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The Deleterious Health Consequences of COVID in United States Prisons

Xiaohan Mei[1] · **Melissa A. Kowalski**[2] · **Leah Reddy**[3] · **Ciara McGlynn**[3] · **Mary K. Stohr**[3] · **Craig Hemmens**[3] · **Jiayu Li**[3]

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Abstract

By January 2024, the COVID-19 pandemic claimed more than 1.1 million deaths in the United States (U.S.). People in prison are particularly vulnerable to COVID-19 as they have no ability to socially distance, secure masks, disinfect their environment or have as much access to tests or vaccinations as is available in the community. In addition, many of these individuals reside in crowded conditions with little ventilation, which makes the spread of the virus more likely. In this paper, we used data from two projects, including the UCLA Law COVID Behind Bars Data Project and the COVID Prison Project, and supplemented these with publicly available data to examine the number of deaths and infection rates caused by COVID-19 among people in prison and prison staff in the U.S., as reported by the population of those facilities. We found that the incidence of infections and death rates in prisons were affected by crowding, prison security type (maximum, medium, minimum, or mixed) and level of prison (state or federal). People in prison who were less likely to have as much human contact (e.g., maximum-security prisons) were also less likely to be afflicted with COVID-19. People in prison were twice as likely to be infected by COVID-19 but had a similar death rate compared to the general public. Prison overcrowding increased the infection rate. The most effective state health policy was to quarantine people who had close contact with confirmed, positive cases. Further, state prisons demonstrated a higher death rate compared to federal prisons. Greater efforts to ameliorate COVID-19 and similar pathogens should be directed at state prisons with lower-level security and prisons with closer contact with the community. Quarantining close-contacts and restricting movements were the most effective state-level responses to reduce infections in prisons during April 2020 to April 2022.

Keywords COVID-19 · Prison · Overcrowding · Policy

Extended author information available on the last page of the article

Introduction

As of December 2020, 1,215,800 persons were incarcerated in state or federal prisons in the United States (U.S.) (Kluckow & Zeng, 2022, p. 2). In a Marshall Project review of the coronavirus disease (COVID-19) in prisons, researchers documented more than half a million cases of COVID-19 among prison staff and people in prison, as well as 3,000 deaths as of June 2021 (Park et al., 2021, p. 1–2). The pandemic's source is the Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2), which is a novel pathogen that causes the virus (Franco-Paredes et al., 2020). COVID-19 is believed to have originated in China in 2019 and has since spread to most countries, wreaking havoc worldwide and resulting in millions of deaths, including 1,169,666 in the U.S. alone as of January 2024 (Centers for Disease Control and Prevention [CDC], 2024).

Prisons have become an epicenter for COVID-19 spread, resulting in thousands of cases (Franco-Paredes et al., 2020; Klein & Turcotte, 2021; Park et al., 2021). People in prisons are particularly vulnerable to the virus (Akiyama et al., 2020; Burki, 2020; Nowotny et al., 2020) as they have no ability to socially distance, secure masks, or disinfect their environment and are dependent on staff for personal protective equipment (PPE) and for testing or vaccination (Franco-Paredes et al., 2020; Klein et al., 2021). Though the CDC promulgated guidelines to protect the health of people in prison and correctional staff during the height of the pandemic, it is not clear that state and federal prison managers adhered to them (CDC, 2021; Park et al., 2021).

In many prisons, there were not standardized means of ensuring that even those afflicted with COVID-19 were separately housed from those who did not have it (Herring & Sharma, 2021). Nor were people in prison always provided with masks, soap, and sanitizing disinfectant solutions necessary to prevent the spread of disease (Klein et al., 2021). Obviously, some availability of these items and practices has since changed as either the virus continued to spread (e.g., provision of PPE or soap and masks) or as COVID-19 cases decreased in prisons (e.g., visitation resumed or masks were no longer required). As a few examples, the Oklahoma Department of Corrections (DOC) (2020) provided persons in prison with free soap as a way to prevent the spread of the virus early on in the pandemic, the New York Department of Corrections and Community Supervision (n.d.) rescinded its masking requirement in September 2022 while mask restrictions were lifted for visitors, staff, and people in prison in March of 2022 in Colorado prisons (Colorado DOC, 2024). Further, the Louisiana DOC (2021) resumed in-person visitation in March of 2021, and the Arkansas DOC (2022) lifted modified in-person visitation restrictions for COVID-19 low- and medium-risk facilities in May of 2022. On a broader level, the CDC revised some of its masking guidelines in the beginning of 2022, suggesting that many people no longer needed to wear them indoors if they were at a lower risk for severe illness (Lovelace & Edwards, 2022).

More recently, the CDC (2023b) recommended the following steps as COVID-19 prevention guidelines specific to correctional facilities: staff and people in prison stay up-to-date on vaccinations, improve ventilation in facilities, test for COVID-19 when needed (e.g., upon exposure or when symptoms arise), possibly suspend medical co-pays for people in prison seeking tests or medical evaluations, wear masks or PPE when appropriate, promote facility control and infection cleaning, quarantine staff and residents who test positive, provide access to treatment, monitor and communicate potential outbreaks, create physical distance in congregate areas. In hindsight, these recommendations seem straightforward given what is presently known about the virus, but there was a lag between practices implemented in the community and those in prisons. For instance, people in prison were some of the last of U.S. adults eligible for testing in many states, even though many among them were in a more precarious position health-wise (e.g., elderly or with underlying health conditions; Burki, 2020; Nowotny et al. analysis of COVID-19 infection and death rates in prisons has been the difficulties researchers encounters in accessing individual-level prisoners' data and medical records. While a Bureau of Justice Statistics (BJS) report supplies basic information about the effect of COVID-19 on correctional populations (Carson et al., 2022), we attempt to address this research gap by employing data from multiple sources, comprising a national sample, and contend that state- and prison-level factors may impact COVID infection and death rates among people in prison.

Literature Review

Prior to the COVID-19 pandemic, it cannot be said that prisons were a healthy place. In fact, prisons are plagued by numerous maladies, and people in prison tend to have weaker immune systems as well as more chronic diseases when compared to the general population (Akiyama et al., 2020; Burki, 2020; Nowotny et al., 2020), and are more susceptible to infection (Kinner et al., 2020). This unhealthy situation, coupled with the growing number of elderly people in prison, set the stage for devastation when the pandemic hit. COVID-19, in concert with pre-existing health (Burki, 2020; Nowotny et al., 2020) and cleanliness issues (Akiyama et al., 2020) as well as overcrowding, intensified the spread. The following discussion details the effects of COVID-19 generally and within prisons in addition to other conditions that have contributed to disease spread within prisons.

