

The COVID-19 Pandemic in Indiana: Documenting Its Spread and the Social Distancing Behavior of Hoosiers



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Introduction

The COVID-19 pandemic has altered life around the world in many ways. One massive change, encouraged by governments and public health officials, is “social distancing” which, loosely speaking, implies that individuals should not gather together as usual, but instead should remain home for all but essential activities (e.g., work for essential employees like police officers, medical professionals, etc., as well as grocery shopping, travel for medical emergencies, etc.). While social distancing has been a large part of the overall strategy to reduce the person-to-person transmission of COVID-19, little is known about its effectiveness in the short run.

Using locational data from individual cellphone users provided by the SafeGraph Corporation, we investigate this question for the state of Indiana, as well as focusing on Delaware County, the home county of Ball State University. More specifically, we examine whether Indiana’s Stay at Home order and other events affected two aspects of social distancing: the percent of people who leave their homes on a given day and the number of visits to common points of interest (POIs), including gas stations, supercenters, and grocery stores. While these are not a perfect measure of social distancing, they provide a picture of the extent to which Hoosiers complied with the state’s stay-at-home order, as well as individual behavior leading up to and then after the issuance of this order and other potentially important events.

After discussing the various sources of data we use, we present our findings, primarily in graphical form, in the pages that follow. Generally speaking, we see little direct evidence that Indiana’s stay-at-home order led people to remain at home more regularly. Rather, it is clear that social distancing, as we measure it, began well before Indiana’s stay-at-home-order, consistent with the idea that earlier information from elsewhere impacted social distancing behavior. In

particular, we show the social distancing, as we measure it, increased substantially following the first confirmed COVID-19 death in Indiana.

Data

We combine data from various sources to examine the association between state and local government policies that aim to slow the spread of COVID-19 and significant related events, social distancing behavior, and COVID-19 cases in the Indiana state. The study sample consists of 92 counties over the period of 59 days from March 1 to April 29, 2020, when the epidemic was expanding in the state.

Data for social distancing comes from SafeGraph. SafeGraph tracks one's mobility by detecting the movement of smartphones from the assigned geolocation of one's home and aggregated anonymized location data at the census block level (SafeGraph 2020). These data thus provide an objective measure of mobility behavior and a proxy for social interaction. For this analysis, the level of social distancing is measured by the share of people staying at home completely at the county-day level and the number of visits to common POIs, including gas stations, supercenters, and grocery stores. One is considered staying at home completely when his or her device does not leave his home at all during the day. Comparing the share of people staying at home completely and the number of visits to POIs over time provides insight on how people changed their mobility and interaction in response to COVID-19 policies and events.

Data on COVID-19, compiled by *The New York Times* from state and local governments and health departments, report the confirmed and probable incidence and deaths at the county-day level. Laboratory test reporting is the most common source of data (*New York Times* 2020). As by the end of the research period, the cumulative testing rate in Indiana was as low as 14.76 per thousand, the number of reported cases is likely to be lower than the actual number of cases, which should also include infections among people who have not been tested and infections among asymptomatic cases. This discrepancy tended to be larger in the early period when the testing rate was very low (by March 31, the testing rate was only 3.72 per thousand) (Indiana Government 2020). This missing data problem likely causes any attempt to associate infections and social distancing measures to be underestimated.

Table 1. Sample Characteristics

	Mean	Standard deviation
Mobile device counts	4,768.80	7,314.50
Share of staying at home completely	0.317	0.025
New COVID-19 cases per day	3.21	10.17
Deaths per day	0.196	0.625
Non-Hispanic white	0.922	0.071
Black	0.025	0.044
Hispanic	0.032	0.030

Urban residency	0.413	0.495
College education and above	0.168	0.075
Population density (100/sq. miles)	1.82	2.94
Per capita income	43,235.9	6,637.5
Share of population living in poverty	0.121	0.348
Unemployment rate (%)	3.45	0.605
<i>Notes:</i> Data are at the county level. Mobile device counts and share of those staying at home from SafeGraph; COVID-19 cases and deaths from the New York Times; shares of race, college education, and urban residency from American Community Survey 5-Year Estimates; per capita income and share of poverty population from Bureau of Economic Analysis; and unemployment rate from Bureau of Labor Statistics.		

