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Closure of Anchor Businesses Reduced COVID-19 Transmission During the Early Months of the Pandemic

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Objectives: To investigate the relationship between the closure of "anchor businesses" – manufacturing plants and distribution centers employing >1000 workers – and the daily, county-level COVID-19 rate between March 1, 2020 and May 31, 2020. **Methods:** We conducted a comparative, interrupted time series analysis of publicly available county-level data. Our main variable of interest was closure, indicating whether one or more of the anchor businesses within the county experienced a full or partial closure of at least 22 days (main analysis) or at least 1 day (sensitivity analyses). **Results:** Closure of an anchor business was associated with 142 fewer positive COVID-19 tests per 100,000 population over a 40-day period. Even short-term and partial closures were associated with reduced spread. **Conclusions:** Temporary closure of anchor businesses appears to have slowed, but not completely contained, the spread of COVID-19.

Keywords: business closure, community health, COVID-19, manufacturing, wholesale trade, worker well-being

Learning Objectives

- Define the concept of anchor businesses and their potential importance to the health of small- to medium-sized communities.
- Discuss the methods used in the study to assess anchor business closures and their impact on COVID-19 transmission during the early months of the pandemic.
- Summarize the findings on how anchor business closures affected community trends in positive COVID-19 tests.

Approximately 23% of all small and medium-sized communities (between 10,000 and 500,000 residents) have an anchor business, defined as a for-profit business, rooted in the community by reason of mission, invested capital, or relationships with customers or employees.[1,2] Manufacturing plants and distribution centers are the most common types of anchor businesses that employ more than 1000 workers in these communities.[1] In addition to being the largest employers in their communities, anchor businesses are potentially important community health partners.[2,3] Most offer health and wellness benefits for employees and their families, and through corporate philanthropy, support community-based programs focused on improving the social determinants of health.[4] There is ample evidence to suggest that anchor businesses benefit from healthy communities and vice versa.[5–7]

Beginning in March 2020, several high-profile news stories reported widespread transmission of the novel coronavirus, SARS-CoV-2 (the virus that causes coronavirus disease 2019 or COVID-19), among workers in food manufacturing facilities,[8,9] with substantial numbers of workers becoming ill. Indeed, most jobs at manufacturing plants and distribution centers require on-site work that cannot be performed remotely, and employees typically work in close proximity to one another for long durations (8–12 hours shifts).[10] Furthermore, some companies experienced a surge in demand for their products (eg, food and cleaning supplies), while others experienced a steep decline in demand (eg, automobiles). Those that experienced increased demand may have even increased the number of shifts. These facilities faced considerable operational challenges to meet the evolving COVID-19 safe distancing and face-mask wearing recommendations for employees.[11]

During the spring of 2020, many governors, county officials, and anchor business leaders had to make difficult decisions about whether to close large plants. These decisions involved weighing the economic well-being of workers and communities with the risk of spreading the COVID-19 virus. However, these decisions were made with little information about how the closure of the plants may affect COVID-19 spread among the community. This paper reports on the relationship between the closures of anchor businesses in the southern region of the United States and reported positive tests for COVID-19 cases between March 1, 2020 and May 31, 2020. This effort is intended to provide baseline information on how anchor businesses reacted in the early months of the COVID-19 pandemic, and whether their ongoing operation or closure was associated with the spread of COVID-19 in the communities they anchor.

METHODS

Data Sources

This study was a comparative, interrupted time series analysis of county-level data in the southern region (15 states) of the United States between March 1, 2020 and May 31, 2020. On March 1, 2020, there were only 62 confirmed COVID-19 cases in the United States; by May 31, every southern state had begun relaxing mobility restrictions (eg, "stay-at-home" orders). As our interest was in small- and medium-sized communities with an anchor

business, we included only counties with fewer than 500,000 residents and located in a CBSA with fewer than 1,000,000 residents identified through the U.S. Census Bureau. We further limited our analysis to counties in the southern region of the United States, as prior work has shown that there are more anchor businesses in the South than elsewhere in the country.[1] In addition, there was also considerable variation in state-level public policies related to the COVID-19 pandemic across the states in this region.