Deleterious Outcomes of COVID-19

COVID-19 presents numerous health side effects, especially in correctional settings. The virus is a respiratory pathogen, and such diseases are not uncommon in the prison setting (Kinner et al., 2020). Viral infections that are highly transmissible, including COVID-19, mumps, and measles, spread quickly among correctional staff and people in prison. COVID-19 infection is unique compared to other disease outbreaks as it spreads extremely quickly and widely within groups without an appropriate intervention (Beaudry et al., 2020; Hummer, 2020). Unlike other infections, the community that was targeted by COVID-19 often lacked pre-existing immunity due to it being a novel virus. Even with immunity, the fast-evolving variants could render the protective efficacy of the immunity less effective over time (CDC, 2023d).

Additionally, attempts to control infections in prisons can be worsened by the prioritization of security needs over the provision of sufficient medical services (Amon, 2020; Wildeman & Wang, 2017). Due to prisons representing high-risk locations for COVID-19 and outbreaks, medical professionals and researchers have suggested that targeted preventive efforts be included in nationwide efforts to mitigate spread of the virus (Kinner et al., 2020; Marcum, 2020; Montoya-Barthelemy et al., 2020). This recommendation is notable as the illness can have a large impact on the community and is not restricted to inside the prison walls.

Beaudry et al. (2020) conducted a review of studies that have addressed infectious diseases in prisons to assess how prisons have managed these diseases in an attempt to inform public health responses to COVID-19. In their review, 12 studies identified possible community impacts of prisons during outbreaks of contagious diseases, including the effect of COVID-19 (Njuguan et al. 2020). In reaction to this reality, steps have been taken to address some of these outcomes. For instance, some jurisdictions incorporated correctional facilities into public health approaches to address the pandemic (Beaudry et al., 2020). Part of limiting the spread of COVID-19 in the community, and within prisons, necessitates a discussion of prison conditions that may contribute to infection and death rates.

Aggravating Factors in Prisons

Prisons are a setting in which any infectious disease can result in calamity as a result of living conditions in these facilities. Many factors, including people in prisons themselves, can contribute to a higher likelihood of a disease spreading. People in prison have more risk factors for infection, especially COVID-19 (Burki, 2020; Kinner et al., 2020; Nowotny et al., 2020) due to the ease of transmission detailed previously. Additionally, people in prison are unable to avoid close contact with each other or staff, they may live in unsanitary conditions, reside in insufficiently ventilated buildings, and may have inadequate access to essential healthcare resources (Dolan et al., 2016; Nowotny et al., 2020). All of these exacerbating factors, in addition to new COVID-19 variants that are even more infectious, means that people in prison are particularly vulnerable to the virus.

Furthermore, COVID-19 is an even greater concern in prisons than other communicable diseases because it is a respiratory pathogen that transmits easily in congregate settings (Akiyama et al., 2020). A lack of space (Dolan et al., 2016; Nowotny et al., 2020) further increases ease of contamination. Social distancing is a tactic that could slow the spread of COVID-19 in such spaces, but it is not necessarily achievable due to mass incarceration and prison overcrowding. A report from the BJS showed that prison population counts in 12 states and the Federal Bureau of Prisons (BOP) met or exceeded maximum rated operational and design capacities, and a further 25 states exceeded minimum capacities before the onset of COVID-19 (Carson, 2020). Therefore, social distancing was not always an option to plausibly reduce COVID-19 spread. Importantly, crowding, while common in some prisons, is less of an aggravating factor in others (Minton et al., 2021; Park et al., 2021).

Access to resources may also aggravate disease spread. While wearing masks and the frequent appropriate use of soap and sanitizer can help prevent the spread of the virus, these options may not be possible if people in prisons are required to pay for personal hygiene products. As a result, transmissibility is heightened in poorly ventilated and resourced facilities that are overcrowded (Dolan et al., 2016; Nowotny et al., 2020). Moreover, as a result of turnover and frequent movements between and within correctional facilities, transmission of the virus can occur rapidly (Rubin, 2020).

It is not only people in prison who are impacted. Correctional staff are also at risk of infection because they, too, operate in the same prison environment that is susceptible to all of these aggravating factors. According to Nowotny et al. (2020), the COVID-19 infection rate of correctional staff, which is similar to that of people in prison, exceeded the case rate of the general population. In fact, in almost 90% of jurisdictions studied, the initial case burden was higher among staff than people in prison (Ward et al., 2021). There is also some evidence that staff were among public service workers that, as a group, were the least likely to be vaccinated, thus exposing people in prison to the virus (Tyagi & Manson, 2021). Moreover, correctional staff are particularly susceptible because they travel and work between the prison environment and their communities (Nowotny et al., 2021). Further, their well-documented occupational risks, including malnutrition, lack of physical activity, sleep deprivation, depression, and anxiety may heighten their vulnerability to infection during disease outbreaks. In short, the prison environment can increase the spread of virus spread for both staff and people who are incarcerated. In the current study, we focus only on the latter.

Correctional Policy and COVID-19

Correctional policy is a relevant factor when considering the number of positive COVID-19 cases and deaths in a given correctional facility. States, counties, and facilities have responded differentially to the virus (CDC COVID-19 Response Team, 2020; Klein et al., 2021; Kowalski et al., 2022). Some of these differential responses are a result of variety in policies and implementation, prison size, crowding, and security level.

Policy Variations Across the U.S.

Due to the differential timing and impact of COVID-19 in states originally (CDC COVID-19 Response Team, 2020) and the subsequent discovery of variants, prevalence of COVID-19 cases and deaths may be expected to vary by state and by prisons within states. There has also been wide variation in restrictions put in place across state lines as well as differences in pandemic response and policy implementation (e.g., masking, quarantine, prison transfers, and early releases) across correctional facilities in the U.S. (Klein et al., 2021; Kowalski et al., 2022; Novisky et al., 2020).

One approach that was implemented in some states and at the federal level during the pandemic was the reduction of prison populations. As noted in a BJS Report, prison populations declined in 49 states from the end of 2019 to the end of 2020, "largely as a result of the COVID-19 pandemic" (Carson, 2022, p. 1). These reductions were achieved through a number of methods. Early releases for individuals at a low risk for recidivism and refraining from incarcerating those convicted of low-level offenses was one approach (Carson et al., 2022; Okano & Blower, 2020; United Nations Office on Drugs and Crime, 2020). In some jurisdictions, judges were advised to consider the impact of COVID-19 in prisons when making sentencing decisions (Davis, 2020). Other jurisdictions released people in prison who were close to their release date while others released people in prison who were less likely to recidivate (e.g., the elderly or pregnant) (Carson et al., 2022; Lines et al., 2020) or those who were high-risk in terms of their health status (Prison Policy Initiative, 2022). Despite different mitigation efforts, the BJS reports that 374,400 people in prison were infected with COVID-19 in state and federal prisons between March 2020 and February 2021 (Carson et al., 2022, p. 1). Further, the pandemic claimed 2,555 deaths among people in prison by April 2021 (Marquez et al., 2021).