We combine data from American Community Survey, U.S. Census Bureau, Bureau of Labor Statistics, and Bureau of Economic Analysis to construct the county characteristics. Table 1 reports basic descriptive statistics including the number of mobile devices tracked, share of people staying at home, the number of new COVID-19 cases and deaths, population race composition, urban residency, share of people with college degree and above, population density, per capita income, share of people living below the poverty line, and unemployment rate for the sample.

In this paper, we look at changes in social distancing behavior in response to Indiana’s Stay-at-Home order and significant events that may affect social distancing behaviors. Dates of the mitigation policies and such events are collected from national media outlets and presented in Table 2.

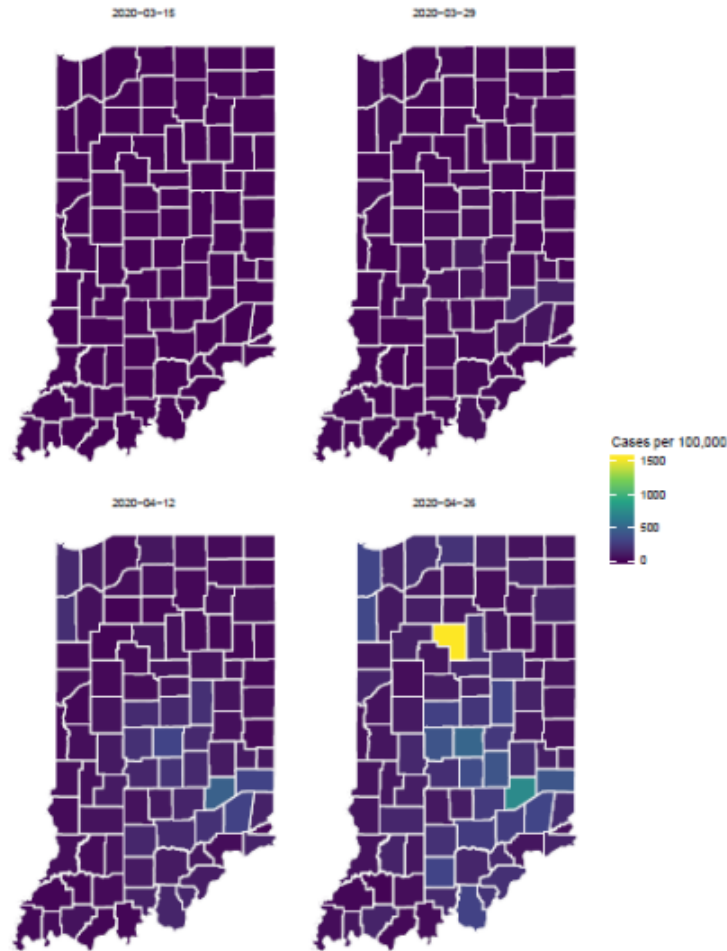
Table 2. Dates of COVID-19-related policies and events

Policies and events	Dates
Indiana stay-at-home order	3/25/2020
First case confirmed in Indiana	3/06/2020
First death confirmed in Indiana	3/15/2020
Ball State University's transition to online teaching	3/16/2020
<i>Notes:</i> Data collected by the authors from national media outlets.	

Analysis and Findings

Before we get into our primary objective of presenting evidence on social distancing behavior in Indiana, we present some background on the evolution of COVID-19 cases and deaths. Figures 1 and 2 show the progression of COVID-19 cases and deaths across the counties of Indiana via a county map of the state over a key six-week period (March 15 to April 26, 2020). Each figure shows either cases (Figure 1) or deaths (Figure 2) per 100,000 county residents at two-week intervals: specifically, March 15th, March 29th, April 12th and April 29th.

