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Mass incarceration and COVID-19: Assessing the relationship between the economy of incarceration in Georgia counties and cumulative COVID-19 incidence from March 1st to December 31st, 2020

By

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Master of Public Health

Global Epidemiology

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Dr. Anne Spaulding
Committee Chair

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By

Katelin Reishus

B.S., B.A., Tulane University, 2016

Thesis Committee Chair: Dr. Anne Spaulding, MD

An abstract of
A thesis submitted to the Faculty of the
Rollins School of Public Health of Emory University
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Abstract

Mass incarceration and COVID-19: Assessing the relationship between the economy of incarceration in Georgia counties and cumulative COVID-19 incidence from March 1st to December 31st, 2020

By Katelin Reishus

Abstract: The purpose of this study is to determine if a county's level of incarceration is associated with overall COVID-19 incidence. The aim of this project is to explore this relationship by modeling the cumulative county incidence of COVID-19 and the presence of large correctional facilities or the percent of the population that is incarcerated in that county. Negative binomial regression was used to assess the relationship between COVID-19 incidence in each of the 159 Georgia counties between March 1st and December 31st, 2020 and the number of large correctional facilities or the percent of the county population incarcerated in large correctional facilities. Several covariates are included in this analysis including urbanicity, number of long-term care facilities located in the county, obesity, race, ethnicity, lack of health insurance, unemployment rates, and education. Ten models were run to assess this relationship and none of the models yielded a statistically significant relationship. Despite the lack of evidence in this study, more research is needed to better understand the impact of the carceral complex on the surrounding community during the COVID-19 pandemic.

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Introduction

The Marshall Project estimates that one in every five state and federal prisoners in the U.S. have already tested positive for COVID-19, which is four times the rate in the general population.[1] Another study published in JAMA estimated that the rate of COVID-19 infection among incarcerated individuals in Massachusetts was 3 times the state's general population and 5 times the overall rate in the U.S.[2] By the end of 2020, the state of Georgia reported over 600,000 confirmed cases of COVID-19 and almost 11,000 deaths.[3] According to the Georgia Department of Corrections (GDC) Dashboard, almost 800 of those cases occurred in GDC facilities alone.[4] This does not account for the confirmed cases in the youth detention centers, ICE facilities, and jails present in 139 out of the 159 Georgia counties. Although the high burden of this disease in this vulnerable population is evident, the relationship between overall incidence and mortality rates due to COVID-19 and incidence mortality rates in correctional facility industry complexes lacks vigorous analysis. Despite numerous studies stating the interconnectedness of correctional facilities and their surrounding communities, there is no systematic analysis of the magnitude of the effect a pandemic like COVID-19 has on the Georgia community as a whole. Because of the decentralized nature of correctional facilities in Georgia, it is crucial to highlight the importance of resource allocation and appropriate prevention strategies in this congregate setting and show local and state-level public health authorities that having incarceration as an industry in a jurisdiction may lead to higher community rates of COVID-19 infection and mortality.

Background on the correctional industry in the U.S.

The U.S. incarcerates a higher proportion of its population than any other country in the world, incarcerating almost 25% of the entire global incarcerated population, with over 2 million people currently incarcerated in prison facilities alone.[5] This phenomenon is referred to as "mass incarceration" or hyperincarceration and has disproportionately affected African Americans, Latinos, and indigenous people since its manifestation.[6] Drucker describes the exponential growth of this "epidemic" in his book *A Plague of Prisons*, highlighting an unprecedented rate of incarceration that experienced exponential growth between the mid-1970s until the early 2000s. Although this period of growth slowed at the start of the new millennia, the corrections industry still shows consistent yearly growth in facilities across the country. The effects of this magnitude of incarceration not only influences those directly involved in the corrections but also their communities where this negative impact adds to the "persistent social and economic problems already prevalent in the lives of the poorest, most marginal populations".[7]

In the most recent survey by the Bureau of Justice Statistics (BJS) in 2018, over 6.4 million people were incarcerated in prison, detained in jails, or on probation or parole. To put these numbers in context, this means 1 in every 40 U.S. adult residents were under correctional supervision. In the state of Georgia, the total correctional population at the end of 2018 included 495,200 unique individuals and a rate of 6,140 adults supervised per 100,000 U.S. adult residents. These statistics do not account for persons ever incarcerated within carceral institutions and does not include recidivism.[8] In another BJS report outlining the racial and

ethnic composition of within the carceral system, the survey found that of Americans ever incarcerated between 1974 and 2001, 38.6% were Black even though the most recent U.S. Census indicates that only around 13% of the whole population identifies as Black.[9] In fact, estimates from the Family History of Incarceration survey calculate that 63% of Blacks have had an immediate family members incarcerated and 25% of Black children have had a parent incarcerated by the time they turn 14.[10] Educational status and its intersectionality with race also plays a factor in carceral trends. A study by Pettit and Western showed that among black men born between 1965 and 1969, 30% of those without a college education and almost 60% of those that did not complete high school went to prison by 1999.[11] The negative health consequences of incarceration are well documented and contemporary research focuses on the community-level interaction between incarceration and adverse health consequences to describe the economic, epidemiological, and societal impact of mass incarceration on community health.