Variations in Prison Crowding and Security Level

In an examination of COVID-19 responses in prison systems across the U.S., Klein et al. (2021) found that the prison population (capacity) was not associated with a prison system's COVID-19 response. Yet, Kowalski et al. (2022) discovered a positive association between jail capacity and a jail's pandemic response. Although jails operate differently than prisons, overcrowding is relevant to both jails and prisons. Kowalski et al.'s (2022) results are relevant to the current study, where we might expect that, because a facility's capacity is related to pandemic response, larger prisons may be better equipped to respond proactively to a pandemic, which in turn may affect the COVID-19 infection and death rate when accounting for overcrowding.

Security level can also have an immense impact (Crick et al., 2014), as people in lower security prisons tend to have more contact with the community through appearances in court, transfers, and work release. As a consequence, prisons can affect community transmission of diseases (Besney et al., 2017; Njuguna et al., 2020). Additionally, correctional facilities that have mixed security types (e.g., intake facilities) may also have higher levels of transmission from the community due to prison admissions of individuals recently detained (Zawitz et al., 2021). Further, community transmission to all security levels may result from visitors (Awofeso et al., 2001) and staff members (Crick et al., 2014; Leung et al., 2014).

Federal vs. State Prisons

There may also have been differences between state and federally run facilities in their mitigation efforts. BJS statisticians have calculated a crude mortality rate of

1.5 per 1000 incarcerated persons. The federal rate was lower at 1.2 as compared to the state rate at 1.6 (Carson et al., 2022, p. 20). Differences in pandemic response are notable as the BOP constitutes the largest single correctional system in the U.S. (Blakinger & Hamilton, 2020), though, collectively, the state systems are much larger.

As an example of one key difference across correctional systems, the BOP (as well as some individual facilities) instituted a system-wide lockdown near the beginning of the pandemic (Unlock the Box, 2020). Another key strategy the BOP attempted to implement to slow the spread of COVID-19 was to transition some people in prison to home confinement, particularly those at a greater risk of contracting the disease as well as those who presented a low risk to the public (Cassels, 2020), in addition to stopping transfers (Segura, 2020). The BOP also established protocols for staff and directed them to refrain from working if they came into contact with a person who was infected with the virus (Hummer, 2020). Although a number of critics have noted that some of these policies were implemented imperfectly or too late (e.g., see Balsamo & Sisak, 2020; Buble, 2020; Hummer, 2020; Hymes, 2020; Williams et al., 2020), there was action taken at the federal level to mitigate the spread of the virus. Clearly, several states also acted proactively to prevent the spread and prevalence of the virus, but as a group, their responses were not as effective as the federal government, as measured by death rates.

The Current Study

An examination of differences in infection and mortality rates across institutions is vital as the threat to public safety likely differed across prisons (Novisky et al., 2020). It is also important to better understand variation in infection and mortality rates in U.S. prisons as such experiences may affect perceptions of the healthcare system within a carceral setting (Novisky, 2018). Moreover, health conditions within prisons are associated with successful reentry (Link et al., 2019; Semenza & Link, 2019) and may affect the mental health of people in prison during a pandemic (Novisky et al., 2020). In other words, a better understanding of factors that contribute to differential rates of infection and mortality across prisons can facilitate an assessment of the long-term effects of the pandemic in relation to physical and mental health outcomes, reoffending, and possible constitutional rights lawsuits.

The deleterious health consequences of the COVID-19 pandemic call for more rigorous justice and health research to produce scientific evidence and inform challenging correctional policies and practices decisions (Miller & Blumstein, 2020). This study contributes to the literature as it presents a more recent update to infection and mortality rates, as well as COVID-19 policies, than other work that has assessed COVID-19 infections and policies within U.S. prisons (Klein et al., 2021; Novisky et al., 2020). Moreover, we are the first to provide a large national sample of prisons while also examining prison- and state-level predictors of infection and mortality rates. We hypothesize that prison crowding, net of certain control variables, will increase the infection and death rates in prisons across the U.S.

Methodology

The current study aims to investigate the impact of prison crowding on the COVID-19 infection and death rates of the incarcerated with a large national sample. Although research has been conducted to investigate similar research questions (Leibowitz et al., 2021), it is almost impossible to study these outcomes at the individual-level because jurisdictions have unique practices (e.g., policy implications) and operationalizations (e.g., "probable" or "actual" COVID-related death) when collecting COVID-19 data. Therefore, the most sensible method to investigate our research question about how and why COVID-19 varied in its prevalence in prisons is to conduct an analysis at the facility-level. It is also critical to note that, because the pandemic is dynamic, data regarding the number of positive cases and deaths resulting from COVID-19 can change on a daily basis. Therefore, our analysis represents a snapshot of the totality of the pandemic: April 12th, 2020 to April 22nd, 2022.

Data and Sample

In this study we explored whether overcrowding is related to COVID-19 infection and related deaths with secondary data derived from multiple sources. First, we obtained a prison-level primary independent variable (prison crowding) and an outcome variable (total number of COVID-19 infection and deaths by prison for people in prison) from The UCLA Law COVID Behind Bars Data Project (Dolovich et al., 2021). Second, we utilized state-level prison policy data from The COVID Prison Project Data (Brinkley-Rubinstein et al., 2022). Third, we gathered additional prison characteristics data, such as security level and sex of people in prison for each prison from each state's DOC public-facing website, BOP websites, and/or PREA audit reports. Fourth, we obtained state-level COVID-19 positive rates from the Johns Hopkins University & Medicine Coronavirus Resource Center (2022). Because the validity of these governmental data supersedes the validity of the data from The UCLA Law COVID Behind Bars Data Project, as a protocol, any disagreement among the data sources was overridden by the governmental data. We removed facilities that were jails, immigration detention centers, youth detention facilities, or administrative facilities (such as headquarters). Fifth, we collected data from The UCLA Law COVID Behind Bars Data Project on March 28, 2022, data from the COVID Prison Project on March 18, 2022, and data from the Johns Hopkins University & Medicine Coronavirus Resource Center (2022) on April 22, 2022.[1] We merged data based on the prison ID/name and their states and obtained a large national cross-sectional sample of 1,006 cases/prisons. The timespan of the sample covers data or governmental records from April 12, 2020, to April 22, 2022. Correctional facilities that did not report COVID-19 death and infection data were

[1] The timespan covered in this study ranges from the beginning of the pandemic, April 12th, 2020, to April 22nd, 2022, when the latest data were obtained at the time of this study. Since we used existing data, we were unable to report exactly how many months were covered in the analysis.

treated as missing and removed from the analyses via listwise deletion.[2] Sample descriptives are shown in Table 1.