Figure 1. COVID-19 cases per 100K people across the counties of Indiana



As can be seen in Figure 1, which uses a color-coded legend, there were effectively no counties with more than a few confirmed cases until March 29th. At that time, as can be seen, only Decatur County, a county of about 25,000 residents in Southeast Indiana, had more than 200-300 cases per 100,000 people. The situation was much different by April 12th as can be seen in the lower left corner of Figure 1. By this time, several counties around and including Marion County, the home of Indianapolis, were moving into the hundreds of cases per 100,000 level, while early hotspot Decatur County had moved into the range of about 600 to 700 cases per 100,000 residents. By April 26th, the number of cases had grown substantially in Marion and adjacent counties, and Decatur County was around 1,000 cases per 100,000 residents. Several other counties were in the hundreds of cases per 100,000 by this time as well. Two things should be noted: first, while the number of cases likely represents an increasing prevalence of COVID-19, it also surely reflects increased testing efforts over time in each of the counties, which was unlikely to be the same or even similar across counties; second, while Decatur County was an earlier leader in cases, and experienced twenty-seven deaths by April 29th, only four more individuals died as of May 23rd. One last note of interest: the yellow county in Northwest Indiana is Cass County, which has about 38,000 residents. On April 29th it exhibited over 1,500 cases per

100,000 residents, the highest level in the state at that time. Press reports indicate that this high level may be due to an outbreak at a pork processing plant in Logansport. Despite this relatively high rate of cases, Cass County reports only six COVID-19 deaths as of May 23rd, over three weeks later.

Figure 2. COVID-19 deaths per 100K people across the counties of Indiana

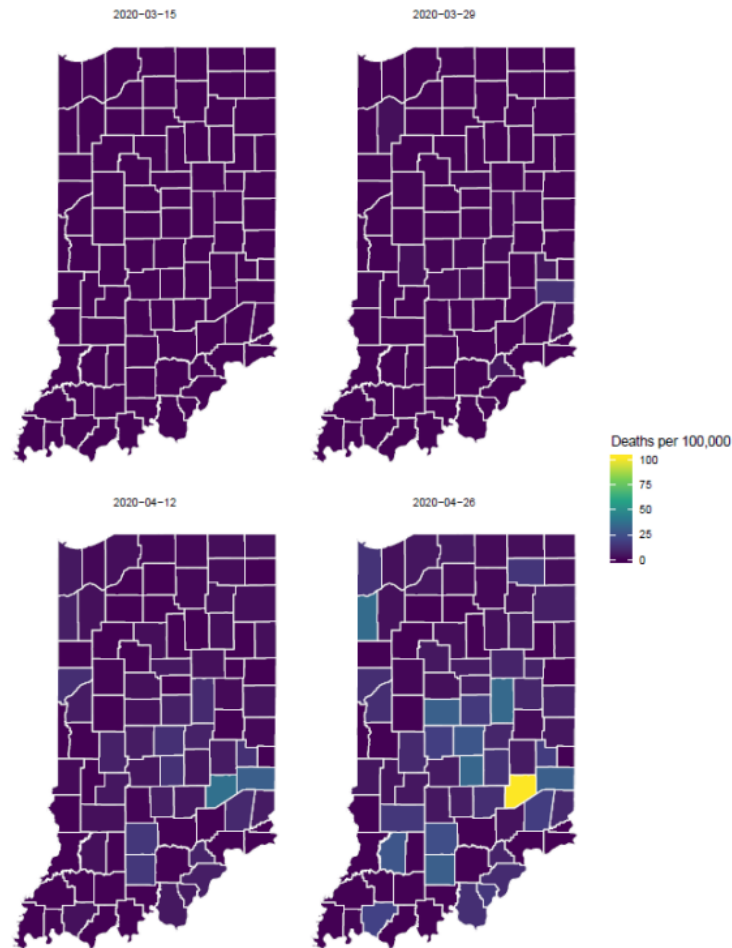


Figure 2 takes the same structure as Figure 1, but the relevant outcome is COVID-19 deaths. As there are far fewer deaths than cases, the color-coded index implies a very different scale. That said, the pattern is similar to Figure 1 in that virtually no county in Indiana had experienced high death rates among COVID-19 patients. Looking at the map corresponding to March 29th, only one county, Franklin County, exhibits deaths per 100,000 greater than ten. However, by April 12th, the story is different as several counties had experienced death rates of between 10 and 25 per 100,000 residents, with aforementioned Decatur County having a death rate of over 50, and adjacent Franklin County having a similarly high death rate for that time. By April 29th, many counties had death rates over 50, with most of these being located in the greater Indianapolis metropolitan area. Our case rate outlier, Decatur County, had over 100 deaths per 100,000

residents, implying that it had the highest death rate in the state at that time. However, as of May 23rd, Decatur County has experienced only four more deaths, as noted above, for a total of thirty-one deaths.