Economic impact of the prison industrial complex

The prison industrial complex (PIC) is defined by the organization Critical Resistance as "the overlapping interests of government and industry that use surveillance, policing, and imprisonment as solutions to economic, social and political problems" and has history of targeting marginalized communities including immigrants, youth, people of color, and people of low socioeconomic status.[12] Since 1971 and the Nixon administration's "War on Drugs", the prison industry has exploded with majority of this exponential growth occurring in rural areas

and embodying the definition of mass incarceration. Because of this phenomenon, the PICs have become “one of the three leading economic enterprises as states and localities seek industries which provide large scale and quick opportunities”.[13] This also created an environment where localities participate in bidding wars for state-run prisons and states compete with each other for federal prison site placement, citing the economics benefits of hosting a large correctional industry within their respective jurisdictions. Despite the economic benefits touted by politicians and economic professionals, there are several factors to consider when these communities develop PICs as a major local industry. According to Huling, these “economic panaceas” do not significantly stimulate the local job market, instead giving the majority of the high-paying jobs in state-run facilities to carceral professionals with more experience than the rural residents while private prisons suffer from high rates of job turnover. Prisons that contract residents for off-site work projects also tend to displace local workers who would normally fill low-wage jobs, further contributing to community poverty, and can discourage other industries from developing in the community.[13] This had led states to cluster prisons in designated rural areas, where prisons “dominate the community’s economic, social, political and cultural landscape”.[13]

In addition to these indirect impacts on the local economy, carceral systems also demand increased government spending because of the increasing costs to house individuals. Second to Medicaid, state correctional spending has increased by 300% since 1980.[14] Part of this cost is attributable to the use of private for-profit correctional care industries, which accounted for 40% of all correctional healthcare in 2005. In Georgia, the state department of corrections

partners with Augusta University's Division of Correctional Healthcare to provide "comprehensive medical services statewide". The prison currently partners with a state medical school but plans on switching to an entirely privatized healthcare model by July 2021. The goal of this switch to privatized healthcare by contracting with the McKinsey consulting firm is to lower the $3,600 average cost of healthcare spent on each incarcerated person per year and improve the poor, delayed healthcare system currently in place. However, critics of this transition argue that this switch will not only drive healthcare costs up but also employ a consulting firm with a history of deficient healthcare practices.[15]

Outside of the correctional facilities themselves, these rural communities are also plagued by overall poor health outcomes and a lack of access to healthcare services. After controlling for demographic characteristics known to affect health, Parsons states that "counties with higher incarceration rates have 3 percent higher mortality rates compared with communities with low incarceration rates".[16] The prison industrial complex involves the residents of the correctional facilities themselves and the employees and officials that work in close proximity with the facilities. According to the Marshall Project, there have been over 100,000 cases of coronavirus among prison staff as of February 16, 2021. This includes 1,607 cases in Georgia with at least 4 deaths among those cases.[17] Coupled with increased risk of exposure to COVID-19 while working in these complexes, employees are also met with substandard healthcare resources in their communities which further contributes to disease burden in the overall community. By failing to effectively control disease spread within the correctional complex, correctional facility

staff members quickly contribute to community spread by regularly interacting with both incarcerated individuals and members of the general population.

Vulnerability of the population

During a workshop on the effects of incarceration and reentry on community health and well-being, Parsons stated that the criminal justice system "directly and indirectly affects the health of individuals and communities, increasing rates of illness while simultaneously undermining the supports that contribute to community health and well-being".[16] Disease burden among this population is dramatically higher than those who are not incarcerated, a condition that is exacerbated by the COVID-19 pandemic. Chronic diseases like asthma and hypertension, infectious diseases like hepatitis and HIV, and mental health illnesses can be magnitudes more prevalent in correctional facilities compared to their surrounding communities. Studies conducted in 2002 reported that the prevalence of tuberculosis was 17 times greater in jails and 4 times greater in prisons compared to the general population. Some estimates show that 40% of all incarcerated persons have at least one chronic health condition. Macmadu and Rich explain in their editorial "Correctional Health is Community Health" that "the health status of prisoners is regarded as something insular, something of no concern to, and uniquely disjointed from, the general population".[14] However, the majority of incarcerated persons are released back into their communities, along with this high disease burden. The coronavirus pandemic inherently causes an increased burden of COVID-19 disease in correctional facilities whose population already exhibits higher rates of pre-existing comorbidities. For example, a retrospective study with a small sample size (N=20) compared COVID-19 outcomes for

community-based patients and residents from a prison in West Texas and found that the average number of comorbidities in the residents was 2.4 compared to 1.8 found in community-based patients. Although the case-fatality rate was 60% in both groups, the detained persons had a longer average length of stay in the intensive care unit, 12.6 days compared to 8.6 days for the community-based patients.[18] "The combination of a captive population exposed to a highly infectious disease and substandard care has the potential to increase the incidence of infection and case-fatality rates among detained individuals, put the public at greater risk, and consume substantial medical and financial resources".[19]

