

Variation in Employment in Healthcare Occupations and County-Level Differences in COVID-19 Cases in the United States of America

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Objective: To study how county-level differences in employment in healthcare occupations contributes to county-level differences in COVID-19 cases. **Method:** The number of active COVID-19 cases were gathered from the Johns Hopkins University Coronavirus Resource Center weekly between April 22, 2020 and July 1, 2020. Data for the number of workers employed in healthcare occupations were collected at the county-level from the American Community Survey. These data were combined to explore the association between employment patterns and rates of COVID-19 cases. **Result:** Counties with more employment in healthcare-related occupations experienced higher rate of COVID-19. This association was strongest in April and May compared to later months of the pandemic. **Conclusion:** Employment in healthcare occupations may contribute to the spread of COVID-19. Intervention to protect workers may help to prevent the spread of COVID-19 and other infectious diseases.

Keywords: COVID-19, healthcare workers, high-risk, occupational risk, employment

In the United States, there have been wide disparities in the rate of COVID-19 infection at the state and county level. At the beginning of the outbreak, states located in the northeast including New York, New Jersey, and Massachusetts experienced the highest number of new confirmed cases. As the pandemic progressed, southern and western states such as California, Texas, Florida, and Arizona experienced high number of cases.¹

There are numerous factors that may be contributing to these geographic differences including population density, median age of the population, socioeconomic factors like poverty, and access to health care.² Differential employment patterns according to industry and occupation could be another crucial factor contributing to state and county level differences in COVID-19. Workers in some occupations are more likely to be exposed to COVID-19 compared to others.³ States and counties have different employment distributions according to occupation which may account for differences in number of COVID-19 cases.⁴ Previous research has suggested that some geographic differences in employment in different industries and occupations at the local level may be associated with different patterns of COVID-19.^{5–7} Employment in high-risk occupations

like healthcare and the meat packing industry may also be a contributor to racial and ethnic disparities in COVID-19.^{8–10}

Some studies have suggested that healthcare workers may be at a greater risk for contracting and spreading COVID-19. Among industries, healthcare workers have a high likelihood of being exposed to COVID-19.^{3,11,12} Through April 9, 2020, of the 49,370 cases of COVID-19 reported to the CDC with information about whether the cases were healthcare personnel or not, 9282 (19%) indicated that they were healthcare workers.¹³ Previous work has found that the seroprevalence of COVID-19 antibodies in certain hospitals to be high.¹⁴ Having direct contact with patients, travelling between home and the workplace may also increase the chance of being exposed.¹⁵

The aim of this study is to investigate whether variations in employment in healthcare occupations at the county level is associated with county-level differences in the rate of active COVID-19 cases.

METHODS

This study used data about COVID-19 cases at the county level from the Johns Hopkins University Center for Systems Science and Engineering (JHU CSSE). The data is gathered through contacting national and state health authorities. The report is updated daily.¹⁶ For this study, we used the number of active cases weekly on Wednesdays from April 22, 2020 to July 1, 2020. Prior to mid-March data was only available at the state, not the county level.

The American Community Survey provides information about the number of workers employed in occupation categories using data collected through random sampling of the US population. This study utilized the 5-year American Community Survey (ACS) (2014–2018) data because more counties had data available than in the 1-year ACS. In order to calculate the total number of workers in healthcare occupations, we combined data about the number of workers employed as healthcare support workers, healthcare practitioners, and technical healthcare workers at the county level.

Numbers of active cases of COVID-19 from JHU and were combined with the ACS data at the county level via matching process using SAS Version 9.4. Matching errors were fixed manually to ensure all counties were matched appropriately. Poisson models were constructed using generalized linear models in SAS to explore the relationship between the percentage of workers employed in different industries and occupations and the rate of COVID-19 cases. To do this modeling, the number of cases was treated as the outcome and deciles of percent employment in healthcare occupations in particular counties were treated as the exposure variables with the population in the county serving as an offset.

RESULTS

Figure 1 shows the relationship between percent employment in healthcare occupations at the county level and the rate of active COVID-19 cases on April 22, 2020. In general, there was a positive relationship, with higher rates of COVID-19 in counties that had more workers employed in healthcare occupations. The only exception was the fifth decile which had a rate substantially higher than the rate for the other deciles.

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Ethical considerations and disclosures: No ethical review was required because this analysis was performed on de-identified data.

Clinical significance: The findings from this paper suggest that the proportion of workers employed in healthcare occupations may have been an important contributor to differences in the rates of COVID-19 in the early days of the COVID-19 pandemic. These findings suggest that protecting healthcare workers may be an important method for controlling pandemics of infectious diseases.

