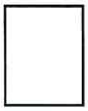

REPORT Government Regulation

A Statistical Analysis of Mandates and Mask Usage in Kansas

April 15, 2021 36 min read

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SUMMARY

Public health officials here and throughout most of the world agree that mask wearing has some value in reducing the rate at which COVID-19 spreads. As a result, numerous states and localities, including the state of Kansas, have issued requirements mandating the use of face masks. Although controlled studies of mask mandates are rare due to the nature of the pandemic, the optional structure of the statewide mandate in Kansas provides an opportunity to evaluate mask usage and efficacy. Our analysis does not deny the efficacy of mask wearing per se, nor should it discourage the practice. In fact, mask use during the pandemic has been recommended by The Heritage Foundation's Coronavirus Commission guidelines. However, our findings do suggest that public health strategies relying predominantly on mask mandates are inadequate, and thus other initiatives, in addition to mask wearing, should have been a component of policies aimed to limit the spread of the disease. We also analyze one of the few published studies of the Kansas mask mandate and find that the study, published by the Centers for Disease Control and Prevention, fails to demonstrate that the mandate was effective.

KEY TAKEAWAYS

A CDC report on Kansas' mask mandates failed to analyze the data with sufficient rigor—and mistakenly argued that mask mandates reversed COVID-19 case rates.

While mask wearing can help reduce virus transmission, the data shows that public health strategies solely relying on mask mandates are ineffective.

The government should use this Heritage report to improve its statistical analysis of public health data so officials can create concrete public health plans.

Centers for Disease Control and Prevention, fails to demonstrate that the mandate was effective.[4]

We find that counties that instituted mask mandates did report lower case incidence (cases per 100,000) in some periods compared to counties that did not. However, our analysis demonstrates that these differences are not statistically significant[5]

and the overall trends are similar in both groups of counties. Our analysis also indicates that, after the imposition of the mandate, trends in COVID-19 proliferation continued to increase in Kansas counties with and without mandates. The CDC study fails to examine the mandate question with this level of statistical rigor—and ultimately makes incorrect statements regarding trends.

Our analysis does not deny the efficacy of mask wearing per se, nor should it discourage the practice. In fact, mask use during the pandemic has been recommended by The Heritage Foundation's Coronavirus Commission guidelines.[6]

However, our findings do suggest that public health strategies relying predominantly on mask mandates are inadequate, and thus other initiatives, in addition to mask-wearing, should have been a component of policies aimed to limit the spread of the disease. We hope that our analysis provides the public, as well government agencies, with a number of ideas for improving statistical analysis of public health data.

Mask Usage in Kansas

At the request of The New York Times, the firm Dynasta conducted a survey between July 2 and July 14, 2020, to assess the level at which people were wearing masks across the country. The firm garnered 250,000 responses, compiling county-by-county data that was presented visually on The New York Times website and posted on Github.com.[7]

As a result, counties such as Johnson and Shawnee are more heavily weighted than less populated counties. Although this feature is precisely the purpose of computing a weighted average—to provide more weight to certain more conspicuous observations than others—this type of analysis can also sometimes be misleading because it can obscure important variation. To see why, Map 1 depicts the probability, for every county in Kansas, that five people in a random encounter are all wearing masks.

As Map 1 illustrates, this probability measure displays significant variation throughout the state. Interestingly, many counties that did not mandate masks had higher probabilities than some that did. For example, after ranking the counties by the probability that all five people in a random encounter would be wearing masks, Douglas County, Johnson County, Wyandotte County, and Shawnee County (all mandate counties) top the list, with probabilities ranging from 0.43 to 0.69. However, Jefferson, Wabaunsee, Pottawatomie, Riley, Osage, and Miami (all non-mandate counties) are ranked next, higher than many counties with mask mandates. Altogether, according to The New York Times data, six of the top 10 counties and 17 of the top 25 counties were non-mandate counites. (See Map 1.)

The New York Times data suggests that the split between mandate and non-mandate counties is far from clean. In fact, nearly two-thirds of the respondents in counties without mandates report either frequently or always wearing masks during early July. Moreover, according to the Times data, many counties without mandates experienced more mask use than others with mandates. This fact, however, is lost when the data is weighted across the Kansas population because heavily populated counties are highly influential in the computation of the associated weighted average. At the very least, the Times data suggest that many people wore masks even in the absence of government mandates to do so.

