Effectiveness of Stay Home Order on Number of New Cases With Social Vulnerability Index (SVI) and Population Density Adjusted By States

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Background

As the COVID-19 pandemic progresses, states in the U.S. are increasingly implementing a range of responses that are intended to help prevent the transmission of this disease. Back in early 2020, in the absence of a COVID-19 vaccine, the potential role of containment measures to suppress the virus transmission is assessed. Yet, there are limited studies comparing the effectiveness of preventive measures on slowing down the growth rate of cases and deaths at the same time adjusted for the population density and other social economic determinants using Social Vulnerability Index.

Objective

This study hypothesized that states with Stay Home Order, known to be the most stringent measure, will yield to less new cases with the covariates adjustment.

Methodology

All 50 states are included the study and data on daily new cases update by states were derived from Centers for Disease Control (CDC) and other covariates data are sourced from publicly available state and territorial government websites.

Measures
Independent Variable: Preventive measures order pertaining Stay Home Order issued by the states on 15th April 2020 as being subjected to availability of data and the early phase of outbreak with unavailability of vaccine.
Outcome variable: new cases reported on 15th May 2020 (one month after measures being in place) that averaged on 7 days' data with 3 days forward and 3 days backward.
Covariates: Other preventive measures order in other 4 areas, Gathering (dichotomous), Operation of Bar (categorical), Restaurant (dichotomous), and Masking Mandates (dichotomous), population density (cont.), SVI in 4 different dimensions. Socioeconomic(cont.), Household Composition & Disability(cont.), Minority Status & Language(cont.), Housing Type & Transportation(cont.).

Statistical Analysis
Linear regression with forward stepwise selection was used to determine the predictors for reduced number of new cases in 50 states that implemented preventive measures and taking into account the population density and SVI in 4 dimensions.

Tables & Figures

Table 1 Characteristics of 50 states

Variable	States M ± SD (range)
Socioeconomic SVI	0.56±0.22 (0.50-0.62)
Household Composition & Disability SVI	0.48±0.18 (0.43-0.53)
Minority Status & Language SVI	0.60±0.21 (0.55-0.66)
Housing Type & Transportation SVI	0.62±0.12 (0.59-0.65)
Overall tract rankings	0.59±0.18 (0.54-0.64)
Population Density	182.73±239.83 (114.58-250.89)
New Cases (Averaged at 7 days)	562.35±740.75 (351.83-772.86)

Table 2 Frequency table on preventive measures employed by states

Preventive Measures		No. of states
Gathering Ban		
	Ban of gatherings over 1-10 people	28 (56%)
	Bans gatherings of any size	14 (28%)
	No Gathering Ban	8 (16%)
Operation of Bar		
	Open with restrictions	1 (2%)
	Delivery/Curb side	38 (76%)
	Closed	11 (22%)
Operation of Restaurant		
	Open with restrictions	1 (2%)
	Delivery/Curb side	49 (98%)
Stay Home Order		
	Mandatory for all individuals	6 (12%)
	Mandatory only for at-risk individuals in the jurisdiction	6 (12%)
	Advisory/Recommendation	2 (4%)
	No order for individuals to stay home	36 (72%)
Masking Mandates		
	No Order	49 (98%)
	Masking Mandates in Public	1 (2%)

Table 3 Results of forward stepwise linear regression

Variable	Parameter Estimate	95% Confidence Interval	Standard Error	F Value	Pr > F	Model R-Square
Population Density	1.19762	(1.09, 1.31)	0.39977	6.94	0.0113	0.1262
Gathering Ban	-683.21393	(-721.96,-644.47)	273.9768	4.39	0.0415	0.2009

Results

The states' characteristics were shown in Table 1 and the frequency of different measures employed by states are described in Table 2. As contrary to hypothesis, after adjusting for covariates, the reduced number of new cases is associated with the order issued on gathering ban (p=0.0113<0.05) with the issue of gathering ban, daily new cases decrease by 683.21 on average. An increased number of new cases is associated with increased population density (p=0.0415<0.05) as population density increase by one unit, daily new cases increase by 1.20 on average. Both variables are related to overcrowding which facilitates the rapid spread of virus, resulting in higher positivity rate.

Conclusion

With stronger association with gathering ban and taking population density into accounts, policymakers are able to make relevant policy adjustments. Future studies to work on different time partitions to examine the effect of measures on different phases of pandemic and with the availability of vaccination.

Reference

Centers for Disease Control and Prevention/ Agency for Toxic Substances and Disease Registry/ Geospatial Research, Analysis, and Services Program. CDC/ATSDR Social Vulnerability Index 2018 Database State. https://www.atsdr.cdc.gov/placeandhealth/svi/data_documentation_download.html. Accessed on 12/14/2021.
Kharroubi S and Saleh F (2020) Are Lockdown Measures Effective Against COVID-19? Front. Public Health 8:549692. doi: 10.3389/fpubh.2020.549692