowledge leading up to 134.7 excess deaths per 100,000 people, compared to urban areas, a phenomenon known as the rural mortality penalty.¹³ Recommendations from health care organizations, and rural governing bodies include: a more rural centric approach to policies and interventions in these areas: encouraging mostly at-risk individuals to stay home, providing transportation to health care facilities, expanding telemedicine, and encouraging agriculture-based workplace social distancing guidelines and approaches.

Background and significance

The SARS-CoV-2 pandemic affected almost every corner of the world in a different way. In the United States, rural areas have had unique challenges to face during this pandemic, such as: working conditions, engendered impacts, severe economic impact, and a decreased healthcare capacity. Rural areas are at an increased risk having older populations, with higher risk of chronic diseases, and a generally more health susceptible population.¹ Rural areas have an over representation of elderly that need protection during this time of crises. Nearly 20% of rural Americans are elderly (defined as >65 years old), and rural areas make up more than 85% of “older counties”, or counties with more than 20% of their population defined as elderly.²

. Migration from cities to rural areas during pandemics are human behaviors documented in history. Many people have fled urban centers: traveling to rural areas especially during quarantine.³ This sudden migration from urban to rural areas created several negative effects. First, the out of state or urban residents who migrated to rural America brought the virus to areas that may otherwise have avoided SARS-CoV-2.³ Second, the sudden increase in population further overloaded the low resource, less equipped, health care systems in the rural areas. the Rural areas, the primary site for US agriculture, are important to the country's sustainability and continued existence, especially in times of crisis, such as the SARS-CoV-2 pandemic. In 2019, agriculture accounted for 10.9% of U.S. employment⁴. In addition to the 22 million jobs in the agriculture sector, there are 19.6 million more jobs in supporting industries.⁴ Agriculture and related food business are essential, workers who have stayed employed during the pandemic are at risk to exposing themselves to the virus just by going to work. However, with economic uncertainty and struggle, economic failure of rural areas due to SARS-CoV-2 could potentially collapse the entire U.S. food chain.⁵ It is therefore more vital than ever to protect these areas of our country.

Rural areas have not been the focus during the pandemic. We lack information, research and policies designed for their specific needs. Research, policies, and advice coming from institutions have become urban-centric and may not translate well to rural areas While lockdowns and strict policies do help limit spread of SARS-CoV-2, they are infeasible to implement as many jobs in these areas are essential, and employees cannot stay home.⁷ Long term recovery policies are focused on mostly urban centered research and have been found to be ineffective for rural areas⁷.

Rural areas have fallen behind in many ways during this pandemic. Economically, rural America has suffered more than the rest of America.⁵ Even in rural areas that lifted lockdown restrictions before urban areas, had worse economic outcomes, due to the shaky local economies¹⁸ Historically, women (especially rural women) suffer more from any health/economic crises, much like the one we are currently facing, when compared to other groups. Some of the ways that these women are impacted are food security, nutrition, time poverty, access to health care facilities and services, and increased risk for gender-based violence during pandemic.⁶ Beyond this, the pandemic has had a negative side effect on rural individuals' mental health, with increased thoughts of suicide, depression in anxiety across all ages, races, and genders in rural areas.⁷

Other studies have looked at the susceptibility of rural health care networks during the SARS-CoV-2 pandemic. Based on the susceptibility scale developed by researchers, rural areas are at a much higher risk of negative outcomes due to SARS-CoV-2, and in most ways the pandemic could continue to play out, rural areas will not have the health care capacity, health care access, and appropriate number of medical staff to take care of their residents when they fall ill.⁸ Unfortunately, current pandemic guidelines don't address these concerns adequately..

