



Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

Elsevier hereby grants permission to make all its COVID-19-related research that is available on the COVID-19 resource centre - including this research content - immediately available in PubMed Central and other publicly funded repositories, such as the WHO COVID database with rights for unrestricted research re-use and analyses in any form or by any means with acknowledgement of the original source. These permissions are granted for free by Elsevier for as long as the COVID-19 resource centre remains active.

Contents lists available at [ScienceDirect](https://www.sciencedirect.com)

Annals of Epidemiology

journal homepage: www.annalsofepidemiology.org

Rapid report

Association between county-level social capital and the burden of COVID-19 cases and deaths in the United States

Mao Yanagisawa, MPH^a, Ichiro Kawachi, MBChB, PhD^b, Christopher A. Scannell, MD, PhD^{a,c}, Carlos Irwin A. Oronce, MD, MPH^{a,c}, Yusuke Tsugawa, MD, PhD^{a,d,*}^a Division of General Internal Medicine and Health Services Research, David Geffen School of Medicine at UCLA, Los Angeles, CA^b Department of Social and Behavioral Sciences, Harvard T.H. Chan School of Public Health, Boston, MA^c VA Greater Los Angeles Healthcare System and the National Clinician Scholars Program, Los Angeles, CA^d Department of Health Policy and Management, UCLA Fielding School of Public Health, Los Angeles, CA

ARTICLE INFO

Article history:

Received 13 December 2020

Revised 28 March 2021

Accepted 14 April 2021

Available online 22 April 2021

Introduction

The United States has confirmed over 15.8 million cases and 295,600 deaths from Coronavirus Disease 2019 (COVID-19) as of December 12, 2020 [1]. While regional variations in the rate of infections and deaths due to COVID-19 are apparent, the underlying causes are not fully understood [2]. Effectively controlling COVID-19 outbreaks requires support from community members to maintain social distancing concerted efforts, such as delivering food to elderly neighbors or making a financial donation to local charities so that community members could stay home safely. In the United States, a major barrier to an effective, coordinated response to COVID-19 may be the lack of social solidarity. In the absence of a strong federal response, states and local municipalities have been left to devise their own policies. Ultimately, individuals are making their own decisions about whether to comply with recommendations such as wearing masks or maintaining social distancing. In turn, divergent individual choices mirror the polarization of American society and the erosion of social cohesion. A recent study found that higher social capital is associated with fewer COVID-19 cases using data from European countries [3], whereas another study suggests that higher level of social capital is associated with faster COVID-19 infection spread in the U.S. counties [4].

In this study, we hypothesized that communities with high social and emotional support exhibit lower numbers of COVID-19 cases and deaths as the community members may be more likely to trust their neighbors and participate in collective actions to contain outbreaks including social distancing and wearing masks, whereas communities with high civic engagement experience higher numbers of cases and deaths through a higher frequency of physical interactions.

Methods

We examined the association between county-level social capital and the number of COVID-19 cases and deaths per 100,000 population (retrieved from the Center for Systems Science and Engineering (CSSE) at Johns Hopkins University (JHU) as of June 30, 2020 [1]) using multivariable negative binomial regression models.

We investigated three measures of social capital, whose validity have been demonstrated in a prior research [5]: (1) Behavioral Risk Factor Surveillance System (BRFSS) Index, (2) Petris Social Capital Index (PSCI), and (3) Penn State University-Social Capital (PSU-SC) Index. The BRFSS Index is defined as the percentage of respondents reporting availability of adequate social/emotional support calculated using BRFSS data from 2005 to 2010, based on the County Health Rankings, 2014. The PSCI is calculated based on the number of employees hired at voluntary organizations (based on the County Business Pattern (CBP) dataset, 2018) divided by the total population of the county. The PSU-SC Index (2014) [6] is a composite score of civic engagement comprised of the number of mem-

The authors have no conflicts of interest.

* Corresponding author. 1100 Glendon Avenue Suite 850, Los Angeles, CA 90024
Tel.: 310-794-2523

E-mail address: mao.yanagisawa@outlook.com (M. Yanagisawa).

bership organizations (i.e., religious organizations, civic and social associations, business associations, political organizations, professional organizations, labor organization, bowling center, fitness and recreational sports centers, golf courses and country clubs, and sports teams and clubs) per 1,000 population, voting rate in presidential elections, the response rate to the Census Bureau’s decennial census, and the number of non-profit organizations per 10,000 population. We also investigated individual measures included in the PSU-SC Index.