Transmission and correctional complexes

Guidance issued by the CDC outlines suggestions on how to manage the spread of coronavirus in correctional and detention centers. This includes quarantining close contacts of confirmed cases, isolating confirmed cases from other residents, practicing good hygiene like hand washing and wearing face masks, social distancing, and encouraging staff members to stay home when sick. Other recommendations for operational procedures include limiting transfer of detained persons between facilities, suspending work release programs, minimizing the financial burden on detainees who seek medical care, and facilitate easy symptom reporting for detainees.[20] A second document contains a detailed explanation for testing practices in these facilities and recommends that "facility-wide testing be considered if a single IDP [incarcerated or detained person] or staff member in the facility tests positive for SARS-CoV-2".[21] In an observational study on an outbreak of COVID-19 in the Cook County Jail in Illinois, one of the

largest jails in the U.S., researchers found that aggressive non-pharmaceutical interventions, such as sanitation and social distancing, coupled with widespread diagnostic testing for detained persons and staff members can lead to significantly lower transmission both within the correctional complex and in the surrounding community. Researchers also found that 23.6% of exposed, asymptomatic detainees were found positive, underscoring the need for vigorous population-wide testing.[22] Due to resource constraints and reporting inconsistencies, this crucial component of preventing large scale outbreaks within correctional facilities has not been widely implemented across jurisdictions in Georgia. Even when testing is available, correctional facilities prioritize symptomatic patients despite the fact that up to 50% of infected people are asymptomatic.

Preliminary research on the effect of mass incarceration and the uncontrolled spread of COVID-19 within the surrounding community demonstrates the potential for increased morbidity and mortality in the general population. In a model developed by Lofgren et al., researchers found that within 30 days of a community's first infection, 2886 infections will occur among incarcerated people and will result in 8 in-custody deaths. When extrapolated to the surrounding community, this model also predicts an increase in 922 cases and 301 deaths in the general population. Ultimately, these researchers suggested that disease prevention strategies need to be improved within jails to protect those associated with the jail system and the community at large.[23] Another analysis by Hooks published in the Prison Policy Initiative used logistic and Poisson regressions to elucidate the relationship between mass incarceration, COVID-19, and community spread. The main conclusions found that caseloads increased faster

in nonmetro counties and BEA economic areas with higher rates of incarceration and added thousands of cases to the overall national caseload at both the state and BEA area levels when controlling for race, average life expectancy, percentage uninsured, and diabetes prevalence.[24]

Conclusion

More robust analysis is needed to determine the association between mass incarceration in the prison industrial complex and community COVID-19 incidence in Georgia. Preventing the spread of SARS-COV-2 in these correctional complexes is hindered by crowded living spaces, lack of social distancing, inadequate testing procedures, insufficient personal and facility-wide hygienic practices, and failure to decarcerate the large populations in these facilities. The economic, political, and clinical failures of this system compounded by the pandemic underscores the urgent need to protect this vulnerable population and the surrounding communities. Because of the decentralized nature of correctional facilities in Georgia, it is important to highlight the importance of resource allocation and appropriate prevention strategies for this congregate setting. This project aims to show local and state-level public health authorities that having incarceration as an industry in a jurisdiction may lead to higher rates of COVID-19 infection and mortality.

Methods

Data Description and Sources

The data used in this analysis consists of case-level data on COVID-19 cases associated with correctional facilities collected by the Georgia Department of Public Health and publicly available data with population statistics. This study was granted an expedited approval with a complete HIPAA waiver by the Emory University Institutional Review Board. Text Box 1 in the supplement section of this paper provides information about the data sources, variable names, and variable descriptions.

This analysis includes all facilities under the authority of the Georgia Department of Corrections, including state prisons, private prisons, probation detention centers, integrated treatment facilities, transitional centers, and county correctional institutes. The analysis does not include residential substance abuse treatment facilities since information about the population size in these facilities is not available or is included in the host facility population. Three federal prisons under the Bureau of Prisons and four Immigration and Customs Enforcement detention centers are also included. Only jails with average daily populations of 500 detainees or more in November or December of 2020 are also included under the assumption that smaller jails do not significantly contribute to the carceral complex industry.