Rationale

Rural areas are at an increased risk for negative SARS-CoV-2 outcomes for a variety of reasons. Firstly, rural residents are older than those in metro and urban areas. Nearly 20% of rural residents are over the age of 65, compared to the 13% in urban areas⁹. Not only does age increase the risk of many chronic diseases, but it is also independently associated with worse SARS-CoV-2 outcomes.¹⁰ Other risk factors for worse SARS-CoV-2 outcomes are chronic conditions such as cancer, chronic kidney disease, chronic obstructive pulmonary disease, heart conditions, smoking, type 2 diabetes¹⁰. Rural Americans are at an increased risk for all of these chronic conditions.¹¹ Rural Americans also have higher rates of unhealthy behaviors (such as smoking) that may lead to poor pulmonary health, and therefore worse SARS-CoV-2 outcomes.¹²

Beyond the health of individuals living in rural areas, there are systematic problems leading these individuals to worse SARS-CoV-2 outcomes and worse health outcomes as a whole. Rural areas experience a phenomenon known as the rural morality penalty. This factor has been studied, and it has been found that rural areas have up to 134.7 excess deaths per 100,000 deaths in the population due to health disparities when compared to urban areas.¹³ There can be a variety of factors that lead into the rural morality penalty.¹³ For example, this could be due less health education, extreme distance to hospitals, and limited access to care.

Rural residents have strong beliefs and are less likely to follow health care advice and guidelines.¹⁴ For example, rural residents are less likely to wear sunscreen to prevent skin-cancer compared to urban residents.¹⁵ This could manifest itself during the SARS-CoV-2 pandemic as reluctance to wear masks and follow social distancing protocols.

Workplace hazards also pose a unique risk for rural areas, with agriculture work being more prevalent in these areas than in urban areas. Like other respiratory diseases, SARS-CoV-2 can be spread via air particles (such as air droplets or dust).¹⁶ Agricultural work can expose workers to a high amount of these particles which puts agriculture workers at a much higher risk than those not exposed to these particles or in agriculture. Additionally, up to 73% of agriculture workers are migrant workers.¹⁹ Migrant agricultural workers can also be at an increased risk due to their work and living environment. Close quartered living spaces, and transportation, in conjunction with decreased access and linkage to care put these individuals and others working in the same space at an increased risk for SARS-CoV-2, all factors that can further overload healthcare systems and result in worse SARS-CoV-2 outcomes in rural areas.¹⁷

Hypothesis, Research question, and goals/objectives

The main question of this analysis is “Have rural areas been more impacted than urban areas during SARS-CoV-2”. This research question can be broken down by looking into the “impact”, which will be assessed as deaths per 100,000 population, cases per 100,000 population, and case fatality rate of each county. The hypothesis is that: counties with rural distinction are significantly more impacted by SARS-CoV-2 in the form of death and cases, and higher case fatality rate.

Methods and Materials

Data was gathered from the data base made from the Centers for Disease Control and Prevention, Google from USAFacts.org. These data sets contained a week-by-week count on cases, and deaths by county, as well as each county's population. The definition of rural was determined by the rural

county index from the US census as areas not part of a metropolitan statistical area, and less than 50,000 residents.²

Data sets were downloaded, merged, and cleaned using excel, and then uploaded to SPSS for statistical analysis. A TTest was performed to assess the statistical difference between rural and non-rural case fatality rates. The deaths per 100k population were defined as:

Death Group	Range (deaths per 100,000 population)
Group 1	0 deaths
Group 2	0<, <50
Group 3	50< and <100
Group 4	100< and <150
Group 5	150< and <200
Group 6	200< and 250
Group 7	250< and <300
Group 8	300+

Cases per 100k population were broken up into categories by:

Death Group	Range (cases per 100,000 population)
Group 1	0-200
Group 2	200<, 300
Group 3	300<, 500
Group 4	500<, 850
Group 5	850< and 1200
Group 6	1200< and 1800
Group 7	1800< and 3000
Group 8	3000< and 5000
Group 9	>5000

These relationships between rural distinction and death per 100k population and the relationship between rural distinction and cases per 100k were assessed via a chi square test. Qualitative tests using University of Chicago’s interactive SARS-CoV-2 maps were also used to assess the patterns in deaths per 100k population, cases per 100k population, and case fatality rate