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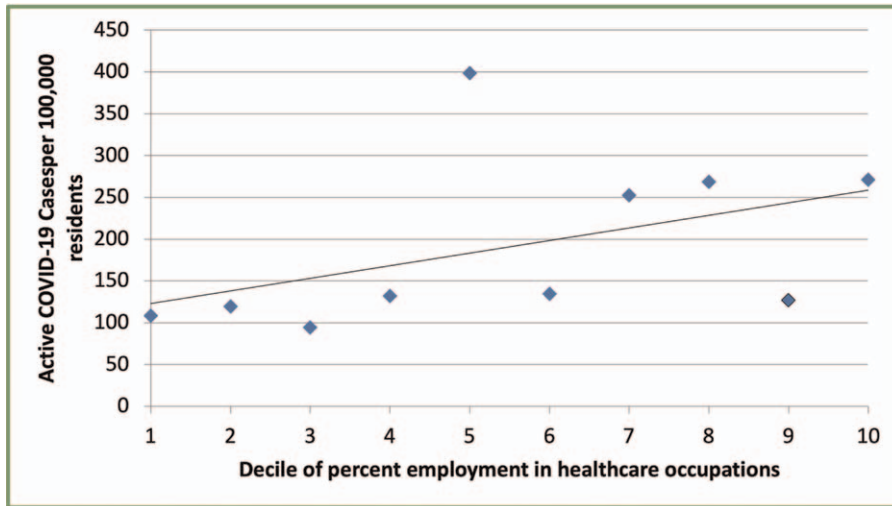


FIGURE 1. The distribution of active COVID-19 cases according to county-level decile of percent employment in healthcare occupations, April 22, 2020. COVID-19, Coronavirus disease 2019.

Table 1 shows the average percent change per decile of percent employment in healthcare occupations for active COVID-19 cases every Wednesday from April 22, 2020 to July 1, 2020. In general, there was a positive association with rates increasing with higher employment in healthcare occupations. This relationship tended to diminish over time, with July 1, 2020 having a small negative association.

DISCUSSION

Workers in healthcare occupations have been at a particularly high risk during the COVID-19 pandemic.³ This study found evidence that counties with more workers employed in healthcare occupations have higher rates of active COVID-19 infections compared to counties with fewer workers employed in these occupations. The association between employment in healthcare and COVID-19 rates tended to decline as the pandemic progressed. This may be due to the effect of other venues for transmission having more of an effect. It could also be due to healthcare facilities practicing more protective methods such as the use of PPE and social distancing. The introduction of lockdowns may have contributed to these reductions.

Although pattern of generally increasing active rates of COVID-19 with a greater proportion of workers in a county being employed in healthcare was true for most deciles, the fifth decile

was an exception. This decile had a rate of active cases much higher than other states. This anomalous finding is likely due to the fact that cases occurring in New York state, which was one of the states that had highest number of cases during that time period, accounted for over 70% of the cases in the fifth decile.

This study has some limitation. The analysis was only performed through the beginning of July, meaning that these findings do not represent the most up-to-date findings. Some counties did not have data available about employment in healthcare or the number of active COVID-19 cases. Additionally, data about employment (which is reflected of the period from 2014 to 2018) does not match with the period when the information about COVID-19 cases was collected (2020). It is possible that some employment patterns may have been different in 2020 compared to the 2014 to 2018 period. Furthermore, in some cases, a worker may work in one county but live in another count, which would mean that the exposure (employment in healthcare) does not perfectly match the outcome. Finally, these are only ecological associations. This study cannot firmly establish that it is in fact employment patterns that are explaining the county level differences explored here. It could be the case that employment in healthcare is a proxy for other factors that impact the risk of COVID-19 transmission. For example, some counties might have more workers employed in healthcare because there is a higher older population in that country necessitating more healthcare workers.

Efforts should be made to protect workers from COVID-19 and other infections. There are a variety of methods that can be used to protect workers who work in high-risk occupations from being infected by COVID-19. Handwashing may be one of the appropriate methods in reducing the pandemic transmission.^{12,17} Moreover, wearing face mask is recommended.¹⁷ The transmission of SARS-CoV-2 is widely known to occur via infectious droplets; therefore, wearing a facial mask can reduce transmission via infectious droplets from infected individual. Personal protective equipment (PPE) such as gloves, face shields, or gowns also recommended for protecting workers from the pandemic.¹⁸ Further research should also explore occupational transmission as a driver of pandemics of infectious disease like COVID-19.

REFERENCES

1. COVID-19 Dashboard by the Center for Systems Science and Engineering (CSSE) at Johns Hopkins University (JHU); 2020. Retrieved August 2020, from Johns Hopkins University and Medicine Coronavirus Resource Center. Available at: <https://coronavirus.jhu.edu/map.html>. Accessed March 14, 2021.