Figures 3 through 5 take on a different structure and address the main topic of this report: the social distancing behavior of Indiana residents. Figure 3 first presents the fraction of people leaving their homes in Muncie, Indiana, the home of Ball State University, for the two-month period of March to April 2020. Figure 4 has an identical structure but presents the amount of social distancing, as we measure it, for Delaware County versus the rest of the state of Indiana, while Figure 5 also has an identical structure, but presents social distancing in urban versus rural counties within Indiana. Before getting into the associated figures, we remind the reader that we measure social distancing as a three-day moving average of the percent of individuals who left their home, as measured by their cellphone location, as described in more detail in the Data section.

Figure 3. Fraction of people leaving their homes in Muncie, Indiana

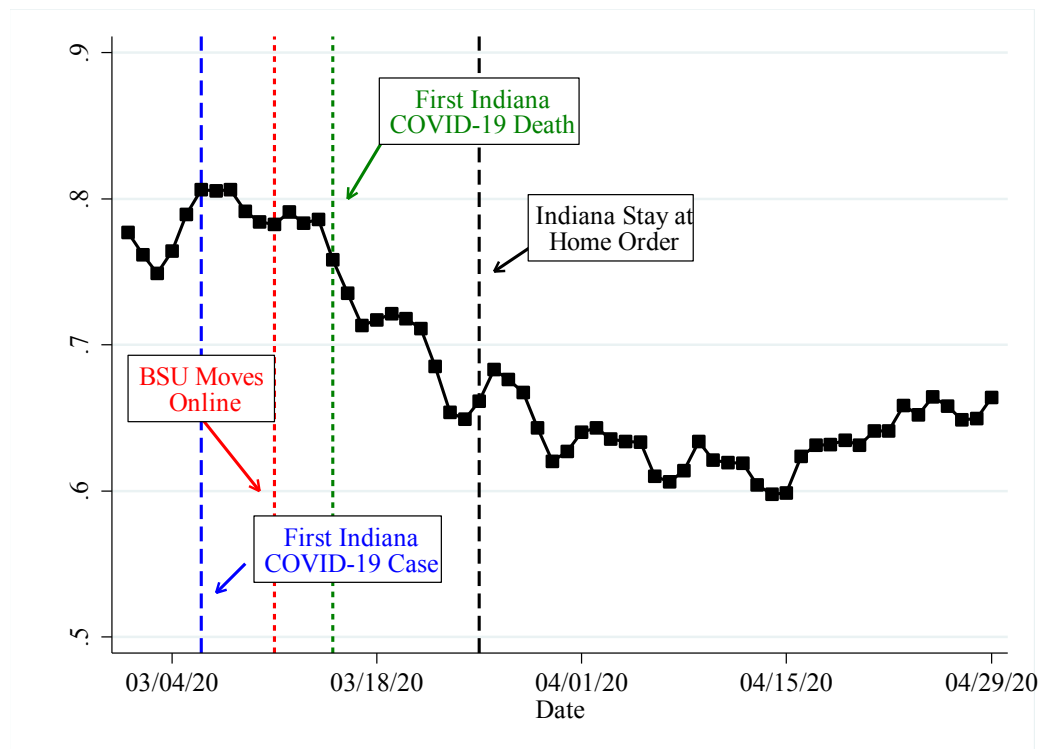


Figure 3 is constructed as follows: the vertical axis measures the three-day moving average of the percent of individuals leaving their home, while the horizontal axis measures time between the start of March and the end of April. As can be seen, the graph displays four important dates—1) the first documented COVID-19 case in Indiana, 2) the date Ball State University moved its courses online, 3) the first documented COVID-19 death in Indiana, and 4) the State of Indiana’s Stay at Home order). Each date has a vertical line that represents its place on the horizontal axis. As can be seen in the figure, there is a steep downward trend in the fraction in

Muncie, Indiana leaving home during the month of March. While it appears to begin near March 6th or so, it accelerates about one week later, around March 15th which coincides with the first documented COVID-19 death in Indiana. Over the next ten days or so, the fraction leaving home drops about ten percentage points. While the percent leaving home in Muncie rebounds slightly around the time of the state’s Stay at Home order, it continues to trend slightly downward thereafter, reaching a minimum of about sixty percent of individuals leaving home, relative to a norm closer to 80 percent.