The CDC Study of Kansas Mask Mandates

The Centers for Disease Control and Prevention (CDC) released a November research paper that studies the efficacy of mask mandates in the state of Kansas.[11]

The CDC paper examines, at the county level, the number of new daily COVID-19 cases reported and the incidence (reported daily new cases per 100,000 people) from June through August.[12]

that left the mask mandate in place, as well as for those 81 counties that opted out of the mandate. The third column shows the same statistics for August 17 to 23, approximately 45 days after the mandates went into effect.

As the first row demonstrates, the CDC reports that cases and incidence in the counties with mandates increased from June to July, and then declined in August. The incidence increased more than fivefold from June to July (from 3 cases to 17), and then fell 6 percent in August (from 17 cases to 16). The bottom two rows provide the same statistics for the 81 non-mandated counties, and show that cases and incidence increased from June to July, and then increased at a faster rate in August (100 percent).[17]

Based on these results, the CDC reports that the mask mandates appear to have reversed the increasing case trend in the counties with mandates, while case incidence doubled in those counties without mandates.

Table 2 replicates each of these calculations using the updated data rather than the earlier released data used in the CDC report (downloaded August 31, 2020).[18]

As these new results show, the updated case data do not change the original results for the non-mandated counties, but it does alter the results for the mandated counties. In particular, the trend no longer reverses in August: It continues to increase, although at a slower rate.

The top row shows that the number of cases in the mandated counties increased 35 percent from July to August (from 333 to 345), and that the incidence increased 6 percent (from 17 per 100,000 to 18 per 100,000). Thus, although the rate of increase appears to have slowed in the counties with mandates, the trend in case growth is still increasing. While it is true that the case (and incidence) growth is still higher as of early August in the non-mandate counties, an important empirical question is whether this result holds beyond early August. Without investigating this question, it is premature to claim that mask mandates were effective in Kansas.

Extension of Dates to Include Fall Surge

The CDC paper does not report any statistics beyond August. In a footnote on page 1777, the CDC report states:

In Johnson County, all students initially attended school in a hybrid environment, but students in grades pre-K through 5 shifted to onsite learning on October 8.[23]

On November 30, all secondary students (grades 6 through 12) shifted fully to remote learning "[i]n acknowledgement and response to the growing spread of COVID-19 infections in Johnson County."[24]

When the school district announced this shift to remote learning, they also proclaimed that "[s]ocial distancing, mask-wearing, and hand washing, for example, have helped to keep transmission low inside the school buildings. However, the district is seeing an impact on staffing due to the sharp increase in cases within the community."[25]

Regardless of these complicating factors, if mask mandates are only effective when schools are closed, then they do not work. Thus, one very important empirical question is whether the COVID-19 trends observed in Kansas through August remained the same—or changed—after August. To investigate this question, this Heritage Special Report extends the CDC's analysis through mid-November.[26]

During this period, not all Kansas schools opened, but each of the 24 counties with public mask mandates also implemented mask mandates in their schools. Thus, the two-thirds of the population under a mandate prior to August remained under a mandate after schools were open, and that mandate was also implemented in the schools that opened. Also, 68 percent of the 81 counties without mandates maintained the state's separate school-mitigation order, and

increased 12 percent in late October (from 33 to 37), and 214 percent in November (from 37 to 116).

These patterns are broadly consistent with the spread of COVID-19 in Kansas throughout the first nine months of the pandemic, both before and after the mandates were in place. Through November, case growth tended to rise and fall concurrently in both groups of counties. The CDC study does not adequately capture the overall pattern, however, because it only examines case totals and incidence (using seven-day rolling averages) through August. Of course, it is also important to examine case growth throughout the pandemic, both before and after the period studied in the CDC report, as well as outside the seven-day periods in the report.

The first reported COVID-19 case in Kansas was on March 8, 2020, in Johnson County, the state's most heavily (and most densely) populated county. The case totals remained higher in the mandate counties until April 27, and the seven-day rolling average of new cases was higher in the mandated counties until April 13. The seven-day rolling average of new cases was then greater in the non-mandated counties through May 29 (for 47 consecutive days). However, from May 30 through November 30 (the endpoint of our analysis), the seven-day rolling average of new cases was greater in the counties with mask mandates.