Measurement

The outcomes of this study are the *COVID-19 infection rate* and *death rates*, measured at the facility-level. Infection rate is operationalized as a ratio between the total number of COVID-19 infections and total number of people in prison or prison beds at the beginning of the pandemic. The death rate is computed as a ratio between the total number of people in prison who died because of the virus and the total number of people in prison overall.[3] Both outcomes did not conform to a Poisson distribution; therefore, we treated them as continuous variables. The outcome variables are further log-transformed to remedy the skewed distributions (Finkelde & Dennison, 2020).

Our primary independent variable is the *crowding index at the facility level*. This variable is operationalized as the ratio between the current prison beds and designed capacity. A ratio of 1.00 indicates that the number of prison beds was equal to the number of designed or available beds. A ratio above 1.00 indicates the prison beds exceeded the designed capacity, and a ratio below 1.00 shows the prison beds were beneath the designed capacity. This is the only variable we group-centered because all of the remaining control variables have a meaningful "0" (Enders & Tofighi, 2007).

We introduced two sets of control variables at both the between- and within-level models. The three within-level (Level 1) control variables involve *sex of people at the facility*, *prison security level*, and *state or federal prison* (jurisdiction). Sex of people at the facility is a nominal level measure which designates whether a prison has male (2), female (1), or male and female residents (0). Prison security level is a nominal variable that separates prison securities into five levels, including maximum (4), medium (3), minimum (2), multiple security levels (1), or "other" (0). An example of "other" may include supervised treatment facilities. Prison jurisdiction is a dichotomous variable where state prisons are operationalized as 1 and federal prisons as 0.

There are eight between-level (Level 2) binary variables that measure states' *operational and masking policies*, where 1 represents having a policy in place whereas 0 indicates no such policy existed. *System-wide quarantine* measures whether the full facility goes on lockdown due to a COVID-19 diagnosis being present. *Mandatory quarantine for admits/transfer* indicates whether new intakes or transfers have a required quarantine period (e.g., 7 or 14 days) upon admittance while *Quarantine COVID+* measures if prison residents go into quarantine after a

[2] In our case, listwise deletion will produce unbiased estimates of the regression slopes. "If the Xs are complete and the missing values of Y are missing at random, then the incomplete cases contribute no information to the regression of Y on X_1, …, X_p (Little, 1992, p. 1227)."

[3] We used the total number of people in prison because the prison beds data is more reliable than the infection data.

Table 1 Sample Descriptive at the Prison Level ($N = 1{,}006$)

	Mean (S.D.) / Percent	Missing (%)
Dependent Variable		
Facility Infection Rate of the Residents	0.526 (0.460)	*19.682*
Facility Death Rate of the Residents	0.003 (0.006)	*30.915*
Independent Variable		
Overcrowding Index	1.024 (0.675)	*2.584*
Level 1 Control Variables		
Sex of people at a facility		0.000
Male	*83.698*	
Female	*9.543*	
Mixed	*6.759*	
Prison security level		0.000
Max	*10.537*	
Medium	*22.465*	
Minimum	*17.097*	
Multiple	*49.404*	
Other	*0.497*	
Prison jurisdiction		0.000
State	*90.258*	
Federal	*9.742*	
Level 2 Control Variables		
System-wide quarantine		0.000
No	*68.688*	
Yes	*31.312*	
Mandatory quarantine for admits/transfer		0.000
No	*48.509*	
Yes	*51.491*	
Quarantine COVID+		0.000
No	*32.406*	
Yes	*67.594*	
Quarantine COVID pending		0.000
No	*52.087*	
Yes	*47.913*	
Quarantine people contacted COVID+		0.000
No	*41.650*	
Yes	*58.350*	0.000
Residents wear masks		
No	*56.262*	
Yes	*43.738*	
Staff wear masks		0.000
No	*28.032*	
Yes	*71.968*	
State Positivity Rate	0.091(0.060)	0.000

Table 1 (continued)

	Mean (S.D.) / Percent	Missing (%)
Cluster Variable - State		
Alabama	*1.889*	*0.000*
Alaska	*0.994*	*0.000*
Arizona	*1.889*	*0.000*
Arkansas	*0.099*	*0.000*
California	*4.274*	*0.000*
Colorado	*2.087*	*0.000*
Connecticut	*1.193*	*0.000*
Delaware	*0.398*	*0.000*
Florida	*6.064*	*0.000*
Georgia	*6.561*	*0.000*
Hawaii	*0.596*	*0.000*
Idaho	*0.696*	*0.000*
Illinois	*3.181*	*0.000*
Indiana	*1.690*	*0.000*
Iowa	*0.795*	*0.000*
Kansas	*0.895*	*0.000*
Kentucky	*1.889*	*0.000*
Louisiana	*1.093*	*0.000*
Maine	*0.497*	*0.000*
Maryland	*1.491*	*0.000*
Massachusetts	*1.392*	*0.000*
Michigan	*2.883*	*0.000*
Minnesota	*1.193*	*0.000*
Mississippi	*2.386*	*0.000*
Missouri	*1.988*	*0.000*
Montana	*0.696*	*0.000*
Nebraska	*0.398*	*0.000*
Nevada	*0.696*	*0.000*
New Hampshire	*0.398*	*0.000*
New Jersey	*1.093*	*0.000*
New Mexico	*1.093*	*0.000*
New York	*5.268*	*0.000*
North Carolina	*5.467*	*0.000*
North Dakota	*0.398*	*0.000*
Ohio	*2.883*	*0.000*
Oklahoma	*2.087*	*0.000*
Oregon	*1.392*	*0.000*
Pennsylvania	*3.082*	*0.000*
Rhode Island	*0.497*	*0.000*
South Carolina	*2.485*	*0.000*
South Dakota	*0.596*	*0.000*

Table 1 (continued)

	Mean (S.D.) / Percent	Missing (%)
Tennessee	*1.590*	*0.000*
Texas	*10.537*	*0.000*
Utah	*0.199*	*0.000*
Vermont	*0.596*	*0.000*
Virginia	*3.380*	*0.000*
Washington	*1.193*	*0.000*
West Virginia	*1.690*	*0.000*
Wisconsin	*3.678*	*0.000*
Wyoming	*0.497*	*0.000*

*$p < .0$

positive test. *Quarantine COVID pending* indicates whether residents go into quarantine during a pending test, and *Quarantine people contacted COVID*+measures whether residents go into quarantine after coming into contact with someone who tested positive. *Residents wear masks* measures if states had policies that required people in prison to wear masks, and *Staff wear masks* indicates whether states had policies that required staff to wear masks (The COVID Prison Project, 2022). *The state positivity rate* measures states' positivity rate for the general population (Johns Hopkins Medical & University Coronavirus Resource Center, 2022).