Figure 4. Fraction of people leaving their homes in Delaware County vs. the rest of Indiana

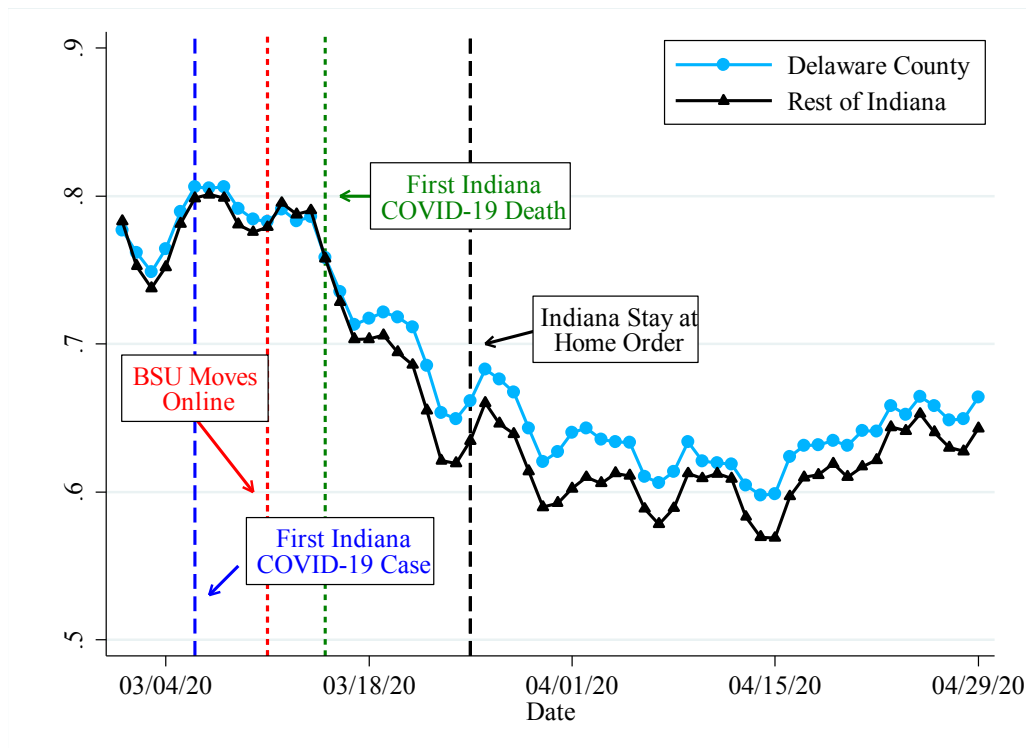
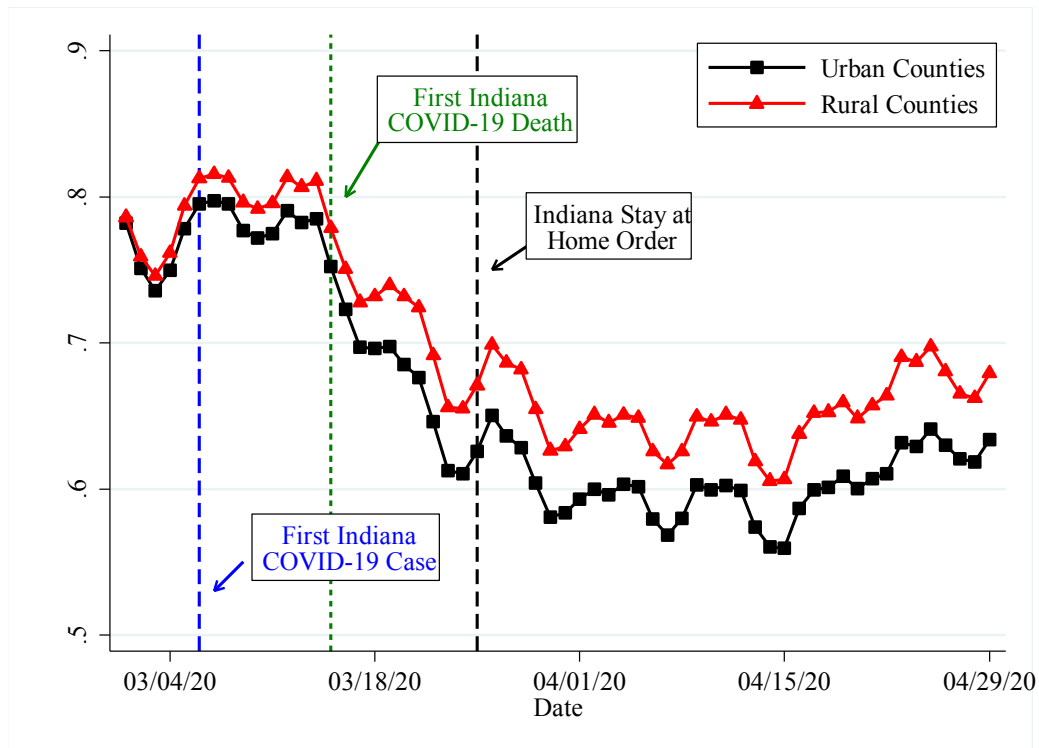


