Predictive Analyses of COVID-19 Case Data to Estimate the Effectiveness of Nationwide Face Cover

Hwanyong Kim, Jimmy Simpson, and Byeonghwa Park

This study provided comparisons of confirmed cases between face-cover-required states and partially or not-required states from a time-series analysis on effects of face mask use in public based on eight different states between March 1 and June 15, 2020. In comparing face-cover-required states and partially or not-required states, it was very encouraging that the slope of the daily case trends turned negative after face-cover requirements in statewide face-cover-required states, including New York, New Jersey, Pennsylvania, and Connecticut. However, the patterns of the daily case have been showing positive trends continuously in partially or not-required states, including California, Texas, Florida, and Virginia. Based on our prediction model, if nationwide face-cover requirements with social distancing were enacted on March 16, the estimated number of deaths would be about 15,600, which is 94,300 less than the actual number of deaths by June 15, 2020. We recommend that all states and the federal government require face coverings in order to reduce the risk of infectious diseases.

KEY WORDS: COVID-19, data analytics, face-cover requirement

Introduction

The COVID-19 has infected over 5 million people and has killed more than 162,000 to date in the United States. The daily increase in coronavirus cases in the United States has slowed gradually since late April but has increased again from mid-June. The United States saw a record number of new coronavirus cases in a single day, with 45,557 diagnoses reported on June 24 (Madani, 2020). The North-eastern States added a substantial number of daily cases during the early stage of the coronavirus pandemic in the United States. However, daily counts of new cases have been decreasing continuously in those states since those states, including New York, New Jersey, Pennsylvania, and Connecticut, have enacted a statewide face cover or mask requirement. Conversely, the daily count in COVID-19 cases has increased continuously in states where face covers are not required or partially required. Since Friday, June 19, a dozen states have seen record highs of new COVID-19 cases. The states that saw the increase were Florida, Texas, Utah, South Carolina, Nevada, Georgia, Missouri, Montana, Arizona, California, Tennessee, and Oklahoma (Deliso & Mitropoulos, 2020). Now, these partially or not-required face cover states are leading the increase of coronavirus daily case counts in the United States. In our previous research, using descriptive data analytics, we explored the efficacy of a face mask or cover in public to protect people from the Coronavirus infection and to slow
the spread of disease. Based on the data analysis, we concluded that a face mask or cover in public has been significantly effective in protecting people from the infection and mitigating the spread of the COVID-19 in states requiring face coverings. In this paper, we explore how many people could be saved if the federal government imposed a nationwide face mask or cover requirement in public. We are going to develop a statistical model to predict an alternate scenario in which a nationwide face mask requirement was issued from a predictive data analytics perspective—a look into what could have happened had we as a nation made different choices. Eventually, a global response based on global cooperation should be taken to fight against COVID-19 because it is a global health crisis.

**Effectiveness of Face Covers**

The emphasis in our previous research using descriptive data analytics was supporting the opinions and research that face covers effectively serve to prevent people from infection and mitigates the spread of coronavirus. There have been voices advocating the use of face coverings as an effective tool against the spread of the virus. Personal protective equipment includes medical masks or respirators used to protect the wearer from droplets, airborne particles, and bodily fluids potentially contaminating the face (Ippolito et al., 2020). The combination of wearing masks along with careful handwashing and the isolation of sick people are effective measures against the spread of respiratory viruses (Sparks, 2020). The primary benefit of wearing a mask is to limit the spread of the virus from someone who knows or does not know they have an infection to others (Servick, 2020). According to a study conducted at Hong Kong University that utilized hamsters, the rate of noncontact transmission through respiratory droplets or airborne particles dropped by as much as 75 percent when masks were used.

Figure 1 shows combined daily cases states having statewide face-cover requirements and states with a partial requirement or no requirement of face covers. In comparison between face-cover-required states and partially or not-required

![](image)

**Figure 1 Daily Cases. Data: www.covidracking.com (Moving Average: March 7–June 15, 2020).**
It is very encouraging that the slope of the daily case trends turned negative after statewide face-cover requirements were put into effect for the face-cover-required category of states, including New York, New Jersey, Pennsylvania, and Connecticut. However, the combined daily case counts exhibited positive slope trends in partially or not-required states, including California, Texas, Florida, and Virginia.