Using the incidence figures, the values across mandate counties versus non-mandate counties are more evenly distributed. For instance, the incidence (seven-day rolling average of new cases per 100,000) was higher in the mandate counties through April 10, and then remained higher in the non-mandate counties until June 3. From June 4, incidence remained higher in the mandate counties until August 27, and then stayed higher in the non-mandate counties through November 30.

Additional Issues with the CDC Study

Several other aspects of the CDC study's methodology deserve further examination. The first of these issues is the method used to calculate incidence. Typically, to adjust case totals for population differences, researchers convert raw values to the number of cases per 100,000 population. For a given geographic area, they calculate this measure by dividing the number of cases by the population, and then multiplying the result by 100,000. That is, the researchers calculate the number of cases as a percentage of the population, and then inflate it by 100,000 (to make it more comparable across areas with different population sizes).

Another perspective from which to analyze growth over the full horizon is by computing average monthly growth rates. Charts 4 and 5 provide this view, with rates calculated as the geometric means of the seven-day rolling average of daily case growth for each month.[35]

As Charts 4 and 5 illustrate, there has been significant variation in case growth in both counties that issued mask mandates and counties that did not. Interestingly, before the imposition of mask mandates on July 2, both groups of counties incurred overall reductions during May. The levels of these reductions differ depending on which approach is used, but the direction of the change is the same.

Subsequent months through September all suggest increases in monthly case growth, with counties not implementing mask mandates incurring slightly higher growth. However, during October and November, the different calculation methods for incidence provide conflicting results as to which group of counties experienced higher case growth. Still, using both metrics, the growth rates for the two groups of counties are quite similar. In a forthcoming section, we examine the difference between the two groups for statistical significance.

Mortality. Another important question—one the CDC study ignores—is an analysis of COVID-19 mortality data between counties that had mask mandates and those that did not. Charts 6 and 7 display the daily values for the seven-day rolling average in mortality, where incidence is calculated using the two approaches discussed in the previous section. As these charts illustrate, the counties that did not implement mandates seemed to fare slightly worse in terms of mortality than the counties that did. However, there was no clear sustained reduction in mortality in either group.

Additionally, Charts 8 and 9 present mortality statistics using the monthly growth rates for deaths.

These charts demonstrate that, in both groups of counties, there has been significant variation in mortality growth rates pertaining to COVID-19 in Kansas. As was also the situation with case growth, both groups varied in terms of which had higher growth rates before the imposition of the mask mandates. After the imposition of mask mandates in July, however, in most months, counties that implemented mandates experienced slightly lower (albeit positive) growth rates for mortality than counties that did not.

5) with marginal posterior means of –0.039 and –0.037, respectively, with probabilities exceeding zero each less than 0.05.

However, after the imposition of July's mandate, there is no clear monthly effect of case proliferation in either group. Overall, these results suggest that, at least statistically, the mask mandates in Kansas did not have a significant effect on monthly case growth. However, the posterior intercept coefficient is positive, with probability exceeding zero above 0.993, suggesting that there are likely other factors influencing case growth that remain unexamined in this model.

Separately, we computed the difference between the monthly marginal posterior coefficients for counties implementing the mandate and counties that did not. These results are contained in Table 6.

Once again, our analysis illustrates that there were slight disparities between the two groups of counties, but only before the mandates were implemented in April and May. After the implementation of the mandates, statistically speaking, there was no clear distinction between the two groups.

Lastly, Tables 7 and 8 present a similar analysis using mortality data. Unlike the case growth model, this model does not fit quite as well in terms of the estimated coefficient of determination, although it does still fit significantly better than its analogous frequentist counterpart. Also, unlike the case growth analysis, the mortality growth examination illustrates neither any monthly effect on mortality nor any meaningful statistical differences between the mandated and non-mandated counties on a monthly basis—before or after the imposition of the mandated order. Thus, these results suggest that although the counties in Kansas with mask mandates did report slower growth in mortality (and fewer deaths per 100,000), this impact was not significant from a statistical perspective.[37]

Discussion and Limitations

Initially after the mandate, on a per-capita basis, counties with mask mandates had more cases (based on seven-day rolling daily averages) than those without mandates. However, in the fall, non-mandated counties reported higher case incidence. In terms of mortality, levels

and thus other initiatives in addition to mask wearing, a practice in line with The Heritage Foundation's Coronavirus Commission guidelines, should have been a component of policies aimed to limit the spread of the disease.