Figure 4 is constructed in the same manner as Figure 3, but now compares the social distancing behavior of Delaware County (home of Muncie, Indiana and Ball State University) compared to the rest of the State of Indiana. Perhaps not surprisingly, Delaware County’s pattern of social distancing follows closely that of Muncie, Indiana, since it is the county seat and largest city in this county of roughly 110,000 people. What may be more surprising, however, is that the rest of the state of Indiana follows almost exactly the same pattern as Delaware County, while also being nearly identical in terms of the level of home-leaving behavior at nearly all points in time. Most noticeably, in terms of changes in social distancing, the percent leaving home dropped dramatically following the first confirmed COVID-19 death in Indiana. It seems that this event induced caution in a substantial number of Hoosiers.

Figure 5. Fraction of people leaving their homes: rural vs. urban in Indiana



In Figure 5, which is constructed similarly to Figures 3 and 4, we examine whether there are any differences over time between urban and rural counties in Indiana. Note, however, that Figure 5 displays only three vertical lines corresponding to (1) the first documented COVID-19 case in Indiana, (2) the first documented COVID-19 death in Indiana, and (3) the State of Indiana’s Stay at Home order (i.e., the date that Ball State University switched to online classes is now omitted since this figure displays state-level behavior only). Again, we see that both urban and rural counties in Indiana follow the same pattern where the percent leaving home dropped dramatically following the first confirmed COVID-19 death in the state. That said, perhaps understandably given their county’s higher population density, those living in urban counties are less likely to leave home (i.e., engage in greater social distancing behavior) over nearly the entire two-month time span, though the difference is never more than about five percentage points.