We used publicly available data from multiple sources. First, we obtained daily county-level COVID-19 cases from USA Facts, which collates the data directly from state and local health agencies.[12] Second, we identified manufacturing plants and distribution centers (North American Industry Classification System codes with prefixes 31–33, 42, 44–45) that employed at least 1000 workers at a site ("anchor businesses") in the 15 southern states using Data Axle's (formerly Reference USA's) Business Database, which is updated annually by telephone verification.[13] Third, dates of anchor businesses' closures and re-openings were collected by searching the internet for local news reports or notices on company websites, and/or by directly calling the plants. These data were gathered twice—in April and June 2020—recognizing that some facilities closed multiple times during the study period. We recorded the days in which each business halted production during the 3 months ("full closure") and the days in which the business experienced a significant reduction in production, for example, eliminating shifts or reducing operations to 50% capacity ("partial closure"). Fourth, we obtained effective dates for the state and county-level "stay-at-home orders" from the Rustandy Center for Social Sector Innovation at the University of Chicago.[14] Fifth, we gathered county-level data from the Robert Wood Johnson Foundation's County Health Rankings and Roadmaps on the percent of each county's population ages 18 or younger and 65 or older.[15] Sixth, we used the Distressed Communities Index (DCI) for each county from the Economic Innovation Group.[16] The DCI combines seven equally weighted metrics (percent adults without a high school diploma, percent habitable housing that is unoccupied, percent adults not working, percent living below poverty, median income as percent of its state's median income, percent change in the number of jobs, and percent change in the number of business establishments), intended to capture distinct aspects of well-being and socio-demographic characteristics at the county level. Finally, we obtained county population and CBSA data for 2019 from the U.S. Census Bureau. The study was deemed exempt by Northwestern University's Institutional Review Board.

Variables and Analysis

All analyses were performed at the county level and limited to counties with an anchor business. Our main variable of interest was Anchor Closure, a variable indicating whether one or more of the anchor businesses within the county experienced a full or partial closure. For counties that had a single anchor business, Anchor Closure was equal to 1 if the business was closed or partially closed for at least 1 day during the study time period; 0 if it remained open. For counties that had more than one anchor business, Anchor Closure was a weighted average calculated by dividing the number of employees at the closed (or partially closed) anchor business(es) by the total number of anchor business employees in the county. Counties that did not experience a closure of an anchor business were considered "open," and were used as controls for the comparative interrupted time series analysis.

Our analysis investigates 20 days before the start of the Anchor Closure and 40 days after, consistent with other studies evaluating the effect of interventions to reduce the daily number of positive COVID-19 tests.[17] For the control counties (those that experienced no closure), we assigned a quasi-intervention date when the anchor businesses theoretically could have been closed. Specifically, we used the average Anchor Closure dates within the

same state as the quasi-intervention date. For example, there were three Anchor Closures in Alabama on March 18 (Etowah County), March 20 (Clarke County), and March 23 (Madison County), so the quasi-intervention date for control counties in Alabama was the average of these three dates: March 20.

Our outcome of interest was the daily incidence of positive COVID-19 tests per 100,000 population. We used an interrupted time-series analysis to compare the change in the incidence of positive COVID-19 tests during the 40 days after the start of the Anchor Closure (or quasi-intervention date) using negative binomial regression.[18] We included control variables for the percentage of the population 65 and older, the percentage of the population below age 18, and the DCI. The model also included state-level time-varying effects for state stay-at-home orders. We used Bayesian Information Criterion to identify the final parsimonious model (See Supplemental Digital Content Section I, http://links.lww.com/JOM/A976).

