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RESEARCH ARTICLE

COVID-19: state population coverage by mask orders in the US

[version 1; peer review: 1 approved, 1 approved with reservations]

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Abstract

Background: A variety of government bodies in the US - cities and tribal councils, counties, and states - have issued mask-wearing orders to prevent the spread of COVID-19.

Methods: We measured the duration of these orders and the populations covered by them in each of the governed areas. We measured the in effect days from April 3, 2020 (the date of the first mask order) to November 30, 2020; the duration of the measured period amounts to 241 days. We used data generated from local and state governments, and news organizations to measure the enactment dates and the duration of the orders; and from the US Census Bureau (dated 2019) to measure municipal, county, and state populations.

Results: The average coverage over all states was 57.7% of the maximum person days of coverage. States which issued statewide orders from their governors had a total of 67.1% coverage; this includes coverage from regional government orders prior to the statewide orders. States with orders only from municipal or county councils had on average 27.1% coverage.

Conclusion: Overall, state governments took leadership in the implementation of mask orders.

Keywords

COVID-19, Face masks, Mandates, Population covered

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version 1	✓	?
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1. **Hannah Clapham**, National University of Singapore, Singapore, Singapore

2. **Shirley Girouard**, SUNY Downstate Health Sciences University, Brooklyn, USA

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This article is included in the **Coronavirus** collection.

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Introduction

As the COVID-19 pandemic proceeded through the US in 2020, face masks as preventive devices grew in importance¹. The US Centers for Disease Control (CDC) and US President Trump first recommended the wearing of face masks on April 3, 2020^{2,3}. The World Health Organization made an interim recommendation on April 6⁴. The first local government order in the US that we found was issued by the San Diego County Council on April 3⁵; this order covered retail employees. New Jersey was the first state to have a mask order, issued by Governor Phil Murphy on April 8⁶. Since then US city and county lawmakers, tribal councillors, and state governors have enacted an assortment of mask orders and, in some cases, subsequently altered them⁷⁻⁹. The result is a patchwork of orders across the nation, with a mixture of types of authorities, varying start dates, change or termination dates, and opt-out rules, all of which have contributed to the amount of COVID-19 protection within each state. Given the importance of masks in slowing down the spread of the virus¹⁰, we estimated the degree of protection - measured in terms of person days of coverage - across states.

Methods

Our goal is to estimate the percentage of **person days** in each state that were either covered by city, tribal council, county, or state orders, or that were not covered, during the period April 3 to November 30, 2020 (a maximum of 241 days). **Person days** are the product of days in a region (241) and the region's population. **Mask days** (days in a region during which there was a mask order in effect) were calculated for each type of government. The calculated percentage is obtained by mask days divided by person days.

- (1) If the state (governor) did not issue an order during the study period - that is, only local governments issued orders - we measured mask days as the time between the order in effect dates and their termination dates, or November 30⁸. We multiplied mask days by the region's 2019 population^{11,12} to obtain person days of mask coverage. If both a city (cities) and its county simultaneously issued orders, we adjusted the populations to avoid the double counting of persons.
- (2) In states where governors issued state orders⁷, and counties were covered by the mask orders (statewide coverage), we measured state coverage as the person days covered by the mask orders multiplied by state population. In these states, there may have been additional coverage by city or county orders that were enacted prior to the states' enacting dates and which lasted up to the day of the governor's order. We estimated these locally generated mask days for city and county coverage⁹ and added them to the statewide coverage days.
- (3) Several states issued orders that allowed for differences in mask related policies between counties. Counties with low COVID-19 incidence rates could be exempt from the state order although, over time, if the rate in one of these counties rose to a level above the state's cut-off, the exemption would be withdrawn. We used news reports to take county specific coverage into account in Louisiana^{13,14}, Mississippi¹⁵⁻¹⁷, Ohio¹⁸, and Texas¹⁹. In Kansas, a county could opt out of the state mandate; it could replace the state's mandate with one of its own^{20,21}. The Kansas Health Institute tracked mask policies across the state and publicly reported them²².

There are a few cities that are not in any county; they are standalone entities called "independent cities." Baltimore, Maryland; St. Louis, Missouri; Carson City, Nevada; and 38 cities in Virginia²³ are independent cities; we classify them as cities. Also, there are several cities - New Orleans, Louisiana; Anchorage and Juneau, Alaska - whose boundaries coincide with those of the counties. The Census Bureau calls them "consolidated cities"²⁴; we consider these as counties.

Results

By the first half of April 2020, legislators in nine states had issued mask orders (See [Figure 1](#)) and by the end of June, this number had grown to 40. Data for the initiation dates for each state are provided in a data set.

The average degree of coverage for all states between April 3 and November 30 was 57.7%. Of the nation's population, 48.6% received coverage under statewide mandates, 6.5% under county mandates, and 2.7% under municipal orders. During the time period covered in our study, states which enacted statewide mandates had an average coverage of 67.1% for all mask days (including those generated by municipal and county mandates); states in which the governors did not introduce statewide mandates had 27.1% coverage from municipal or county orders.