**Methods**

We collected COVID-19 data from multiple open sources, such as the CDC, Health Departments’ of states, and the COVID Tracking Project (www.covidtracking.com). We chose New York, New Jersey, Pennsylvania, and Connecticut as statewide face-cover-required states and combined these four states’ daily case data to produce a prediction model. In Figure 1, it appears that there are a decreasing number of daily cases in the face-cover-required state that started around April 10, 2020. We found that there is a cyclical trend in the data set. The cyclical trend might come from differences in the number of tests administered. There has been a greater number of tests and cases during weekdays and fewer during the weekend. To remove the cyclical variability, we used a 7-day moving average and adjusted data with the number of daily tests for our data analytics. In Figure 2, the adjusted data show that the decrease in the daily case count started on April 22, 2020. Also, we can see that the daily cases have decreased by decreasing amounts over the period, thus appearing curvilinear, not linear.

Using the adjusted data set between April 22 and June 15, we conducted a time-series analysis to develop a logarithmic trend equation, \( \log Y = \log(a) + \log(b)t \), for predicting daily cases after the face-cover requirement was enacted. The developed prediction model (equation), \( \log Y = 4.1512 − 0.019t \), is statistically significant with \( r = −0.977 \) and \( p = 4.83E−37 \) at \( \alpha = 0.05 \) (95% confidence interval), as shown in Table 1. We could predict the daily cases by the antilog of \( \log Y \) (Lind, Marchal, & Wathen, 2018).

![Figure 2 Combined Daily Cases: NY, NJ, PA, and CT. Data: www.covidtracking.com (Adjusted: March 17–June 15, 2020).](image-url)
To apply this prediction model to national data, we adjusted it. The prediction model to predict daily COVID-19 cases in the United States is \( \log(Y) = 4.467554 - 0.0190t \). We estimated the beginning value, 29,346.35, based on the 7-day moving average of the national daily cases on April 22. The intercept (4.467554) in the prediction model for the national data is the logarithmic value of the beginning value.

Figure 3 shows the actual daily coronavirus cases and the predicted daily cases (April) if all states had enforced statewide face-cover requirements when the northeastern states started it. Figure 4 shows the actual COVID-19 total cases and the predicted total cases (April). According to the actual data, the total number of coronavirus infections and the total number of deaths were 2,103,549 and 109,982,

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![Graph showing COVID-19 daily cases](image-url)
respectively, by June 15 in the United States. If all states required face-covering in public in mid-April, we could predict, 1,408,599 people would be infected by June 15. Since the average death rate of the coronavirus is about 5.228 percent in the United States on June 15, the estimated death would be about 73,700. Approximately 36,300 lives could have been saved if the federal or all state governments had enacted mandatory face-cover requirements in mid-April.

President Trump, on March 16, urged social distancing for at least 15 days to stop the spread of the coronavirus. The national social distancing guideline coverage was extended. If the federal government or state government had enforced face-cover requirements along with the social distancing practice on March 16, it would be expected that there would be decreases in the number of daily cases in the United States around March 23 (7 days after the face-cover requirement enactment: Kim, Simpson, Kim, & Park, 2020). The prediction model to predict daily cases if face covers were required nationwide on March 16 is \( \log Y = 4.072 - 0.019t \) with the estimated beginning value of 11,803.3 in daily cases on March 23. If nationwide face-cover requirements with social distancing practice were enacted on March 16, only 299,349 Americans would be infected by June 15. That would be 1,804,200 less than the actual infections. If the same average rate of 5.228 percent is applied, the estimated number of deaths would be about 15,600. Thus, we predict that approximately 94,300 individuals would not have died of the coronavirus by June 15.

**Discussion and Conclusion**

Wearing a face mask could significantly reduce the risk of contracting and perhaps dying from COVID-19. By far, the most significant deterrent was mask-wearing, which had a 70 percent impact on death rates (Chen, 2020). Based on a forecast from the University of Washington, if nearly everyone wears masks in public, tens of thousands of lives could be saved during the coronavirus pandemic (Wolford, 2020). A survey found that about two-thirds of Americans say
they always or mostly wear a face mask or other covering when they are in public and near other people. And, 62 percent of Americans believe that wearing a face mask is more a matter of public health than a matter of personal choice (Edwards-Levy, 2020). Based on many pieces of research and our research, it is apparent that covering the face is effective in protecting people from the coronavirus, mitigating the spread of the virus, and saving many lives. Still, many Americans are reluctant to wear face covers and would not wear these face covers on a volunteer basis.