Results

Maps

Confirmed count per 100k²⁰

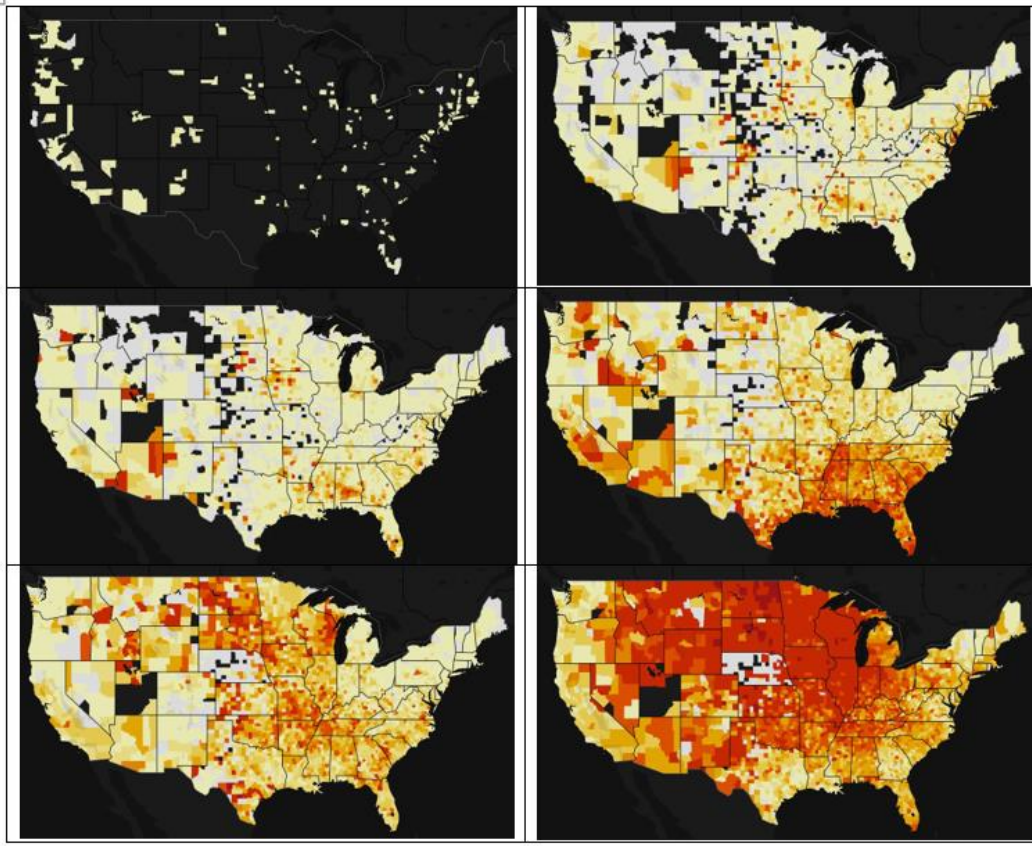


Figure 1: illustrates the confirmed count per 100k in each county from the US Covid Atlas.²⁰ These images (start left top) show the progression from urban areas being affected to rural areas being mainly affected

At the start of the SARS-CoV-2 pandemic, many metropolitan areas started out as the major epicenters. However, as time went on, SARS-CoV-2 entered many of the rural areas of the country. Subsequent “waves” of SARS-CoV-2 have caused variations between which counties have the highest number of cases per 100,000 population. However, due to the “waves” surrounding holiday seasons and other events, many areas of the country experienced spikes at varying times.

Confirmed deaths per 100,000 population



Figure 2 illustrates the death count per 100,000 population, on a county level. From the US Covid Atlas.²¹ This shows the progression in severity of death counts in rural areas through the pandemic

Many of the rural areas suffered greatly once SARS-CoV-2 reached the area. This can be seen in the death counts while comparing rural and nonrural counties (figure 2). Many of the rural counties have darker and more red colors than many of the urban areas (figure 2).