Conclusion

Rigorous statistical analysis is fundamentally important in assessing public policy. Our analysis indicates that, after the imposition of an optional mandate, trends in COVID-19 proliferation continued to increase in Kansas counties with and without mandates. The CDC report on the Kansas mask mandates fails to analyze the data with a sufficient level of rigor and mistakenly argues that the trend in case growth reversed. The authors hope that this report gives the public, as well as government agencies such as the CDC, tools and ideas for improving future analyses of public health data.

Appendix 1: A Note on Population-Adjusted Case Values

Throughout the COVID-19 pandemic, various agencies and news outlets have relied on both raw numbers of reported cases as well as population-adjusted figures. Typically, population-adjusted figures allow better comparisons across countries, states, or counties with different population sizes. Sometimes, the raw values and the adjusted figures can produce a very different ranking between counties, for example, leaving readers to wonder which version of these COVID-19 figures they should rely on. Unfortunately, both versions are important, and neither is necessarily the "right" one to use. In other words, both measures can provide valuable information depending on the context in which they are used.

One of the most common population-adjusted figures is the number of cases per 100,000 population. For a given geographic area, this measure is calculated by dividing the number of cases by the population, and then multiplying the result by 100,000. That is, it takes the number of cases as a percentage of the population, and then inflates it by 100,000. To explore what kind of information these figures provide, this appendix presents statistics from two Kansas counties with very different population sizes: Meade County, with an estimated population of 4,033, and Johnson County, with an estimated population of 602,401.

As of June 5, Johnson and Meade Counties reported a total of 939 and 30 COVID-19 cases, respectively. Since Johnson has a much larger population, it is not overly surprising that officials are reporting a higher number of cases. One way to make a better comparison is to calculate what percentage of the respective populations reported having COVID-19. Using

versus Meade: There are literally 150 times the number of people living in Johnson County than in Meade County.

Thus, focusing only on the population-adjusted total or only on the raw total leaves out valuable information about the spread of COVID-19. The population-adjusted total tells us very little, if anything, about the probability of catching the disease. Outbreaks might look worse in smaller communities when using population-adjusted totals, but there nonetheless might be less opportunity to cause community spread relative to more populated areas (or locations with more human interaction).

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Appendix 2: Hierarchical Bayesian Model

In our model, we specified for month i=1,…I, day t=1,...,t_i, and j=1 to represent the set of counties that implemented the mask mandate, and 2 for the set that did not. We defined the log daily growth rate in incidence $\log(y_{ijt}) \sim N(\mu_{ijt},\sigma_{ijt}^2)$, with the following linear predictor:

$$\mu ijt=\alpha ijt+\beta ijt$$

and the following prior structure:

$$\alpha ijt \sim N(\mu\alpha,\sigma\alpha 2)$$

$$\beta ijt \sim N(\mu\beta ij,\sigma\beta ij2)$$

$$\mu\beta ij \sim N(\Delta j,\sigma\Delta j2)$$

$$\mu\alpha \sim N(0,100)$$

We computed Bayesian coefficients of determination using the approach outlined in Gelman et al. (2019).[42]

We assessed for convergence of our posterior distribution using the approach outlined in Geweke (1992).[43]

Comparing the first 40 percent of our posterior sample to the remaining 60 percent failed to elicit a lack of statistical significance for all coefficients examined, thus suggesting that the posterior distribution had been adequately sampled and was therefore accurately characterized by our sample.[44]

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[1]
Office of the Governor, "Governor Laura Kelly Announces Masks Must Be Worn Statewide," State of Kansas, June 29, 2020, https://governor.kansas.gov/governor-laura-kelly-announces-masks-must-be-worn-statewide/ (accessed February 19, 2021). For the executive order, see Office of the Attorney General, "Memorandum of July 2, 2020," State of Kansas, July 2, 2020, https://ag.ks.gov/docs/default-source/documents/addendum-3-to-march-24-law-enforcement-duties-and-authorities-memo.pdf?sfvrsn (accessed February 19, 2021).