To assess whether incarceration is considered an industry in a jurisdiction, the number of these large correctional facilities, described above, is calculated for each county. Counties with 0 correctional facilities is used as the reference population and are considered to have a minimal carceral industry, such as a small local jail. The first exposure variable in the model, *prison1*, compares counties with 1 correctional facility to the reference population. The second exposure variable in the model, *prison2*, compares counties with 2 or more correctional facilities to the reference population. The counties with 2 or more correctional facilities are considered to have a large carceral complex industry.

A second method to assess whether incarceration is considered an industry in a jurisdiction used the percent of the total county incarcerated in the facilities described above. Counties with 2.0% or less of their total population incarcerated is used as the reference population and are considered to have a minimal carceral industry. The first exposure variable in this model, *prison3*, compares counties with more than 2.0% but less than 10.0% of their population incarcerated in these correctional facilities to the reference population. The second exposure variable in the model, *prison4*, compares counties with 10.0% of more of their population incarcerated within these correctional facilities to the reference population. The counties with 10.0% or more of their total population incarcerated are considered to have a large carceral complex industry.

The outcome variable for these models is the number of confirmed cases of COVID-19 reported in each county. As described in Text Box 1, this case count uses data reported on the Georgia Department of Public Health's public COVID-19 dashboard and includes cases that were confirmed by either PCR or antigen tests. Graph 1, also located in the supplementary section, shows the distribution of these cases across all Georgia counties in order of ascending percentage of each county's incarcerated population and color coded according to the number of facilities located in each county as defined in the methods.

Negative binomial regression

Initial analysis used a Poisson regression model, which did not appropriately fit the data due to overdispersion where the variance of the outcome data was much larger than the mean. Negative binomial regression was used to correct the overdispersion and yield more appropriate deviance values. This model adds an additional parameter that accounts for overdispersion and allows for more accurate measures of association between the exposure and outcome variables. The following covariates were selected to assess effect modification. Negative binomial regression requires categorized variables in order to fit the model and these covariates were categorized according to the cut-points listed in Text Box 2, located in the supplement section of this paper. For all of these models, the two-level exposure is represented by *prison1* and *prison2* and the outcome is the cumulative number of confirmed cases of COVID-19 in each county between March 1st, 2020 and December 31st, 2020.

Once the data was appropriately categorized, these negative binomial regression models were used to assess the relationship between mass incarceration and county COVID-19 incidence and determine if there was effect modification by one of the other covariates. This association was assessed using *proc genmod* in SAS under negative binomial regression and offset by the county population size.

Model 1a: Assessing the relationship between mass incarceration and county COVID-19 incidence using rural versus urban areas as an effect modifier

$$\ln[\lambda_{i,j,k}] = \alpha + \beta_1 PRISON1 + \beta_2 PRISON2 + \gamma_1 RURAL + \delta_1 PRISON1 * RURAL + \delta_2 PRISON2 * RURAL$$
$$where\ i = 0,1$$
$$j = 0,1$$
$$k = 0,1$$

Model 2a: Assessing the relationship between mass incarceration and county COVID-19 incidence using the number of nursing home facilities as an effect modifier

$$ln[\lambda_{i,j,k}] = \alpha + \beta_1 PRISON1 + \beta_2 PRISON2 + \gamma_1 Cat\_ltcf + \delta_1 PRISON1 * Cat\_ltcf + \delta_2 PRISON2 * Cat\_ltcf$$
$$where\ i = 0,1$$
$$j = 0,1$$
$$k = 0,1$$

Model 3: Assessing the relationship between mass incarceration and county COVID-19 incidence using obesity prevalence as an effect modifier

$$ln[\lambda_{i,j,k}] = \alpha + \beta_1 PRISON1 + \beta_2 PRISON2 + \gamma_1 Cat\_obese + \delta_1 PRISON1 * Cat\_obese + \delta_2 PRISON2 * Cat\_obese$$
$$where\ i = 0,1$$
$$j = 0,1$$
$$k = 0,1$$

Model 4: Assessing the relationship between mass incarceration and county COVID-19 incidence using race (percentage black/African American) as an effect modifier

$$ln[\lambda_{i,j,k}] = \alpha + \beta_1 PRISON1 + \beta_2 PRISON2 + \gamma_1 Cat\_race + \delta_1 PRISON1 * Cat\_race + \delta_2 PRISON2 * Cat\_race$$

$$where\ i = 0,1$$
$$j = 0,1$$
$$k = 0,1$$

Model 5: Assessing the relationship between mass incarceration and county COVID-19 incidence using ethnicity (percentage Hispanic) as an effect modifier

$$ln[\lambda_{i,j,k}] = \alpha + \beta_1 PRISON1 + \beta_2 PRISON2 + \gamma_1 Cat\_hisp + \delta_1 PRISON1 * Cat\_hisp + \delta_2 PRISON2 * Cat\_hisp$$
$$where\ i = 0,1$$
$$j = 0,1$$
$$k = 0,1$$