Sensitivity Analyses

The main analysis compared counties with an anchor business closure or partial closure to those without closure and assumes that closure will have an immediate effect on the spread of COVID-19 within the county. However, previous studies have reported a delayed effect of interventions.[19] In Sensitivity Analysis One, we examined the effect of closure beginning at day 7 and at day 14. We also posit that the effect of short-term closures may be different from long-term closures. Therefore, in Sensitivity Analysis Two, we compared counties with a long-term closure (22 days or longer) with those that remained open. We also compared counties with a short-term closure (1–21 days) with those that remained open. Finally, in Sensitivity Analysis Three, we examined the effect of full and partial closures, comparing each to counties that remained open.

RESULTS

Characteristics of Counties

We identified 110 counties that had a total of 153 anchor businesses. Forty-five counties experienced an anchor closure (Table 1, Fig. 1). County-level daily incidence of positive COVID-19 tests ranged from 0 to 214 per 100,000 population on March 31, 2020; from 0 to 59 per 100,000 population on April 30, 2020; and from 0 to 46 per 100,000 population on May 31, 2020.

TABLE 1. Characteristics of Counties Included in the Analysis

	Counties in the Southern Region with an Anchor Business ($N=110$)
Number of anchor businesses	
Number with one anchor business	83
Number with two anchor businesses	16
Number with more than two anchor businesses	11
Closure duration	
Number with no closure	65
Number with a short-term closure (1–21 days)	17
Number with a long-term closure (22 or more days)	28
Closure type	
Full closure only	27
Partial closure	8
Full and partial closure*	10

Author's analysis of data collected on the closure of anchor businesses.
*Some companies shut down completely (full closure) then went to half capacity (partial closure) before reopening at full capacity.
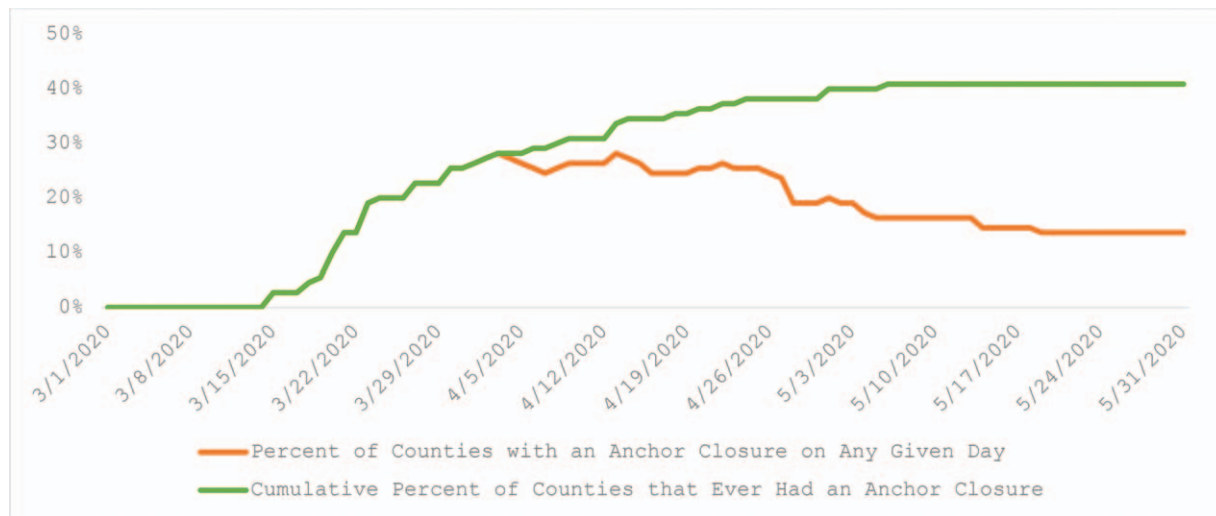
FIGURE 1. Percent of counties with an anchor closure, March 1, 2020 to May 31, 2020.