A British historian, Lewis Namier, suggested: “Imagine the past, remember the future.” Let us now imagine our own recent past had we made a few different choices. If all states required mandatory face covers in April or if the federal government ordered a nationwide face-cover requirement when the United States was still in the early stages of this pandemic, many fewer people might have succumbed to the coronavirus. We predicted what could have been avoided in the past event, with face-cover requirement enforcement early, to demonstrate the use of historic data to suggest and prepare future development. Many experts predict a second wave of pandemic and maybe even another unknown wave. There are those who say that in the United States, we are still immersed in the first wave. In other areas of the world, the seeds of the second wave may already be germinating. Now is the time to shape the future in this struggle with a virulent opponent. To save more people and not to repeat the past, we recommend that all state governments and/or the federal government will require face cover statewide and nationwide to stem the advance of infection and to save many lives.

Conflicts of interest: None declared.
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Note

1. While there has been a growing consensus on wearing face masks, face mask use still remains controversial.
References

Chen, Stephen. 2020. "Coronavirus: Face Masks Save Lives, Japanese Study Says." South China Morning Post, Hong Kong. https://www.scmp.com/news/china/science/article/3090440/coronavirus-face-masks-save-lives-japanese-study-says. Accessed June 25, 2020.

Deliso, Meredith, and Mitropoulos, Arielle. 2020. “12 States Have Set Record Highs in New COVID-19 Cases Since Friday.” ABC News, New York City, NY. https://abcnews.go.com/US/12-states-set-record-highs-covid-19-cases/story?id=7137520. Accessed June 22, 2020.

Edwards-Levy, Ariel. 2020. “Here’s How Most Americans Really Feel About Wearing Face Masks.” Huffpost, New York City, NY. https://www.huffpost.com/entry/face-masks-poll-partisan-culture-war_n_5ec584fcc5b642a7d150e103. Accessed May 20, 2020.

Ippolito, Mariachiara, Filippo Vitale, Giuseppe Accurso, Pasquale Iozzo, Cesare Gregoretti, Antonino Giarratano, and Andrea Cortegiani. 2020. "Medical Masks and Respirators for the Protection of Healthcare Workers From SARS-CoV-2 and Other Viruses." Pulmonology 26 (4): 204–12.

Kim, Hwanyong, Jimmy Simpson, Daniel Kim, and Byeonghwa Park. 2020. “Analyzing COVID-19 Case Data to Examine the Effectiveness of Face-Covering for Mitigating Virus Spreading.” Manuscript submitted for publication.

Lind, Douglas, William Marchal, and Samuel Wathen. 2018. Statistical Techniques in Business and Economics, New York: McGraw-Hill Higher Education.

Madani, Doha. 2020. “U.S. Hits Highest Single Day of New Coronavirus Cases With More Than 45,500, Breaking April Record.” NBC News, New York City, NY. https://www.nbcnews.com/news/us-news/u-s-hits-highest-single-day-coronavirus-cases-36-358-n1232065. Accessed June 25, 2020.

Servick, Kelly. 2020. “Would Everyone Wearing Face Masks Help Us Slow the Pandemic?” Science, Washington, DC. https://www.sciencemag.org/news/2020/03/would-everyone-wearing-face-masks-help-us-slow-pandemic. Accessed March 28, 2020.

Sparks, Hannah. 2020. “Does Wearing a Face Mask Really Help Prevent Coronavirus?” New York Post, New York City, NY. https://nypost.com/2020/04/02/does-wearing-a-face-mask-really-help-prevent-coronavirus/. Accessed April 2, 2020.

Wolford, Brooke. 2020. “If 95% of People Wear Masks, Tens of Thousands of Lives Could be Saved, Model Shows.” The News Tribune, Tacoma, WA. https://www.thenewstribune.com/news/coronavirus/article243781132.html. Accessed June 24, 2020.