Model 6: Assessing the relationship between mass incarceration and county COVID-19 incidence using the percentage of the population that does not have health insurance as an effect modifier

$$ln[\lambda_{i,j,k}] = \alpha + \beta_1 PRISON1 + \beta_2 PRISON2 + \gamma_1 Cat\_unins + \delta_1 PRISON1 * Cat\_unins + \delta_2 PRISON2 * Cat\_unins$$
$$where\ i = 0,1$$
$$j = 0,1$$
$$k = 0,1$$

Model 7: Assessing the relationship between mass incarceration and county COVID-19 incidence using the percentage of the population that is unemployed as an effect modifier

$$ln[\lambda_{i,j,k}] = \alpha + \beta_1 PRISON1 + \beta_2 PRISON2 + \gamma_1 Cat\_unemp + \delta_1 PRISON1 * Cat\_unemp + \delta_2 PRISON2 * Cat\_unemp$$
$$where\ i = 0,1$$
$$j = 0,1$$
$$k = 0,1$$

Model 8: Assessing the relationship between mass incarceration and county COVID-19 incidence using high school education rates as an effect modifier

$$ln[\lambda_{i,j,k}] = \alpha + \beta_1 PRISON1 + \beta_2 PRISON2 + \gamma_1 Cat\_educ + \delta_1 PRISON1 * Cat\_educ + \delta_2 PRISON2 * Cat\_educ$$
$$where\ i = 0,1$$
$$j = 0,1$$
$$k = 0,1$$

Model 1b: Assessing the relationship between mass incarceration and county COVID-19 incidence using rural versus urban areas as an effect modifier

$$\ln[\lambda_{i,j,k}] = \alpha + \beta_1 PRISON3 + \beta_2 PRISON4 + \gamma_1 RURAL + \delta_1 PRISON3 * RURAL + \delta_2 PRISON4 * RURAL$$
$$where\ i = 0,1$$
$$j = 0,1$$
$$k = 0,1$$

Model 2b: Assessing the relationship between mass incarceration and county COVID-19 incidence using the number of nursing home facilities as an effect modifier

$$ln[\lambda_{i,j,k}] = \alpha + \beta_1 PRISON3 + \beta_2 PRISON4 + \gamma_1 Cat\_ltcf + \delta_1 PRISON3 * Cat\_ltcf + \delta_2 PRISON4 * Cat\_ltcf$$
$$where\ i = 0,1$$
$$j = 0,1$$
$$k = 0,1$$

Results

Table 1 outlines the characteristics of the sample population by county and distribution of the covariates included in the analysis.

Table 1. Characteristics of Study Population

Characteristic	0 correctional institutions (n=88)	1 correctional institution (n=51)	2 or more correctional institutions (n=20)
Urban setting under USDA definition (n)	42	20	12
Number of Long-term care facilities (n)			
0-1	57	26	3
>1	31	25	17
Average % obesity (SD)	34.45 (6.52)	35.16 (4.69)	32.62 (5.52)
Average % black (SD)	24.96 (17.64)	31.30 (16.06)	38.10 (16.78)
Average % Hispanic (SD)	6.58 (5.77)	6.66 (5.32)	9.69 (6.85)
Average % uninsured (SD)	13.30 (2.35)	12.10 (2.06)	13.08 (2.02)
Average % unemployment (SD)	1.87 (0.25)	1.84 (0.30)	1.94 (0.23)
Average % high school graduation (SD)	88.50 (5.32)*	88.07 (4.56)	84.45 (6.28)

*n=86 due to 2 missing values

After assessing the eight effect modifiers outlined in the equations above, none showed a significant difference in the relationship between the number of correctional facilities in a county and the overall COVID-19 case count. This means there is no evidence of interaction between rural or urban settings, the number of nursing homes, the percentage of the adult population that is obese, the percentage of the county's black population, the percentage of the county's Hispanic population, the percentage of the county that is uninsured, the percentage of unemployment, or high school graduation rates and the exposure or outcome variables. Both effect modifiers were also insignificant when performing the analysis using the percentage of the population incarcerated in the county as the exposure.

After dropping the interaction terms, the final reduced model used to assess the relationship between the number of large correctional facilities in a county and cumulative county COVID-19 cases is:

$$ln\left[\lambda_{i,j,k}\right] = \alpha + \beta_1 PRISON1 + \beta_2 PRISON2$$
$$where\ i = 0,1$$
$$j = 0,1$$
$$k = 0,1$$

The parameter estimates for β_1 and β_2 are not significant, meaning there is not evidence of an association between the number of correctional facilities and the cumulative COVID-19 cases in a county in Georgia between March 1st, 2020 and December 31st, 2020.