[2]
The order did not create a true randomly selected control group. Not only did the state's largest counties (with more people and more cases) tend to participate in the mandate, while the smaller counties (with fewer people and fewer cases) opted out, but there is no way to fully account for the prevalence with which citizens in non-mandated counties wore masks.

[3]
Nothing in this Heritage Foundation Special Report challenges the efficacy of mask-wearing per se. As argued in previous Heritage Foundation research, the results in this report should not be seen as discouraging the practice. See Doug Badger and Norbert Michel, "Mask

are wearing masks in five random encounters is calculated by assuming that survey respondents who answered 'Always' were wearing masks all of the time, those who answered 'Frequently' were wearing masks 80 percent of the time, those who answered 'Sometimes' were wearing masks 50 percent of the time, those who answered 'Rarely' were wearing masks 20 percent of the time and those who answered 'Never' were wearing masks none of the time." A similar analysis was presented by The New York Times for the entire country. See Katz et al., "A Detailed Map of Who Is Wearing Masks in the U.S.," and "Mask Wearing Survey Data."

[10]

If one were to take the individual probabilities calculated for each of the counties and average them by weighting across population size, the probability of five people in a random encounter all wearing a mask is 0.38 amongst counties mandating masks and 0.19 amongst counties not mandating masks.

[11]

Van Dyke et al., "Trends in County-Level COVID-19 Incidence in Counties With and Without a Mask Mandate."

[12]

The CDC report defines the number of new daily cases reported as the "seven-day rolling average number of new daily cases," and it defines the incidence as the "seven-day rolling average number of new daily cases per 100,000 population." This Heritage Special Report follows the same convention.

[13]

Van Dyke et al., "Trends in County-Level COVID-19 Incidence in Counties With and Without a Mask Mandate," p. 1778.

[14]

Heritage analysts brought this matter—including the results discussed in Table 2 of this Special Report—to the attention of the CDC paper's corresponding author, as well as to several CDC editors and a CDC Associate Director for Policy.

[15]

"Erratum: Vol. 69, No. 47," Weekly, Vol. 69, No. 47 (January 1, 2021), p. 1663, https://www.cdc.gov/mmwr/volumes/69/wr/mm695152a6.htm?s_cid=mm695152a6_w (accessed February 19, 2021) [emphasis in original].

[16]

Van Dyke et al., "Trends in County-Level COVID-19 Incidence in Counties With and Without a Mask Mandate," p. 1778.

[23]

Kansas Unified School District No. 232, "Elementary Students Move to On-Site Learning, Oct. 8," September 29, 2020, https://www.usd232.org/covid19 (accessed February 20, 2021).

[24]

Kansas Unified School District No. 232, "Secondary Students Shifting to Remote Learning," November 17, 2020, https://www.usd232.org/covid19 (accessed February 20, 2021).

[25]

Ibid.

[26]

Analyzing the effectiveness of mask mandates in Kansas beyond November requires a different framework because the governor issued a new executive order on November 18. This order gave counties one week to implement their own face covering ordinance, and automatically opted them into the state's mandate if the county had failed to implement their own. See Laura Kelly, "Executive Order No. 20–68: Establishing a Face-Coverings Protocol," Office of the Governor, State of Kansas, November 18, 2020, https://htv-prod-media.s3.amazonaws.com/files/eo-20-68-face-coverings-protocol-executed-1-1605739312.pdf (accessed February 20, 2021). In April, Kansas lawmakers repealed the Governor's statewide mandate. See Brie Stimson, "Kansas GOP Ends State's Mask Mandate Hours after Dem Governor Extended It," Foxnews.com, April 4, 2021, https://www.foxnews.com/politics/kansas-gop-ends-states-mask-mandate-hours-after-dem-governor-extended-it (accessed April 9, 2021).

[27]

The authors did not perform a census of every Kansas school district in every county, but it is clear that at the very least, many county-seat cities implemented their own school mitigation measures even if they did not have a public mask mandate. See, for example, Great Bend Together, Unified School District 428, "Restart Plan 2020–2021," Barton County School District, August 10, 2020, https://drive.google.com/file/d/1TEk8twReJ6fJg1aSt3lMzTimYGc3jaPp/view (accessed March 5, 2021).

[28]

As discussed in a previous section, it is doubtful that the non-mandate/mandate distinction was purely representative of whether citizens were actually wearing masks prior to when schools opened.

[29]