Figure 6. Daily number of visits to three types of stores in Indiana

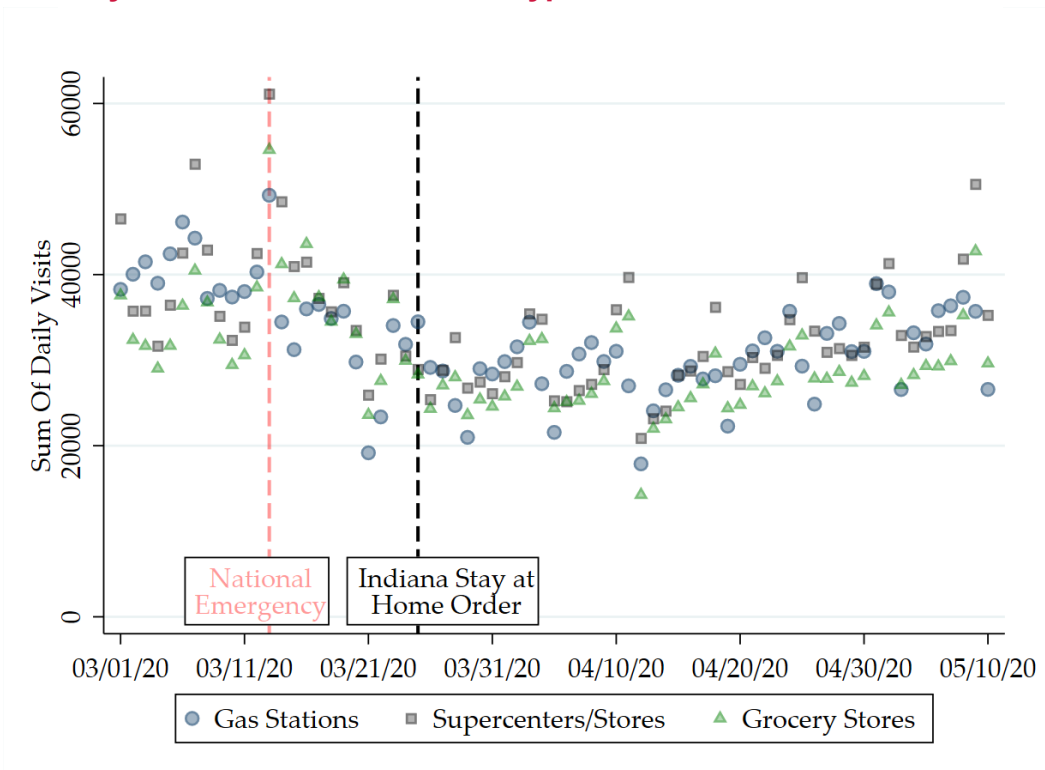
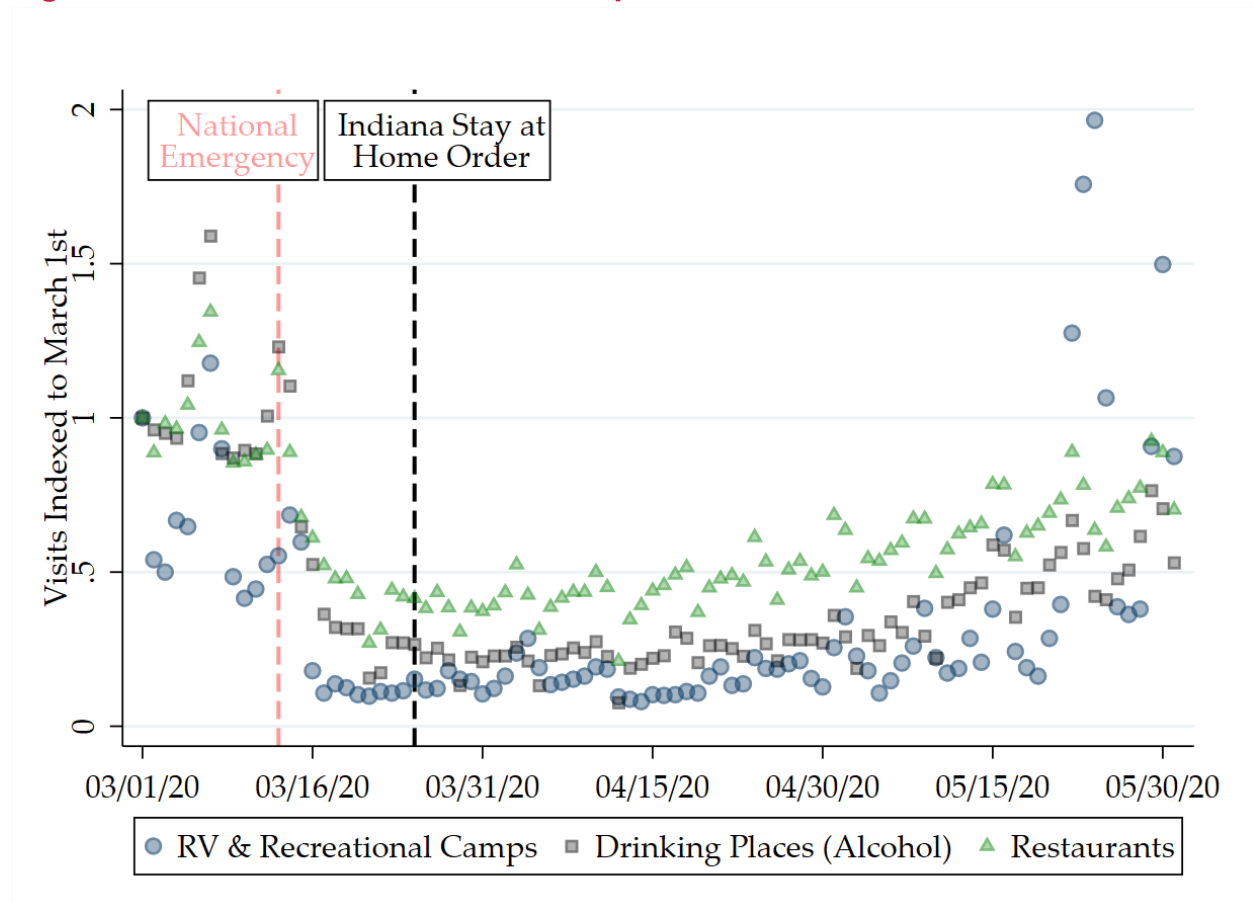