Table 2. Parameter estimates and significance for reduced model using the number of correctional facilities as an indicator of a larger carceral complex			
Parameter	**Estimate**	**Wald 95% CI**	**p-value**
β_1	-0.0104	(-0.1385, 0.1177)	0.8731
β_2	-0.0098	(-0.1897, 0.1702)	0.9153

After dropping the interaction terms, the final reduced model used to assess the relationship between the percentage of the population incarcerated in a county and cumulative county COVID-19 cases is:

$$ln[\lambda_{i,j,k}] = \alpha + \beta_1 PRISON3 + \beta_2 PRISON4$$
$$where\ i = 0,1$$
$$j = 0,1$$
$$k = 0,1$$

The parameter estimates for β_1 and β_2 are not significant, meaning there is not evidence of an association between the percentage of the population incarcerated in a county and the cumulative COVID-19 cases in a county in Georgia between March 1st, 2020 and December 31st, 2020.

Table 3. Parameter estimates and significance for reduced model using the percentage of the population incarcerated as an indicator of a larger carceral complex			
Parameter	**Estimate**	**Wald 95% CI**	**p-value**
β_1	0.0909	(-0.0802, 0.2762)	0.2811
β_2	0.1165	(-0.2138, 0.2429)	0.9005

Discussion

This study showed no significant relationship between incarceration as an economic enterprise and COVID-19 prevalence by county in Georgia between March 1st, 2020 and December 31st, 2020. Despite the null findings in this analysis, there is clear evidence that incarceration plays an instrumental role in COVID-19 transmission not only within correctional facilities but also in the surrounding community. A recent article published in the New York Times found that within U.S. prisons, the rate of COVID-19 infection is 34 in every 100 incarcerated persons, more than three times higher than the global infection rate.[25] High incarceration rates, especially in rural settings where carceral complexes play a key role in the local economy, directly impact community health and the interconnectedness of these industries and their communities is an important link in the transmission pathway of infectious diseases like COVID-19. Public health agencies should coordinate with correctional facilities to increase testing, provide public health resources to direct testing procedures, and allocate clinical supplies to correctional healthcare providers. This would not only address disease burden inequities in this population but also improve the statewide health due to the interconnectedness of these facilities and their surrounding communities. Health disparities in communities with large carceral complexes are often located in rural areas with high rates of poverty, low education levels, and with low rates of health insurance coverage. Coupled with an incarcerated population that already experiences disproportionate disease burden and substandard healthcare for correctional

employees, equitable disease mitigation efforts are needed to protect the health of the entire community.

The lack of association in study is likely due to several limitations in this analysis. This analysis used a very small study population size, consisting of only 159 counties. Future analyses should incorporate larger geographic areas and use a larger sample size. In addition, the number of prisons per county and the percentage of the population incarcerated might not be an appropriate assessment for the economic influence of carceral complexes and fail to describe the relationship between the carceral industry and the outcome of interest. BEA economic areas that do not restrict the analysis to populations that reside in the county and include interactions between counties, such as staff commuting between counties, might be a more appropriate method to assess the intersection between economy and geography. Future analyses should assess this association using BEAs as a unit of analysis and can be implemented with a larger study population. In addition, the complex relationship between COVID-19 incidence, the carceral industry, and the effect modifiers selected in this analysis are difficult to assess using modeling techniques. Further research is needed to better understand the dual relationships between demographic factors, such as race and socioeconomic status indicators, and COVID-19 incidence in communities with a large correctional complex.

Finally, inaccurate case reporting and a severe underestimation of the true number of confirmed cases within correctional facilities might bias these results towards the null. Despite the CDC's recommendation to frequently test the correctional facility population, it is likely that

most of these facilities have not adopted routine testing practices. This leads to an underestimation of the true number of cases, also known as ascertainment bias, within the facilities themselves. In small counties with high percentages of incarcerated populations, underreporting cases affects the overall county COVID-19 incidence and minimizes the association between counties with larger carceral complexes and overall COVID-19 rates. One indicator of the lack of robust testing is the high mortality rate among incarcerated persons compared to staff members, calculated from the cases reported on the public Georgia Department of Corrections dashboard, which might be due to an inflated numerator, or the number of deaths, over a small denominator, or the number of cases.[4] Additionally, an article published by the Atlanta Journal-Constitution decried the lack of testing in correctional facilities and interviewed a former employee at one of the state prisons who was fired for attempting to conduct testing in an area of the prison that was experiencing a large outbreak. The number of infections in states with comparable prison populations that implemented mass testing procedures, such as Tennessee, is also a strong indicator of the lack of robust testing procedures within Georgia correctional facilities.[26]

Conclusion

There is a growing amount of evidence pointing to the alarmingly high rates of COVID-19 in carceral settings and their surrounding communities. State departments of public health should coordinate with correctional facility complexes to increase testing availability, provide public health resources to improve the health their incarcerated population, and allocate clinical supplies to correctional healthcare providers. This would not only address the disease burden

inequities within the correctional population but also alleviate statewide disease burden due to the interconnectedness of these complexes with their surrounding communities.