Analytic Strategy

We conducted the following analyses within a multi-level modeling (HLM) framework, which is the preferred analysis for prison studies involving at least two levels of analysis (Gillespie, 2005), namely, micro-level (Level 1 - prison) and macro-level (Level 2 - state). When lower-level observations are nested within the higher level, HLM is more advantageous than a traditional regression model because the assumption of independent error terms is violated for the data with nested structure, and a traditional regression model may inflate the alpha level and produce a Type I error (Kreft & de Leeuw, 1998). In HLM, "the error variances are partitioned between the micro- and the macrolevels" (Gillespie, 2005, p. 235), which allows the model to produce adjusted and unbiased estimations.

Empirically, we follow the three-step procedure proposed by Sommet and Morselli (2017) when performing multi-level analyses. In step one, we examine whether the multilevel modeling analytical strategy is warranted. We conduct a null/empty model with no predictor – the unconditional mean or random intercept model to calculate the Intraclass Correlation Coefficient (ICC) (Hox, 2017; Snijders & Bosker, 2011) and the Design Effect (DEFF) (Kish, 1965; Muthén & Satorra, 1995). The ICC represents a clustering effect, ranging from 0 to 1, where 0 presents perfect independence of residuals, and 1 indicates perfect interdependence of residuals (Sommet & Morselli, 2017). The DEFF quantifies the extent to which the HLM differs from the model with perfect independence of residuals based on the mean cluster size (n) and ICC. Further, ICC values of 0.01, 0.05, and 0.20 are thresholds for the effect size while a DEFF value of 1.5 or larger suggests that the nested structure of the data should not be ignored. Both the ICC and DEFF are employed when determining whether HLM is warranted (Sommet & Morselli, 2017).

In step two, we conduct a constrained intermediate model (fixed-slope random-intercept) and an augmented intermediate (random-slope random-intercept) model. Methodologists disagree whether the augmented intermediate is needed when the augmented intermediate does not improve model fits (Sommet & Morselli, 2017). In this study, we report both model results but retain the better-fitting models. We also perform likelihood-ratio tests (LR χ^2) to determine whether the model fit is significantly improved from the constrained intermediate model to the augmented intermediate model. In step three, we test the cross-level interaction effects, and if no cross-level interaction is detected, we retain the augmented intermediate model to avoid over overparameterization, convergence, and statistical power issues (Bates et al., 2015). Following these three steps, we produce two sets of models predicting infection and death rates of people in prison.

Results

Infection and Death Rates of People in Prison

Because the national sample and data at the individual-level are not available, we infer the individual-level descriptive statistics based on the prison-level data. On average, 52.6% of the prison population was infected with COVID-19 at the prison-level. Hence, it is safe to conclude that prisoners' risk of infection is doubled, compared with the general public's infection rate of 24.0%. The total number of people in prison who died because of COVID-19 is 2,562 individuals in the dataset, which includes 22.9% missing data. Again, assuming the data are missing at random, we estimated the total number of people in prison who died because of COVID-19 to be 3,322 by the time of this study's endpoint. Therefore, we estimated the case-fatality rate as 0.57%, compared with the general public's case-fatality rate of 1.22%. Nevertheless, death rate per prison on average is comparable to the death rate (0.3%) of the general population.

Predicting Residents' Infection Rate

The analyses demonstrated a large clustering effect with an ICC value of 0.37 and a DEFF of 7.42. We found that there is significant variation in the COVID-19 infection rate, which can be explained at the state-level. Therefore, we conducted multi-level model analyses when testing our hypothesis that prison crowding is positively associated with the COVID-19 infection rate. Second, we retained the random-slope random-intercept (augmented intermediate) model as the final model. The augmented intermediate model demonstrated a significant improvement over the fixed-slope random-intercept (constrained intermediate) model with a -2 Log Likelihood

Table 2 Multilevel Model Predicting: (Logged) COVID Infection Rate of People in Prison ($n = 808$)

	Fixed-slope Random-intercept Model			Random-slope Random-intercept Model (Retained Model)		
	Coefficient	S.E.	Sig.	Coefficient	S.E.	Sig.
Intercept	0.126	0.031	0.000	0.133	0.029	**0.000***
Independent Variable						
Prison crowding index	0.006	0.004	0.182	**0.024**	0.010	**0.035***
Level 1 Control Variables						
Sex of people at a facility						
Male (reference group)				0.011		
Female	0.014	0.011	0.198	0.011	0.012	0.373
Mixed	0.034	0.014	0.012	**0.038**	0.015	**0.012***
Prison security level						
Max (reference group)						
Medium	0.019	0.011	0.087	0.016	0.013	0.231
Minimum	0.036	0.013	0.004	**0.036**	0.014	**0.015***
Multiple	0.029	0.012	0.014	**0.032**	0.014	**0.020***
Other	−0.016	0.052	0.759	0.002	0.055	0.968
Prison jurisdiction	−0.004	0.011	0.711	−0.001	0.016	0.952
Level 2 Control Variables						
System-wide quarantine	−0.002	0.026	0.928	0.024	0.023	0.303
Mandatory quarantine for admits/transfer	0.008	0.023	0.728	−0.018	0.021	0.395
Quarantine COVID+	0.044	0.027	0.106	0.038	0.025	0.146
Quarantine COVID pending	−0.013	0.023	0.577	0.016	0.020	0.447
Quarantine people contacted COVID+	−0.056	0.025	0.030	**−0.059**	0.025	**0.022***
Residents wear masks	0.063	0.022	0.008	0.024	0.021	0.259
Staff wear masks	−0.021	0.025	0.393	0.008	0.023	0.727
State positivity rate	0.193	0.166	0.252	0.073	0.149	0.630
Model Fit						
-2 Log Likelihood (-2LL)	-1567.245			-1614.518		
Degree of Freedom (df)	19			23		

(-2LL) of – 47.27 difference that is associated with a 4 degrees of freedom change ($p < .05$). Furthermore, we tested cross-level interactions, none of which were statistically significant. As such, we chose the augmented intermediate model as the final model because of its significant improvement over the constrained intermediate model.

As shown in Table 2, we found prison crowding, sex of people at the facility, security level and the state' quarantine policy are significant predictors of infection rates. First, prison crowding is a significant predictor of residents' COVID-19 infection rate ($p < .05$). For every one-unit increase in the overcrowding index, or every time prison beds exceed the designed capacity by 100%, the infection rate is increased by 2.4%. Moreover, mixed-sex prisons demonstrate an increased infection rate by 1.2% compared to male-only prisons ($p < .05$). Additionally, minimum-security prisons demonstrate an increased 3.8% infection rate compared to maximum-security prisons ($p < .05$). Prisons with multiple levels of security display a higher rate of infection than maximum-security prisons by 3.3% ($p < .05$). States requiring prisons to quarantine residents who had close contact with other individuals who contracted COVID-19 have an infection rate that is 6.1% less compared to states with no such policy ($p < .05$).