We adjusted for median household income, percent poverty, percent unemployment, percent female, percent 65+ years, percent uninsured, and mean household size (the 2018 American Community Survey and the February 2020 Bureau of Labor Statistics unemployment report), urbanization level [7], air quality (Particulate Matter [PM2.5] level) and health outcome quartile (county ranking of aggregated indicator of the length and quality of life within a state [8]), total physicians and hospital beds per 100,000 population (2018–19 Area Health Resources Files from the Health Resources and Services Administration), the presence of a stay-at-home policy as of April 20, 2020 (New York Times database [9]), number of days from the first reported COVID-19 case (JHU CSSE), political affiliation (the percent of vote share won by Donald Trump in the 2016 US Presidential election [10]), and state fixed effects (effectively comparing counties within the same state).

The analyses were conducted using Stata 15.1. This study was exempted from review by the UCLA Institutional Review Board.

Results

After adjusting for other county characteristics and state fixed effects (within-state comparisons), we found that counties with a higher BRFSS Index had fewer COVID-19 cases (adjusted percent change, -1.9% for a 1-point increase in social capital index; 95%CI, -2.8% to -1.0%; *P* < .001) and deaths (-2.7%; 95%CI, -4.4% to -1.0%; *P* = .002) (Table 1). We found no evidence that PSCI or PSU-SC Index were associated with COVID-19 cases and deaths. Among individual components of the PSU-SC Index, counties with higher voter turnout in presidential elections experienced a higher number of COVID-19 deaths (+1.8%; 95%CI, +0.3% to +3.3%; *P* = .02).

Discussion

We found that counties with a higher level of social and emotional support experienced fewer COVID-19 cases and deaths, while those counties with greater civic participation (e.g., voter turnout) experienced a higher burden of COVID-19. Our findings indicate that higher social capital in a county may be a “double-edged sword,” that is, counties with greater civic engagement are more inclined to have frequent communal in-person gatherings that contribute to a greater disease burden, whereas individuals living in communities with better social and emotional support may be more adherent to social distancing as they are better able to adapt to the isolation of stay-at-home orders.

Limitations of our study include potential unmeasured confounding, and individual-level associations could not be inferred based on county-level data. Our estimates might be underpowered to detect true differences, especially for our analyses of PSCI measure and of the membership organizations subcategory for the PSU-SC Index for which confidence intervals were large.

Our findings suggest that the association between the burden of COVID-19 and social capital at county level vary depending on different measures of social capital: social and emotional support may mitigate the burden of COVID-19 while civic engagement through physical interactions may lead to an increased burden of COVID-19 outbreaks. Counties with high civic engagement may require

Table 1
Adjusted association between county-level social capital and COVID-19 cases and deaths per 100,000 population

	%Change in number of cases per 100,000 population (95% CI)	P-value	%Change in number of deaths per 100,000 population (95% CI)	P-value
BRFSS Index (social/emotional support)	-1.9% (-2.8% to -1.0%)	<.001	-2.7% (-4.4% to -1.0%)	.002
PSCI (% of population hired at voluntary organizations)	-3.0% (-11.4% to +6.2%)	.51	-15.5% (-29.1% to +0.6%)	.06
PSU-SC Index	+0.5% (-4.2% to +5.5%)	.83	-2.4% (-9.7% to +5.6%)	.55
Membership organizations* (per 1,000 population)	+5.3% (-1.8% to +13.0%)	.15	-4.9% (-18.3% to +10.5%)	.51
Voter turnout in presidential elections (%)	+0.2% (-0.5% to +0.9%)	.63	+1.8% (+0.3% to +3.3%)	.02
Response rate to the Census Bureau’s decennial census (%)	-0.4% (-0.8% to +0.1%)	.13	+0.4% (-0.6% to +1.3%)	.45
Non-profit organizations (per 1,000 population)	-0.8% (-1.9% to +0.2%)	.13	-0.8% (-2.3% to +0.7%)	.27

The number of cases and deaths due to COVID-19 in US counties as of June 30, 2020.

Adjusted for county-level median household income, percent poverty, unemployment, female, 65+ years, and uninsured, mean household size, urbanicity, air quality, health outcome quartile, total physicians and hospital beds per 100,000 population, presence of a stay-at-home policy, number of days from the first county-reported COVID-19 case, the percent of vote share won by Donald Trump in 2016 US Presidential election, and state fixed effects (effectively comparing counties within the same state).

