BMJ Open

Effects of the COVID-19 pandemic on people experiencing incarceration: a systematic review

Darius Benedict Williams [1], Bethany Spinks,[1] Denitza Williams,[2] Ruth Lewis [3], Francesca Bull,[1] Adrian Edwards [2]

To cite: Williams DB, Spinks B, Williams D, *et al*. Effects of the COVID-19 pandemic on people experiencing incarceration: a systematic review. *BMJ Open* 2024;**14**:e076451. doi:10.1136/bmjopen-2023-076451

► Prepublication history and additional supplemental material for this paper are available online. To view these files, please visit the journal online (https://doi.org/10.1136/bmjopen-2023-076451).

DBW and BS are joint first authors.

Received 07 June 2023
Accepted 01 March 2024

[1]Division of Population Medicine, School of Medicine, Cardiff University, Cardiff, UK
[2]Health and Care Research Wales Evidence Centre, Division of Population Medicine, School of Medicine, Cardiff University, Cardiff, UK
[3]North Wales Centre for Primary Care Research, School of Medical and Health Sciences, Bangor University, Bangor, UK

Correspondence to
Dr Darius Benedict Williams; williamsd81@cardiff.ac.uk

ABSTRACT

Objective To assess the effect of the COVID-19 pandemic on people experiencing incarceration (PEI), focusing particularly on clinical outcomes compared with the general population.

Design Systematic review with narrative synthesis in accordance with the Centre for Reviews and Dissemination's good practice guidelines.

Data sources Medline, Social Policy and Practice, Criminology Connection, ASSIA, EMBASE, SCOPUS, Web Of Science, CINAHL, Cochrane Library, Cochrane COVID-19 reviews, COVID-19 Evidence Reviews and L*OVE COVID-19 Evidence databases were searched up to 21 October 2022.

Eligibility criteria for selecting studies We included studies presenting data specific to adults ≥18 years experiencing incarceration, with exposure to SARS-CoV-2 infection. All studies with a comparison group, regardless of study design and country were included. Studies with no comparison group data or not measuring clinical outcomes/health inequalities were excluded. Studies focussing on detained migrants, forensic hospitals, prison staff and those not in English were also excluded.

Data extraction and synthesis Two reviewers extracted data and assessed risk of bias. Data underwent narrative synthesis using a framework analysis based on the objectives, for infection rates, testing, hospitalisation, mortality, vaccine uptake rates and mental health outcomes. There was no scope for meta-analysis, due to the heterogeneity of evidence available.

Results 4516 references were exported from the databases and grey literature searched, of which 55 met the inclusion criteria. Most were from the USA and were retrospective analyses. Compared with the general population, PEI were usually found to have higher rates of SARS-CoV-2 infection and poorer clinical outcomes. Conflicting data were found regarding vaccine uptake and testing rates compared with the general population. The mental health of PEI declined during the pandemic. Certain subgroups were more adversely affected by the COVID-19 pandemic, such as ethnic minorities and older PEI.

Conclusion PEI have poorer COVID-19 clinical outcomes than the general public, as shown by largely low-quality heterogenous evidence. Further high-quality research of continuing clinical outcomes and appropriate mitigating interventions is required to assess downstream effects of the pandemic on PEI. However, performing such research in the context of incarceration facilities is highly complex and potentially challenging. Prioritisation of resources for this vulnerable group should be a focus of national policy in the event of future pandemics.

PROSPERO registration number CRD42022296968.

STRENGTHS AND LIMITATIONS OF THIS STUDY

⇒ Systematic review presenting evidence published during the first 30 months of the COVID-19 pandemic for outcomes in people experiencing incarceration (PEI) worldwide.
⇒ The study used comprehensive search terms applied to 12 databases to collate evidence from both high-income and low/middle-income countries and focussed on objective data relating to clinical outcomes making comparisons, both within incarceration facilities and with the general population.
⇒ High-quality evidence was lacking about the COVID-19 outcomes of PEI—many studies were of low quality, relying on third-party observational data and prone to bias.
⇒ Published data were heterogeneous with varying statistical measures, meaning meta-analysis was not feasible.
⇒ Studies were excluded if not published in English, potentially leading to some selection bias.