Predicting Residents' Death Rate

The null model for the death rate yielded an ICC value of 0.04 and a DEFF of 1.38. We conducted multilevel analyses because a non-zero, albeit small, ICC could still produce biased results when using traditional regression analyses (Huang, 2018). Second, as indicated in Table 3, the −2LL difference between the augmented intermediate and constrained intermediate models is -0.71, which is associated with 4 degrees of freedom change that is statistically non-significant. Also, no significant cross-level interaction term is detected. Therefore, we retain the constrained intermediate model as the final model. Given the results from the constrained intermediate and augmented intermediate models, any concern regarding which model is better is alleviated. As presented in Table 3, we found two significant predictors for death rate at the prison level, including the sex of people at the facility and whether the prison is a state or federal prison. First, mixed-sex prisons have higher death rates by 29.7% in comparison to male-only prisons ($p < .01$). Second, state prisons demonstrated a higher death rate by 16.5% compared to federal prisons ($p < .05$). Notably, this finding that federal prisons experienced proportionately fewer deaths than state prisons was validated in a BJS report on the effect of COVID-19 on prisons (e.g. see Carson et al., 2022, p. 20).

Discussion

We conducted a set of multilevel analyses to investigate whether COVID-19 infection or death rates in prisons were affected by prison overcrowding, prison type (security level), prison jurisdiction (state or federal), or state-level health-related mandates (e.g., quarantine) adopted to prevent spread of the virus. Crowding levels were predictive of a higher infection rate, indicating that CDC health protocols mandating the greater separation of persons in the free world (distancing) had some relevance for people in prisons (CDC, 2021). Perhaps in recognition of the validity of this recommendation, decarceration of prisons heightened during the pandemic, resulting in the release of about 200,000 people and a 17% decrease in prison populations from February 2020 to February 2021 (Carson et al., 2022, p. 3; Marshall Project, 2022).

The findings that mixed-sex, minimum- and multiple-security level prisons, with their greater population flux and movement of people, had an increased infection rate

Table 3 Multilevel Model Predicting: (Logged) COVID Death Rate of People in Prison ($n=453$)

	Fixed-slope Random-intercept Model (Retained Model)			Random-slope Random-intercept Model		
	Coefficient (95% CI)	S.E.	Sig.	Coefficient	S.E.	Sig.
Intercept	-2.687	0.096	**0.000*** **	-2.686	0.098	0.000
Independent Variable						
Overcrowding index	0.030	0.049	0.606	0.029	0.049	0.589
Level 1 Control Variables						
Sex of people at a facility						
Male (reference group)						
Female	−0.042	0.080	0.601	−0.034	0.080	0.667
Mixed	**0.260**	0.089	**0.004***	0.262	0.089	0.003
Prison security level						
Max (reference group)						
Medium	0.027	0.063	0.663	0.026	0.063	0.676
Minimum	0.093	0.081	0.248	0.087	0.081	0.283
Multiple	0.010	0.062	0.870	0.011	0.063	0.858
Other	−0.210	0.404	0.604	−0.253	0.403	0.530
Prison jurisdiction	**0.153**	0.059	**0.010***	0.152	0.060	0.012
Level 2 Control Variables						
System-wide quarantine	−0.057	0.067	0.407	−0.069	0.067	0.314
Mandatory quarantine for admits/transfer	0.034	0.055	0.537	0.035	0.056	0.533
Quarantine COVID+	0.014	0.066	0.836	0.009	0.067	0.897
Quarantine COVID pending	−0.015	0.049	0.763	−0.001	0.050	0.986
Quarantine people contacted COVID+	−0.048	0.059	0.423	−0.053	0.061	0.390
Residents wear masks	−0.098	0.055	0.086	−0.091	0.056	0.111
Staff wear masks	−0.017	0.058	0.768	−0.014	0.059	0.815
State positivity rate	0.307	0.402	0.451	0.254	0.408	0.536
Model Fit						
-2 Log Likelihood (-2LL)	422.022			421.315		
Degree of Freedom (df)	19			23		

*$p<.05$, *** $p<.001$

when compared to male and maximum-security prisons, respectively, also mimic and validate CDC and state-level business and travel limitations that imposed in the general community as a means of limiting the spread of COVID-19 (CDC, 2023c).[4] Mixed-sex, minimum- and mixed-security prisons are more likely to hold people who have greater contact with others, including other residents and individuals from

[4] Importantly, travel restrictions changed during the study timeframe. Most recently, CDC guidelines recommends people who are positive for the virus do not travel until they complete their isolation period.

the general community. This support for the veracity of COVID-19 health protocols is further reinforced by the finding that, when quarantine policies were implemented in prisons, the number of infections decreased. Relatedly, masking policies as a preventative policy in prisons were more likely to predict reduced numbers of deaths in prisons, as they had in the general community (CDC, 2021). Hence, failing to comply with CDC health guidelines has resulted in various Eighth Amendment lawsuits because of the alarming infection rates of people in prison (Berkowitz, 2021).

We also found that along with increased infection rates, mixed-sex prisons were more prone to increased death rates as a result of COVID-19. State prisons, with their myriad COVID-19 related health protocols varying by state, also had higher death rates than federal prisons whose policies and practices were more likely to be monolithic. This is also a finding validated by BJS research (Carson et al., 2022).

Data availability on COVID-19 indicates that the virus has the most detrimental effect on the health of the elderly, those with underlying health conditions (e.g., heart disease, obesity, diabetes, and anxiety), and those who are immuno-compromised (CDC, 2023a). These established vulnerabilities to COVID-19 and the concomitant health consequences are all pronounced in prisons, putting such individuals at a high risk of harm (Dumont et al., 2012). Therefore, it is not surprising that people in prison, much like the residents of care homes for the elderly, are more likely to suffer the negative health consequences of COVID-19 exposure. According to our analyses, about 52.6% of the residents per prison on average have contracted COVID-19, compared to the general population infection rate of 24%.[5]

Nevertheless, the death rate per prison on average is similar to the death rate of the general population, which is likely the result of multiple factors. First, the prison-level death counts are either underreported or not reported. According to our analyses, about 31% of prisons did not report the total number of COVID-19 deaths. Second, there is the complication of when the cause of death is reported, as correctional institutions are usually slow in reporting the cause of death. Third, the demographics of a given prison may have an impact. Some jurisdictions may have conducted compassionate releases for elderly residents, and COVID-19 deaths of formerly incarcerated, elderly persons might have been captured by the community data instead of the prison data. Next, it is possible that the death rate varies from unit to unit in prisons as some prisons have a separate living unit for the elderly and/or chronically sick individuals. Also, the operationalization of the case-fatality rates is affected by the diagnostic criteria of the disease. If a positive COVID-19 nucleic acid test is defined as a diagnosis, a large number of asymptomatic infections or mildly-ill patients will be included in the statistics. The denominator will increase, which will inevitably lead to a decrease in the calculated value of the case-fatality rate. Unfortunately, the diagnosis criteria might not be publicly available, and is therefore difficult for us to draw a firm conclusion. Finally, it is not possible to fully understand why the prisons' death rate is similar to the death rate in the community without access to vaccination data at the prison-level. Nevertheless, it is likely

[5] Calculated by dividing the total number of infections in the U.S. with the total number of the U.S. population by U.S. and World Population Clock (2022).

the interaction among the reasons described above produced an underreported death count per prison.