Effects of Anchor Closure on the Spread of COVID-19

Anchor Closure was associated with a significant decrease in the increasing incidence trend of positive COVID-19 tests. The adjusted daily incidence after Anchor Closure was 0.93 ($P < 0.001$) times lower than in the absence of closure (See Supplemental Digital Content Section II, http://links.lww.com/JOM/A976). After 40 days of closure, the daily incidence of positive COVID-19 tests was 1.0 per 100,000 population in counties with an Anchor Closure (Fig. 2). In the absence of closure, the incidence was predicted to be 17 per 100,000 population. For a county with a population of 100,000 people, this translates to 142 fewer positive COVID-19 tests over a 40-day period associated with Anchor Closure.

The percentage of the population under age 18 was associated with a significant increase in the increasing trend of positive

COVID-19 tests; state stay-at-home orders were associated with a significant decrease in trend. All other control variables were insignificant.

Results from the sensitivity analyses were consistent with our main analysis. There was essentially no difference in results from examining the impact of closure at day 1 versus day 7 or day 14. There was also very little difference between long- and short-term closures and between full and partial closures (See Supplemental Digital Content Section III, http://links.lww.com/JOM/A976).

DISCUSSION

Our findings suggest that the closure of large anchor businesses is another tool that policymakers have at their disposal to address high COVID-19 rates. More importantly, we demonstrate that even short-term closures (1–21 days) and partial closures may
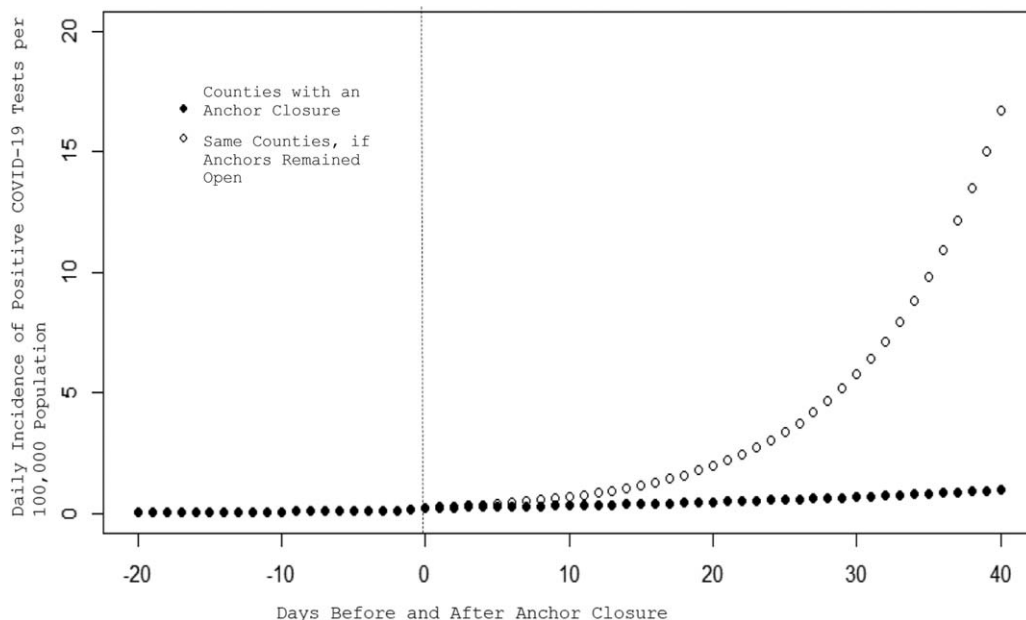

FIGURE 2. Daily incidence of positive COVID-19 tests per 100,000 population, by anchor closure day.

be beneficial. Indeed, the effect sizes were similar between short- and long-term closures and full and partial closures. The reduction in the growth of confirmed COVID-19 cases associated with plant closures reported here is similar to findings of other interventions (eg, social distancing orders and mandated face masks) in that closure blunted the increasing trend in the daily incidence of positive COVID-19 tests per 100,000 population, but did not stop it.[17,20]