INTRODUCTION

People experiencing incarceration (PEI) were particularly likely to be impacted by the COVID-19 pandemic but the extent and range of impacts and effects on pre-existing inequalities in health compared with the general population are not fully understood.[1 2] Health inequalities are unequal and disadvantageous differences in the health of different populations, such as life expectancy or access to healthcare, which are socially determined.[3] PEI have a high prevalence of physical and psychiatric morbidity, with many coming from marginalised backgrounds, experiencing homelessness or with limited educational backgrounds.[1 4–6] There are complex social problems, including being deprived of liberties, a lack of social and

familial support and violence, each contributing to ill health.[2 5]

When the COVID-19 pandemic began, high transmission rates were seen in incarceration facilities.[7] PEI are susceptible to infectious diseases due to many factors, including living in confined crowded spaces.[1 2] Incarceration facilities raise difficulties with social distancing and lesser access to hygiene products and personal protective equipment.[8] Prolonged isolation in cells contributed to declines in mental health of PEI during the pandemic.[9–11] Family visits were also suspended, court hearings delayed and educational programmes cancelled.[9 12]

The pre-existing health inequalities and increased risk of transmission suggest a greater risk for PEI from COVID-19. High prison COVID-19 death rates were seen in the UK—3.3 times greater than for the same age and sex in the public.[13] Internationally, data from the USA show that PEI are more likely to require vasopressors when hospitalised with COVID-19 and have a higher in-hospital mortality rate than the general population.[14] It is possible that rates of long COVID, a condition characterised by a range of manifestations across organ systems, including fatigue, shortness of breath and cognitive impairment persisting 12 weeks after onset of COVID-19 symptoms, may be more prevalent in PEI.[15 16] However, comprehensive research on this population is lacking.

An earlier systematic and scoping review were undertaken assessing the effect of COVID-19 in PEI.[17 18] These reviews appraise the evidence base regarding COVID-19 outcomes worldwide, published up to mid-October 2021 and in the USA only, up to February 2022, respectively. An up-to-date review of the cumulative literature base in this field is needed, to understand the impact and identify lessons for further pandemics or cycles of COVID-19.

This systematic review aimed to assess the effect of the COVID-19 pandemic on PEI. The objectives were to assess the following clinical outcomes of the COVID-19 pandemic, comparing them to the general population: infection rates of SARS-CoV-2/COVID-19, testing rates, hospitalisation, mortality, COVID-19 vaccine uptake and mental health outcomes. We also sought to evaluate whether inequalities between PEI and the general population widened during the pandemic and, if identified, to investigate potential reasons for this in relation to mediators of COVID-19 and risk factors faced in prisons.

METHODS

This systematic review was conducted in accordance with the Centre for Reviews and Dissemination's good practice guidelines.[19] Guidance from stakeholders assisted with developing the eligibility criteria. We excluded studies focussing on detained migrants, forensic hospitals and staff; also studies published pre-pandemic, not in English or lacking comparison groups. The inclusion and exclusion criteria for selecting eligible studies are shown in table 1.

12 databases were searched, including health, criminology, sociology and COVID-19 specific databases (Medline via OVID, Social Policy and Practice via OVID, Criminology Connection via ProQuest, ASSIA via ProQuest, EMBASE via OVID, SCOPUS, Web Of Science, CINAHL, Cochrane Library, Cochrane COVID-19 reviews, COVID-19 Evidence Reviews, L*OVE COVID-19 Evidence). Preprints were searched via the online EMBASE database to minimise publication bias.

A 'COVID-19' search string, developed for use by the Wales COVID-19 Evidence Centre, and a 'people experiencing incarceration' search string, developed by the authors, were combined. The full search strategy is provided in online supplemental appendix 1. Grey literature suggested by stakeholders was screened to reduce publication bias and gain early insight from unpublished work. Databases were searched up to 21 October 2022.

Search outputs were exported onto a reference management software, Endnote,[20] and screened for eligibility by DBW and BS (table 1). Approximately 10% of the screening was duplicated by other reviewers (FB and AE), with differences in outcomes discussed, to ensure consistency. Disagreements occurred in approximately 2% of the screening process and were resolved through consensus discussion.

Full texts of references selected based on title and abstract were retrieved for analysis by DBW and BS. Assessment by a second reviewer (AE) was completed for 5% of full texts with disagreements occurring in approximately 1% and resolved through consensus discussion.

Data were extracted into Microsoft Excel. Headings included: Study Title and Authors, Country of Study, Study Type, Aim of Study, Participants and Setting, Data Collection, Exposure, Study Outcomes and Methodological Appraisal (online supplemental appendix 2).