Conclusions

Our findings indicate that there are some steps prisons can take to mitigate these effects. Given the complex set of circumstances that render people in prison as a group more vulnerable to viral infections, it is perhaps incumbent on policymakers, state administrators, and wardens to take greater care to prevent exposure and the spread of COVID-19. Masking and distancing might be even more important for prisons than for the wider community. These responses are all now evidence-based practices that have served to reduce the spread of COVID-19 and infection rates (CDC, 2021). Providing up-to-date vaccinations to people in prison, if they elect to receive them, might also help with continued and repeated infections with the same virus or its variants (Joy, 2022). Also, findings from the current study support policies of increasing social distancing and reducing population density in the prison environment, especially for overcrowded facilities. Nonetheless, it is recommended that justice professionals strike a balance between public health and justice or security demands. Some researchers contend that the extreme form of social distancing such as system-wide or facility-specific lockdown might unintentionally produce more serious crimes such as intimate partner violence by people with minor offenses and reduced homicides because of the opportunities that emerged or disappeared in the general community (Boman & Gallupe, 2020). Unfortunately, there is a lack of research on how social distancing policies were carried out in practice in prison settings. To date, we know little regarding how mandated social distancing for people in prison affects prison security among cellmates and the general prison population. More research and evidence on benefits and drawbacks from social distancing, isolation, and prison lockdown is needed to offer more informative decisions on how to balance public and security demands in correctional settings. Furthermore, in this study we were not able to test the efficacy of ventilation; however, improved ventilation could reduce infection and prevent death in enclosed environments (Dolan et al., 2016; Nowotny et al., 2020).

Our findings may suggest ethical implications regarding more protection for people in prison as their living conditions are worsened and their health risks are heightened because of the outbreak of infectious diseases, such as COVID-19. Despite the elevated vulnerability of people in prison, there is reason to believe that states were slow to provide or mandate the use of masks, soap, the ability to distance, or implement quarantine of those who were ill, or steps that were necessary to reduce or prevent infections of staff and people in prison. Lawsuits or lawsuits in correctional clients' name were filed in several states with limited success (e.g., see Crombie, 2021; Michigan DOC, 2020; Wiita, 2021). Though most of these lawsuits were not successful, their narratives indicate that people in prison were not provided with the kind of protection needed to avoid exposure and the subsequent negative health outcomes associated with COVID-19. As a consequence, people in prison were more likely to be infected than those in the community. Failing to provide sufficient protections for people in prison during the pandemic may have produced unhealthy living conditions, if not cruel and unusual punishment by legal standards.

Recent research has demonstrated that the presence of correctional facilities is associated with increased COVID-19 cases in any given community. Sims et al. (2021) examined the relationship between the presence of a correctional facility and COVID-19 case and death counts in the U.S. These authors estimated the correlation between these facilities and spread of the virus, finding evidence that the presence of a correctional facility was associated with increased county-level COVID-19 case counts in the first wave of the pandemic. As these results suggest, what happens in prisons with respect to COVID-19 should be of great concern to the public, indicating that correctional facilities should be considered when developing policies to respond to a pandemic.

Limitations and Future Directions

Our study is not without limitations. First, we conducted this study with secondary data from multiple projects, and therefore, the authors cannot guarantee the accuracy of the data (DeWolf et al., 2021). However, we attempted to cross-validate the data with publicly available information. In other words, the data was provided within a public-facing context and may not reflect daily practice or life in prisons. Also, like any other secondary analysis with existing data, we have to accept the existing operationalization of the variables, which may not be the ideal measurement of the underlying constructs.

Second, we have a substantial amount of missing data on several variables that were not included in the model but may theoretically impact infection and death rates. We have about 39.1% missing data for the total number of COVID-19 staff infections and 81.9% missing data on vaccination rates. Although the missing data on the total number of staff infections is relatively small, it cannot be easily transformed into a rate variable when we have no direct access to the total number of staff per prison. We approached the data as missing at random, which does not preclude that there might be systematic reasons that caused the missing data. In fact, missing data has been a common theme in other studies that have assessed COVID-19 in correctional settings (Klein et al., 2021; Kowalski et al., 2022; Novisky et al., 2020). As an example, Novisky et al. (2020) reported that over a third of the jurisdictions they examined did not have any information related to the number of people in prison who were tested while over three fourths of jurisdictions did not provide information regarding the number of staff tested on their DOC public websites. Likewise, to our knowledge, we could not find any publicly available data on the (average) age of the people in prison per facility. Although we made some death rate comparison comparisons between the facilities and the general public, such comparisons might not be meaningful enough to give definitive conclusions regarding the health consequences in state and federal prisons. This lack of information is not only an issue for research and might cause analytical errors or noise but also presents as a potential problem with respect to transparency, and possibly, public trust in the correctional system. Hence, we recommend that more resources be diverted to publishing data regarding COVID-19 in prisons.

One explanation for missing information concerning the deaths of people in prison may be due to verification that the death was the result of COVID-19. It could be the case that other complicating illnesses (e.g., asthma or diabetes) contributed to the death while they also had COVID-19. A medical examiner or coroner would have to determine the cause of death. As an example, the COVID-19 dashboard for the Wisconsin Department of Corrections indicates that deaths of people in prison reported involve the date that they received verification of the cause of death from a medical examiner or coroner (Wisconsin DOC, 2022a). Accordingly, there is a delay between the actual death and the reported death. It is also likely that the death information is not fully reliable due to the verification of cause of death. If a medical examiner or coroner determines that some other illness, and not COVID-19, caused an individual's death even though the individual had the virus, then the death will not be reported as a COVID-related death. This has been an issue evidenced in the general community as well: under-counting the number of deaths due to COVID-19.