Figure 6 shows the daily number of visits to three types of stores in Indiana by people with cellphones that can be tracked in the manner outlined in the Data section. These three types of stores are: Gas Stations, Supercenters and Grocery Stores. While Figure 6 is somewhat busy visually, the number of visits to grocery stores and supercenters seems to decline consistent with the increase in social distancing (i.e., the drop in the fraction leaving home) seen in Figures 3-5. We note that there are several media accounts of hoarding behavior with respect to food and non-durable household goods, and so one might have expected an increase in such visits. However, online shopping does not require one to leave home and we note that our data do not cover those who do not own and/or actively use cellphones. Perhaps surprisingly, there was less of a drop in the number of visits to gas stations, but we note that many individuals use gas stations with convenience stores attached to purchase items beyond gasoline, including groceries and prepared foods. Perhaps there was also incentive to visit gas stations due to the precipitous drop in oil prices which led to large drops in the retail price of gasoline during this period. While datapoints exhibit weekly seasonality, one of the biggest jumps in shopping behavior occurred on March 13th, the date that President Trump declared the COVID-19 pandemic a national emergency. More devices were located at supercenters and grocery stores on March 13th than any other day in the two months of data presented. This suggests that people were flocking to supercenters and grocery stores to stockpile supplies as the COVID-19 pandemic was spreading.

Figure 7. Visits to different recreational places



The final figure, Figure 7, shows a longer run view of visits to different recreational venues. Daily visits are indexed to the number of visits on March 1st by taking visits on a given date and dividing by the number of visits on March 1st. We note that March 1st is a Sunday and that visits to restaurants, bars, and RV/camps vary by day of week. In addition, the number of devices captured by SafeGraph data exhibit a u-shaped pattern so it is more appropriate to compare the relative trends of the three recreational activities illustrated. Visits to all three recreational venues decreased in early March, before Indiana's stay at home order. Following the declaration of a national emergency, visits to drinking places and camps decreased more than visits to restaurants. We note that we cannot determine whether an individual went inside a venue or ordered takeout. While visits to restaurants were quicker to recover than visits to other venues, the visits to all three kinds of venues remained at a lower and relatively stable level compared with before March 13th. Visits to the three recreational venues have been steadily increasing since Indiana's Stay-at-Home order expired (May 1st). Visits to RV and recreational camps exhibit a remarkable increase on May 22nd, the date that Governor Eric Holcomb announced Stage 3 of the reopening plan and allowing campgrounds to open. It appears that activity at campgrounds has been one of the quickest to surpass baseline visitation.

Conclusions

This brief report examined the evolution of COVID-19 cases and deaths in Indiana during March and April 2020. Then, we described plausible social distancing behavior, using cellphone tracking data from SafeGraph Corporation. This analysis revealed that individuals in Indiana almost uniformly increased their social distancing behavior, as we measure it, at or around the time of the first confirmed COVID-19 death in the state. It is our hope that this brief report adds to the understanding of what happened, how Hoosiers responded so that more effective government policies might be devised to deal with the current pandemic situation, and a possible second wave of COVID-19 as the economy reopens.

References

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We are grateful to SafeGraph for providing Social Distancing Metrics and Weekly Patterns data.

“SafeGraph, a data company that aggregates anonymized location data from numerous applications in order to provide insights about physical places. To enhance privacy, SafeGraph excludes census block group information if fewer than five devices visited an establishment in a month from a given census block group.”