Our study was the first to report on the link between the closure of large businesses and the spread of COVID-19 within a county. In doing so, our study also makes a unique contribution by reporting on the frequency and lengths of closures among large businesses. News reports have primarily focused on the closure of restaurants, small businesses, and large businesses where outbreaks occurred, such as meat processing facilities. Among the 51 anchor businesses in our sample that experienced a closure (153 anchor businesses in total), the vast majority of closures were temporary, lasting between 1 and 78 days. Some of the anchor businesses that closed reportedly did so to undertake a "deep clean" of the facility.[21,22] Our results suggest that the closure itself may have been as beneficial—and possibly even more beneficial—than the cleaning.[23]

We found that the population under age 18 was associated with a significant increase in the increasing trend of positive COVID-19 tests. Positive tests are twice as prevalent among working-aged adults (ages 18–64), many of whom have children.[24] Additionally, although children were not as heavily tested as older people in the early months of the pandemic, research suggests that children and young adults played an elevated role in disease spread, increasing the risk to more vulnerable older persons and those with comorbid conditions, who are more likely to be symptomatic.[25]

Public Health Implications

The focus on anchor businesses in this study is important since our prior research has shown that residents of communities with anchor businesses tend to have higher rates of obesity and diabetes,[1] which are associated with an increased risk of severe illness from COVID-19. One advantage of closing anchor businesses to slow the spread of COVID-19 is that it is relatively straightforward to enforce, unlike individual behaviors such as mask-wearing, social distancing, and restrictions on indoor gatherings. Nevertheless, state and county policymakers overwhelmingly exempted manufacturing and other large facilities from closure orders, likely due to the immediate sizable costs in terms of lost revenue for businesses and lost wages for employees. Closure of schools was a much more prevalent policy strategy for policymakers. Cost estimates for school closures are also very high—trillions of dollars in lost future earnings—but those costs will be borne far into the future.[26]

Although the closure of anchor businesses may slow the spread of the virus, it will not completely contain it. Therefore, the closure of anchor businesses must be adopted in combination with other strategies that have been shown to slow the spread of the virus, such as those described above. It is also important to note that not all counties have an anchor business; out of 1194 small- and medium-sized counties we investigated from the southern region of the United States, only 110 had a manufacturing or distribution center anchor business employing 1000 or more workers. Additionally, some anchor businesses produce medication, medical supplies, or food, and would be considered essential under almost any definition. Therefore, the closure of an anchor business is a policy option available in a relatively limited number of U.S. counties.

Limitations

There were several limitations to our analysis. First, our study was limited to manufacturing plants and distribution centers, businesses that employ 1000 or more people, the early months of the pandemic, and the southern region of the united States. Expanding our sample may have yielded different results. Second, our model does not include other factors that may have influenced the spread of the virus, for example, local restrictions on social distancing and the propensity of residents to wear masks. Third, we used positive COVID-19 tests per 100,000 population as our outcome measure, rather than the positivity rate (the number of positive tests divided by the total number of tests administered), because our interest was in disease spread at the county level, and testing intensity varied considerably during the study period. An alternative outcome measure may have yielded different results. Fourth, Data Axle's Business Database is imperfect in terms of completeness. We explored the Dun and Bradstreet database as an alternative and discovered similar errors. To mitigate against any errors, we conducted our own search of anchor businesses within the 110 counties included in the analysis, using primarily information from local Chambers of Commerce. In a small number of cases (less than five) we made adjustments to the list of anchor businesses included in the analysis. Finally, we identified one error in the reporting of one county's COVID-19 cases. The county reported negative two cases on a particular day; we used zero instead.

CONCLUSION

Temporary closure of anchor businesses is a strategy that governors, county officials, and business leaders could consider to slow the spread of COVID-19. Importantly, even short-term (1–21 days) and partial closures were associated with declines in the spread of the virus. Closure of anchor businesses must be adopted in combination with other strategies that have been shown to slow the spread of the virus (eg, social distancing measures), as closure will slow, but not completely contain, the spread of COVID-19.

ACKNOWLEDGMENTS

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