Other variables such as decarceration practices at the facility-level that might affect infection and death rates were not available at the time of this study. However, as researchers begin to gather more data, DOCs start to make more COVID-related information available to the public, and researchers synthesize more data from various sources, future research could reexamine or revalidate the results of this study with more complete data. Relatedly, we did not examine COVID-19 infection and death rate differences across racial/ethnic groups, which may vary as a result of disparities in sentencing, admission, and decarceration policies (Klein et al., 2023); therefore, future research should examine variations in these rates across race/ethnicity. Additionally, and as suggested by Novisky et al. (2020), further information about policies and practices could help inform reentry and sentencing reform efforts if it is the case that early releases did not result in greater recidivism during the pandemic.

Additionally, prison policy responses and administrative decision-making vary by state (Jones, 2018; Klein et al., 2021; Novisky et al., 2020), and greater dissimilarity may occur within states. Our binary measures of state policies did not capture the dynamic nature of state policies that might have changed over time. For instance, visitation policies have changed over time as a result of fluctuations in state cases (in and outside of prisons) of COVID-19 and has involved transitioning to in-person visits to video visits and back to in-person visits (see for example, Wisconsin DOC, 2022b). Another example involves the suspension and eventual resumption of transfers to work release facilities in Washington State in 2020 as a way to mitigate the spread of the virus (DOC Washington State, 2022). Such examples can be found in DOCs across the country. Similarly, the findings cannot be generalized to U.S. jails or youth correctional facilities as our data includes only adult prisons. Given the different operations and procedures of these other facilities, it would be inappropriate to apply our findings to those settings. However, we encourage other researchers to investigate COVID-19 within jail and youth detainment settings.

Moreover, we focused only on infection and mortality rates of people in prison. As discussed above, staff are an important component in disease mitigation efforts as they are not confined to the total institution that prisons represent. Instead, staff travel between the community and prison as well as between different prisons. A notable gap in prior research is the lack of information on prison staff members' health and well-being (Beaudry et al., 2020). Yet, we were unable to include information pertaining to staff infection and death rates due to missing data.

In addition, our data does not account for another deleterious outcome of the pandemic – mental health issues. A policy variable included in our study was quarantine in relation to COVID-19 outbreaks. For some people in prison, quarantine may lead to isolation if they test positive. Although this step can be an important measure to reduce spread of the disease, it can produce unintended consequences. For example, harm may result at the individual-level because isolated people may experience mental health symptoms. As such, consideration is needed between physical and mental health, as certain mental health symptoms may contribute to self-harm or suicidal ideation. More work is needed to mitigate detrimental outcomes of isolation (Hewson et al., 2020; Liebrenz et al., 2020) and to ascertain how isolation during the pandemic has affected both physical and mental health (Novisky et al., 2020). Regardless, this is data that may be difficult to obtain due to privacy rights that people in prisons have related to health information afforded by the Health Insurance Portability and Accountability Act of 1996.

Finally, although the current study addresses a clustering effect by conducting multilevel analyses, it does not negate the limitation of a cross-sectional study, which might not sufficiently consider how variables were constructed and interact with each other over time. For instance, the prison population changes over time, and using the number of the people in prison or prison beds at the beginning of the pandemic to construct our variables might introduce statistical noise given the dynamic nature of the prison population, which changes over time. As another example, our outcome variables are crude measures of infection and death prevalence because it was assumed that no repeated infections occurred. As state policies, national political leadership, state mandates, prison population, and virus and variants change over time, our current study cannot sufficiently explore the direct and indirect effects of these variables (e.g., the effect of vaccination rates on infection and death rates). Nevertheless, the direct, indirect and moderation effect between these factors can be tested with a longitudinal sample, which is not currently available to researchers.

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Data Availability The datasets analyzed during the current study are available in: https://uclacovidbehindbars.org/ and https://covidprisonproject.com/.

Declarations

Ethics Approval This study used publicly available data; therefore, was not examined by Institutional Review Board (IRB).

Consent to Participate and Publish Not Applicable.

Competing Interests The authors declare no conflicts of interest regarding the publication of this article.

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Xiaohan Mei, Ph.D. is an assistant professor in the School of Criminal Justice and Criminalistics at the California State University – Los Angeles. His research focuses on needs assessment validation, policy/program evaluation, and corrections.

Melissa A. Kowalski, Ph.D. is a Research Analyst-Advanced for the Wisconsin Department of Corrections. Her research areas include juvenile justice, risk/needs assessment, dynamic needs, responsivity, mental health, trauma, and gender-specific offending and programming. Dr. Kowalski's work aims to improve case management and the reentry process for individuals involved in the criminal justice system through evidence-based practices.

Leah Reddy is a Ph.D. student in the Department of Criminal Justice and Criminology at Washington State University, holding an M.S. in Criminology and Criminal Justice from Portland State University.

Leah's research interests are primarily centered on perceptions of crime and the legal system, with a special emphasis on sexual violence.

Ciara McGlynn is a Ph.D. Candidate in the Department of Criminal Justice and Criminology at Washington State University. She has a B.A. in Criminal Justice from Gonzaga University and an M.S. in Criminology and Criminal Justice from Portland State University. Her interests are in the area of courts and corrections, with a focus on pretrial justice and treatment courts.

Mary K. Stohr, Ph.D. is a Professor in the Department of Criminal Justice and Criminology at Washington State University. She has published over 100 books, articles and other works primarily regarding correctional staff and management, gender, drug policy and evaluations. She is a recipient of a number of awards, including the Fellows and Founder Awards from the Academy of Criminal Justice Sciences and the John Howard Award from the Correction's Section of ACJS.

Craig Hemmens, JD, PhD, is a professor in the Department of Criminal Justice and Criminology at Washington State University. He has published 20 books and more than 250 articles and other writings.

Jiayu Li, (Ph.D., Washington State University), her research focuses on young people's substance use and sexual health and aims to inform the public and the intervention efforts on the risk and protective factors associated with young people's well-being.

Authors and Affiliations

Xiaohan Mei[1] · Melissa A. Kowalski[2] · Leah Reddy[3] · Ciara McGlynn[3] · Mary K. Stohr[3] · Craig Hemmens[3] · Jiayu Li[3]

✉ Xiaohan Mei
xmei4@calstatela.edu

Melissa A. Kowalski
melissa.kowalski@wisconsin.gov

Leah Reddy
leah.reddy@wsu.edu

Ciara McGlynn
ciara.mcglynn@wsu.edu

Mary K. Stohr
mary.stohr@wsu.edu

Craig Hemmens
craig.hemmens@wsu.edu

Jiayu Li
jiayu.li2@wsu.edu

1 California State University – Los Angeles, 5151 State University Dr, Los Angeles, CA 90032, USA

2 Wisconsin Department of Corrections, 3099 E Washington Ave, Madison, WI 53704, USA

3 Washington State University, Pullman, WA 99164, USA