TABLE 1. Average Percent Change in Active COVID-19 Cases Per Decile of County-Level Employment in Healthcare Occupations, Weekly from April 22, 2020 to July 1, 2020

Date	Average Percent Change in Active Cases of COVID-19 Per Decile Change in Employed in Healthcare Industry (95% Confidence Interval)
April 22, 2020	6.74 (6.63, 6.85)
April 29, 2020	5.94 (5.84, 6.04)
May 6, 2020	5.52 (5.44, 5.61)
May 13, 2020	4.48 (4.40, 4.56)
May 20, 2020	3.70 (3.63, 3.78)
May 27, 2020	3.13 (3.07, 3.20)
June 3, 2020	2.53 (2.47, 2.60)
June 10, 2020	2.14 (2.08, 2.20)
June 17, 2020	1.47 (1.41, 1.53)
June 24, 2020	0.69 (0.64, 0.75)
July 1, 2020	-0.33 (-0.38, -0.27)

2. Patel JA, Nielsen F, Badiani AA, et al. Poverty, inequality and COVID-19: the forgotten vulnerable. *Public Health*. 2020;183:110–111.
3. Baker MG, Peckham TK, Seixas NS. Estimating the burden of United States workers exposed to infection or disease: a key factor in containing risk of COVID-19 infection. *PLoS One*. 2020;15:e0232452.
4. American Community Survey (ACS). (n.d.). Retrieved August 2020, from United States Census Bureau. Available at: <https://www.census.gov/programs-surveys/acs/methodology/design-and-methodology.html>. Accessed March 14, 2021.
5. Burrer SL, de Perio MA, Hughes MM, Kuhar DT, Luckhaupt SE, McDaniel CJ, Porter RM, Silk B, Stuckey MJ, Walters M. Characteristics of health care personnel with COVID-19—United States, February 12–April 9, 2020.
6. Hawkins D. Social Determinants of COVID-19 in Massachusetts, United States: an ecological study. *J Prev Med Public Health*. 2020;53:220.
7. McLaren J. *Racial Disparity in COVID-19 Deaths: Seeking Economic Roots with Census data* (No. w27407). National Bureau of Economic Research; 2020.
8. Almagro M, Orane-Hutchinson A. The determinants of the differential exposure to COVID-19 in New York City and their evolution over time. Covid Economics: Vetted and Real-Time Papers; 2020.
9. Steinberg J, Kennedy ED, Basler C, Grant MP, Jacobs JR, Ortbahn D, Osburn J, Saydah S, Tomasi S, Clayton JL. COVID-19 outbreak among employees at a meat processing facility—South Dakota, March–April 2020. *Morb Mort Wkly Rep*. 2020;69:1015.
10. Hawkins D, Davis L, Kriebel D. COVID-19 deaths by occupation, Massachusetts, March 1–July 31, 2020. *Am J Ind Med*. 2021;64:238–244.
11. Hawkins D. Differential occupational risk for COVID-19 and other infection exposure according to race and ethnicity. *Am J Ind Med*. 2020;63:817–820.
12. Ran L, Chen X, Wang Y, Wu W, Zhang L, Tan X. Risk factors of healthcare workers with corona virus disease 2019: a retrospective cohort study in a designated hospital of Wuhan in China. *Clin Infect Dis*. 2020;71:2218–2221. Available at: <https://doi.org/10.1093/cid/ciaa287>. Accessed March 14, 2021.
13. CDC COVID-19 Response Team. Characteristics of Health Care Personnel with COVID-19—United States, February 12–April 9, 2020. *MMWR Morb Mortal Wkly Rep*. 2020;69:477–81.
14. Self WH. Seroprevalence of SARS-CoV-2 among frontline health care personnel in a multistate hospital network—13 academic medical centers, April–June 2020. *Morbidity and Mortality Weekly Report*, 69.
15. Heinzerling A, Stuckey MJ, Scheuer T, et al. Transmission of COVID-19 to health care personnel during exposures to a hospitalized patient—Solano County, California, February 2020. *Morb Mortal Wkly Rep*. 2020;69:472–476.
16. Dong E, Du H, Gardner L. An interactive web-based dashboard to track COVID-19 in real time. *Lancet Infect Dis*. 2020;20:533–534.
17. Izzetti R, Nisi M, Gabriele M, Graziani F. COVID-19 transmission in dental practice: brief review of preventive measures in Italy. *J Dent Res*. 2020;99:1030–1038.
18. Rational use of personal protective equipment (PPE) for coronavirus disease (COVID-19); 2020. Retrieved August 2020, from World Health Organization. Available at: https://apps.who.int/iris/bitstream/handle/10665/331498/WHO-2019-nCoV-IPCPPE_use-2020.2-eng.pdf. Accessed March 14, 2021.