Supplement

Text Box 1. Data sources and descriptions

Data Source	Variable name	Description
Georgia Department of Public Health (GDPH) COVID-19 case data	staff_cases, staff_deaths, inmate_cases, in mate_deaths	Counts of the number of confirmed/probable staff and inmate cases and confirmed deaths* March 1st - December 31st, 2020
Georgia Department of Public Health public COVID-19 data[3]	county_cases, county_deaths	Counts of the number of confirmed/probable total county cases and confirmed deaths* March 1st - December 31st, 2020
Georgia Department of Corrections (GDC)[4]	tot_incarcerated	Count of the total number of incarcerated persons in GDC facilities as of the December 2020 report (except probation detention centers and integrated treatment facilities).
Prison Policy Initiative[27]	tot_incarcerated	Count of the number of incarcerated persons housed in probation detention centers and integrated treatment facilities in 2020.
Bureau of Prisons (BOP)[28]	tot_incarcerated	Count of the total number of incarcerated persons in federal BOP facilities.
Georgia Department of Community Affairs (GDCA)[29]	tot_incarcerated	Count of average daily population by county jail in December 2020**
U.S. Census county Population estimates as of 7/1/2019[30]	tot_pop, tot_male, tot_female, adult_tot, adult_male, adult_female, white_male, white_female, black_male, black_female, hispanic_male, hispanic_female	Counts of population demographics in each county. This includes total population, total adult population by gender, population by racial identity (White or Black) and population by ethnic identity (hispanic).
2020 Small Area Health Insurance	no_unins, no_unemp,	Counts of the number of uninsured

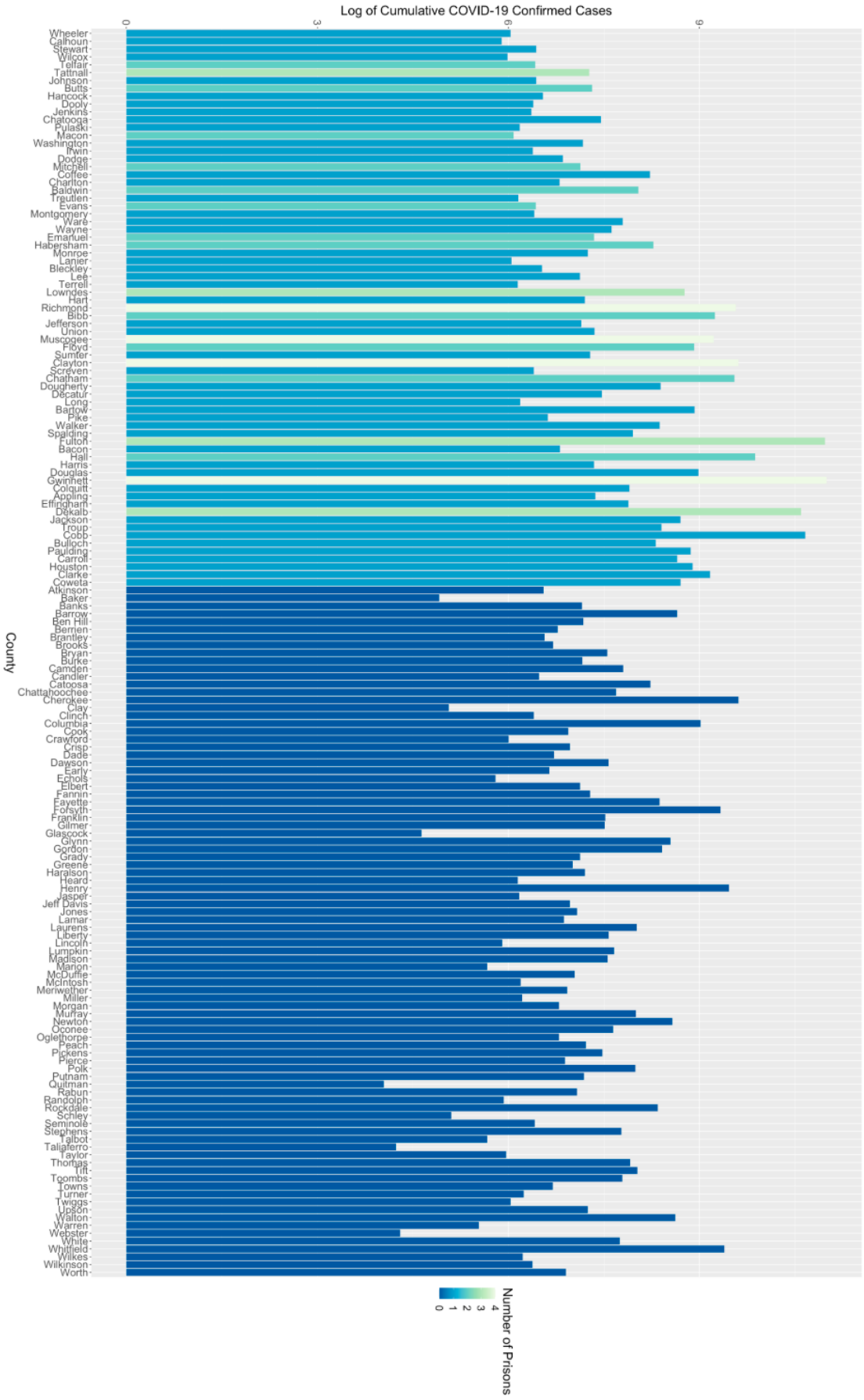
Estimates (SAHIE) using the American Community Survey (ACS)[31]	highschool_rate, some_college, pct_adult_obesity	and unemployed by county. High school graduation and some college rates by county. Percentage of the adult population that is considered obese by county.
The Centers for Medicare and Medicaid Services (CMS)[32]	no_ltcf	Counts of the total number of nursing homes in each county.
USDA Economic Research Service 2013 Rural-Urban Continuum Codes[33]	rural_urban	1, 0 coding on counties that are classified as metro or nonmetro counties.