The BRFSS Index is defined as the percentage of respondents reporting availability of adequate social/emotional support calculated using BRFSS data from 2005 to 2010 based on the County Health Rankings, 2014. The PSCI is calculated based on the number of employees hired at voluntary organizations (based on the County Business Pattern dataset, 2018) divided by the total population of the county. The PSU-SC Index is a composite score of civic engagement comprised of the number of membership organizations per 1,000 population, voting rate in presidential elections, the response rate to the Census Bureau’s decennial census, and the number of non-profit organizations per 10,000 population.

*A composite measure calculated based on the number of establishments in religious organizations, civic and social associations, business associations, political organizations, professional organizations, labor organization, bowling center, fitness and recreational sports centers, golf courses and country clubs, and sports teams and clubs, divided by the total population of the county.

stricter enforcement of social distancing to contain COVID-19 outbreaks while strengthening social and emotional support in the long-run may make communities more resilient for future pandemics.

Contributors

MY contributed to conceptualization, methodology, and writing-original draft preparation. IK contributed to conceptualization and writing-review and editing. CAS and CIAO contributed to resources and writing-review and editing. YT contributed to conceptualization, writing-review and editing, and supervision.

Funding

Drs. Scannell and Oronce were supported by the National Clinician Scholars Program at the University of California, Los Angeles, and by the VA Office of Academic Affiliations through the VA/National Clinician Scholars Program. Dr. Tsugawa was supported by the National Institutes of Health (NIH)/NIMHD Grant R01MD013913 and NIH/NIA Grant R01AG068633 for other work not related to this study.

Disclaimer

The contents do not represent the views of the US Department of Veterans Affairs or the US Government.

Patient consent for publication

The study was exempted from human subjects review by the institutional review board at University of California, Los Angeles.

Data sharing statement

All data are publicly available.

References

- [1] COVID-19 Data Repository by the Center for Systems Science and Engineering (CSSE) at Johns Hopkins University. Available from: <https://github.com/CSSEGISandData/COVID-19>. Accessed Dec 12, 2020.
- [2] CDCMMWRGeographic Differences in COVID-19 Cases, Deaths, and Incidence – United States, February 12–April 7, 2020. *MMWR Morb Mortal Wkly Rep* 2020;69:465–71.
- [3] A.K. Bartscher, S. Seitz, S. Sieglöcher, M. Slotwinski, N. Wehrhöfer Social Capital and the Spread of COVID-19: Insights from European Countries. Available from: <https://www.iza.org/publications/dp/13310/social-capital-and-the-spread-of-covid-19-insights-from-european-countries>. Accessed Dec 13, 2020.
- [4] F. Borgonovi, E. Andrieu, S.V. Subramanian Community-level social capital and COVID-19 infections and fatality in the US. *VoxEU.org*. 2020. Available from: <https://voxeu.org/article/community-level-social-capital-and-covid-19-infections-and-fatality-us>. Accessed Dec 13, 2020.
- [5] Lee C-J, Kim D. A Comparative Analysis of the Validity of US State- and County-Level Social Capital Measures and Their Associations with Population Health. *Soc Indic Res* 2013;111:307–26.
- [6] Rupasingha A, Goetz SJ, Freshwater D. The production of social capital in US counties. *J Socio Econ* 2006;35:83–101.
- [7] NCHS Urban-Rural Classification Scheme for Counties. Available from: https://www.cdc.gov/nchs/data_access/urban_rural.htm. Accessed Jun 16, 2020.
- [8] Health Outcomes. County Health Rankings & Roadmaps. Available from: <https://www.countyhealthrankings.org/explore-health-rankings/measures-data-sources/county-health-rankings-model/health-outcomes>. Accessed Jun 16, 2020.
- [9] S. Mervosh, D. Lu, V. Swales See Which States and Cities Have Told Residents to Stay at Home. *The New York Times*. Available from: <https://www.nytimes.com/interactive/2020/us/coronavirus-stay-at-home-order.html>. Accessed Jun 16, 2020.
- [10] MIT Election Data And Science Lab. County Presidential Election Returns 2000-2016. *Harvard Dataverse*; 2018. Available from: <https://dataverse.harvard.edu/citation?persistentId=doi:10.7910/DVN/VOQCHQ>. Accessed Mar 7, 2021.