The degree of coverage and source of order by state is shown in [Figure 2](#). New Jersey had the highest degree of coverage (97.9% of all person days) because of its early start in introducing a statewide mandate. Of those states without statewide coverage, Arizona and Florida had large county components which kept their non-coverage ratios in the mid-range.

Figure 1. Distribution among states of the period that a mask order came into effect. We divided time periods into 15 day increments, beginning April 1, 2020. The first mask order was on April 3.

Figure 2. Mask days: state breakdowns by source of order. Percent breakdown in each state of person days into days under mask order and days without any mask order. Days under mask orders are further broken down by source of mandate - state (green), municipal (yellow) and county (blue). Mask-days with no government orders are colored red.

Among the states with lower levels of mask coverage, Alaska and Oklahoma had relatively high degrees of municipal coverage.

Discussion

The proportion of person days between April 3 and November 30, 2020 that came under face mask orders varied considerably by state. South Dakota had the lowest percent coverage and New Jersey the highest. There was also a variation by the source of the order: states with only local orders exhibited an average coverage of 27.1% of all person days while those which included state orders exhibited an average of 67.1%.

We brought together mask order duration and population to measure the relative degree of coverage of mask policies by state. There are numerous lists of mask orders that indicate the dates of the orders; these were found in news reports and in state and local government web pages⁷⁻⁹. However, they have not been brought together to indicate duration of coverage that was weighted by populations. Thus, the degree of population coverage of the mask policies are not indicated in any of these sources.

While the ratio of mask days to person days for each state has been estimated, we should point out some qualifications when interpreting these statistics as indicators of COVID-19 preventive activities.

- We used the total regions' populations. All regional orders had some exceptions such as age and disability. Although these omitted persons made up small portions of the populations, their inclusion in our estimates

suggests that our analysis captured the number of persons who resided in an area with mask orders, rather than the number who were ordered to wear masks.

- Some legislators changed mask policies over time in response to changing COVID-19 incidence and public pressure. Over time the degree of coverage in some states changed as mask orders were initiated or terminated. We have tried to capture these changes using news reports but, among the states, only Kansas, through the Kansas Health Institute, reported mask policies in a comprehensive and systematic way. As a result, there may have been missing orders and termination dates in our estimates.
- As we have indicated in a previous paper⁷, there have been considerable differences in enforcement across regions. Enforcement, usually done at the local level, is not documented in any statistics and is especially difficult to capture in relation to local government policies. This is a limitation which would be difficult to control for.
- Masks are not the only deterrent for the pandemic. Others included social distancing in its many forms and frequent handwashing²⁵. Mask-wearing is only a partial solution to containing the virus.

In conclusion, leadership regarding mask-wearing came from the state level of government. Among the states with the greatest percentage of mask-order person days, state leadership was prominent. In those states with the lowest level of coverage, local government leadership predominated.

Data availability

Underlying data

University of Alberta Libraries (UAL) Dataverse: First days in states of mask mandates, <https://doi.org/10.7939/DVN/FJHBSS>²⁶.

This project contains the following underlying data:

Distribution among states of the date of the first mask order

University of Alberta Libraries (UAL) Dataverse: COVID-19 Mask days as a per cent of state person days <https://doi.org/10.7939/DVN/GJZKVV>²⁷.

This project contains the following underlying data:

Distribution of mask days by legislative body

Data are available under the terms of the [Creative Commons Zero “No rights reserved” data waiver](#) (CC0 1.0 Public domain dedication).

Acknowledgments

We received suggestions from Charles Hunt.

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Shirley Girouard

SUNY Downstate Health Sciences University, Brooklyn, NY, USA

Well designed and executed study and description of numbers of people in US who live where mask policies are in place. Title and text could be rephrased a bit to make it clear that this is what the findings refer to. Would be helpful to relate these findings to COVID-19 actual mask wearing (there are some data re this) and rates of disease/test positivity rates. Compliance and impact of having policies is, of course, what is important.

Is the work clearly and accurately presented and does it cite the current literature?

Yes

Is the study design appropriate and is the work technically sound?

Yes

Are sufficient details of methods and analysis provided to allow replication by others?

Yes

If applicable, is the statistical analysis and its interpretation appropriate?

Yes

Are all the source data underlying the results available to ensure full reproducibility?

Yes

Are the conclusions drawn adequately supported by the results?

Yes

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Health services researcher, policy analyst and nurse

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard, however I have significant reservations, as outlined above.

Reviewer Report 26 March 2021

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Hannah Clapham

Saw Swee Hock School of Public Health, National University of Singapore, Singapore, Singapore

This summary of mask mandates is useful. A few comments:

- The methods could have some more detail on where the information on mask mandates was found
- It is unclear whether the only variation is time of introduction or has been introduced and lifted in some places. This would be helpful for understanding.

Is the work clearly and accurately presented and does it cite the current literature?

Yes

Is the study design appropriate and is the work technically sound?

Partly

Are sufficient details of methods and analysis provided to allow replication by others?

Partly

If applicable, is the statistical analysis and its interpretation appropriate?

Yes

Are all the source data underlying the results available to ensure full reproducibility?

Yes

Are the conclusions drawn adequately supported by the results?

Yes

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: infectious disease epidemiology and modeling

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard.

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