*Confirmed cases are defined as individuals who test positive for COVID-19 with a PCR test that are reported to the state notifiable disease system. Probable cases are individuals that test positive for COVID-19 with an antigen test and are reported to the state notifiable disease system. Confirmed deaths include confirmed COVID-19 cases that were reported to the state department of public health by healthcare providers or medical examiners, identified by death certificates with COVID-19 listed as the cause of death, or if public health professionals found evidence that COVID-19 contributed to the cause of death.
**The November report from the GDCA was used to acquire the average daily population for Fulton and Dekalb County Jails because of missing or inaccurate information for these facilities in the December report.
***Includes active nursing homes, including rehab services, certified by CMS

Text Box 2. Covariate Selection and Cut-point determination

Variable name	Variable description	Cut-point
Prison1	0 = no correctional facility	N/A
	1 = 1 correctional facility	
Prison2	0 = no correctional facility	N/A
	1 = 2 or more correctional facilities	
RURAL	0 = rural	N/A
	1 = urban	
Cat_ltcf	0 = 1 or less LTCFs within county	N/A
	1 = 2 ore more LTCFS within county	
Cat_obese	0 = less than cut-point	34.45%*
	1= greater than or equal to cut-point	
Cat_race	0 = less than cut-point	28.65%*
	1= greater than or equal to cut-point	
Cat_hisp	0 = less than cut-point	7.00%*
	1= greater than or equal to cut-point	
Cat_unins	0 = less than cut-point	12.88%*
	1= greater than or equal to cut-point	
Cat_unemp	0 = less than cut-point	1.87%*
	1= greater than or equal to cut-point	
Cat_educ	0 = greater than or equal to cut-point	87.85%*
	1 = less than cut-point	

*These cut-points were determined by calculating the mean value of the variable across the entire study sample and splitting into two groups around that cut-point



Graph 1. The natural log of cumulative COVID-19 cases in Georgia by county in order of ascending percent of the population incarcerated

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What's Next

Mass incarceration and its use as an economic driver, especially in rural communities, has created a plethora of health inequities that impacts the people residing in correctional facilities and the adjacent community. These health inequities are worsened by inherent racial disparities in the carceral system, a lack of healthcare resources for incarcerated persons and staff members who work at these facilities, and government policies that support this industry. The COVID-19 pandemic has exacerbated the poor health status of the people impacted by the carceral complex and prompted calls for more equitable distribution of healthcare services to this vulnerable population, decarceration especially in large facilities, and a demand for government intervention.

From a public health perspective, three immediate actions should be taken in order to address this health crisis and protect the wellbeing of one of the most vulnerable populations during the COVID-19 pandemic. First, local and state public health agencies should work to establish and improve existing healthcare infrastructure for correctional complex populations. This means prioritizing physical and mental healthcare services for incarcerated persons despite their current status as an incarcerated person. Secondly, decarceration within these facilities would alleviate disease burden during the COVID-19 pandemic by increasing the ability to quarantine and isolate infected and exposed persons. Finally, public health efforts should focus not only on healthcare during incarceration but also ensure that formerly incarcerated individuals have access to adequate resources upon re-entry into their community. These three

actions are key to protecting the rights of incarcerated persons and ensuring the overall well-being of the communities located around large carceral complexes.