Case fatality rate



Figure 3 illustrates the case fatality rate on a county level, from the US Covid Atlas.²² At the start of the pandemic (top left) the main epicenters had high case fatality rates, however, as the pandemic progressed, more rural areas had increased case fatality rates

At the beginning of the pandemic, the main epicenters (mostly urban) had the highest case fatality rates. However, as the pandemic progresses, more and more of the rural areas began to have higher case fatality rates. After August, many rural areas consistently had much higher case fatality rates than non-rural areas (Figure 3), despite urban areas decreasing the localized case fatality rates.

Case fatality rate

The case fatality rate between urban and rural counties was assessed using an independent t test. Their relationship was found to be statistically significant with a p value of 0.000584. This suggests a relationship between rural designation and increased case fatality rates.

Deaths per 100k population

Performing a chi-sq test on death group vs rural distinction, the results yielded a chi-square value of 4.269 and a p value of .039 This shows that there is little chance of the association occurring by chance, and there is an association between rural distinction and deaths per 100k.

Cases per 100k

Performing a chi-square test yielded a chi square value of 11.179 and a p value of .192. There is not a statistical relationship between rural distinction and number of cases per 100k.

Discussion

The results show that rural areas may not experience more cases when adjusted for population, but cases that do happen have worse outcomes (greater relationship between rural and case fatality rate and number of deaths per 100k). This is likely attributed to the rural mortality penalty and limited health care resources that rural areas have within their health care system. The limited resources these areas do have may not be able to aid those infected with covid, compared to the urban areas where there may be more hospital and ICU beds, physicians, nurses, subspecialists, other resources.

There are limitations when it comes to assessing these relationships. Firstly, there are many counties with incomplete SARS-CoV-2 data, and there is a possibility that urban areas have better hospital record keeping and testing capabilities. Secondly, there was limited data on many demographics, which made it difficult to control for, race (majority Black or majority white counties) and ethnicity (Hispanic, not Hispanic) were able to be compiled but were not shown to be significant when controlling for these factors. Other potentially important demographics, such as SES (socioeconomic status) were difficult to find sufficient county level data and controlling for this could potentially introduce bias? over control and eliminate the effect.

Conclusions and Recommendations

Our study shows that (This is the first study to show that?) rural areas have more deaths per 100k due to SARS-CoV-2 and a higher case fatality rate. It is likely this is due to overstrained hospital systems, and a result of the rural mortality penalty effect being exacerbated during SARS-CoV-2. More research into how to reach rural areas and communicate appropriately with them on SARS-CoV-2 is desperately needed. With rural areas not having as many healthcare systems and resources, and long distances in between their residents and hospitals, transportation services, and an increase in telemedicine could be beneficial. Additional resources such as sending out SARS-CoV-2 symptom check texts could be extremely beneficial in making sure individuals understand what symptoms look like and evaluate themselves. Beyond these measures, it is extremely important that rural residents have proper PPE. Rural residents may be wearing farm PPE which does not protect against coronavirus. Methods and policy to distribute PPE to farm workers or rural Americans could be very beneficial.

In urban areas, it is often encouraged that everyone “shelter in place” and stay locked down. This may not only be infeasible for rural Americans, as they have to go to work and cannot work from home, they may be less likely to follow these guidelines. It is instead more important to stress that individuals who are extremely high risk (elderly, obese, those with lung conditions) stay away from others, as this is a guideline which more likely can be followed.

Within rural workplaces, it is important for rural employers to enforce and strictly implement social distancing and contact tracing within farms. Additionally, it would be good for employers to split workers up into groups and keep them in these groups during the nonworking hours for housing (if employers provide housing) transportation and work. This will help limit the spread of covid to smaller clusters, and ease contact tracing efforts.

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Appendix

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