Critical appraisals of included studies were conducted using a Joanna Briggs Institute checklist based on study design.[21–23] From an initial literature scoping exercise it was hypothesised that most studies would be low-quality. All studies meeting the inclusion criteria were included, rather than excluding low-quality evidence.

External validity assessment was undertaken by commenting on study limitations. An overall quality of evidence assessment was done for each study, through analysis of critical appraisals, the methodology and key limitations. The assessment graded the studies as low-quality, medium-quality or high-quality evidence. Where preprint articles were found, efforts were made to access subsequent peer-reviewed published versions, used the latter's data in preference to preprint data.

A narrative synthesis of the results was conducted. There was no scope for meta-analysis, due to low-quality heterogeneous evidence available. Data were synthesised using a framework analysis,[24] based on the objectives, for infection rates, testing, hospitalisation, mortality, vaccine uptake rates and mental health outcomes. We analysed potential mediators of COVID-19 outcomes, such as age or ethnicity, if the data were available.

Table 1 Criteria for including and excluding studies in this review

	Inclusion	Exclusion
Population	Adults experiencing incarceration, aged 18 and over, worldwide, during the COVID-19 pandemic	Studies not based on people experiencing incarceration (eg, forensic hospitals, migrants in detention centres People experiencing incarceration under the age of 18, in juvenile or youth prisons Studies on people after release from incarceration Studies on the families of people experiencing incarceration Studies on staff working in prisons
Exposure	SARS-CoV-2/COVID-19	Studies based on other pandemics or infectious diseases Studies covering the judicial process for example, trial, bail, parole
Comparators/Controls	Comparison to the public Comparison to other minoritised groups Comparing from during to before the pandemic Comparators between prison population subgroups	Studies with no comparison
Outcomes	Clinical outcomes of COVID-19: Incidence/prevalence/transmission rate Hospitalisation rate Mortality rate Vaccine uptake Long term effects of COVID-19, for example, long COVID and mental health outcomes Secondary outcomes: Health inequalities during the pandemic	Clinical outcomes not measured or health inequalities not reported
Study design	Hierarchy of evidence with no restriction on study design; prioritising primary evidence, observational studies (such as surveys, case studies and cohort studies)	Systematic or scoping reviews Opinion pieces News reports

Patient and public involvement

None.

RESULTS

A total of 4516 references were exported from the databases searched. After de-duplication, 2684 references remained. Following screening of titles and abstracts, 182 articles were retrieved for full-text analysis, from which 51 studies were included. Six resources from grey literature were identified of which four were included. Reasons for exclusion were documented (see figure 1).[25] Therefore, 55 studies were included (see online supplemental appendix 2).

Studies were included from USA (36, 65.4%), UK (5, 9%), Canada (3, 5.4%), Italy (3, 5.4%), Denmark (2, 3.6%), Brazil (2, 3.6%), China (1, 1.8%), Ethiopia (1, 1.8%), France (1, 1.8%) and Switzerland (1, 1.8%). Study designs included were 29 retrospective analyses of data (52.7%), 8 retrospective cohort studies (14.5%), 7 longitudinal studies (12.7%), 6 cross-sectional studies (10.9%), 3 outbreak reports (5.5%), 1 matched case–control study (1.8%) and 1 policy analysis (1.8%).

Infection rates of COVID-19/SARS-CoV-2 in PEI

Incidence of COVID-19/SARS-CoV-2 varied significantly across countries and prison facilities. Crude incidence rates were mostly higher in prisons than in the general population.[26–36] Relative risk of COVID-19 positivity versus the general population was increased by 4.32 times[37] and 5.29 times.[36] However, a UK study documented a crude incidence rate in prisons which was not statistically different to the general population[38] and four studies, from the UK, USA, Italy and Denmark, respectively, showed a lower incidence rate in the incarcerated population.[39–42] Testing strategies were not clearly documented in these studies, so results must be interpreted with care. Analysis often used population estimates, which are not accurate.

Conflicting evidence was found about the seropositivity levels of PEI compared with the general population. A study in Paris, France found 18.4% positivity rates compared with 20.6% in the general Parisian population.[43] However, in Montreal, Canada 22% of participants were seropositive over the study period compared with 13.75% in a comparator general population sample of Montreal blood donors.[44]

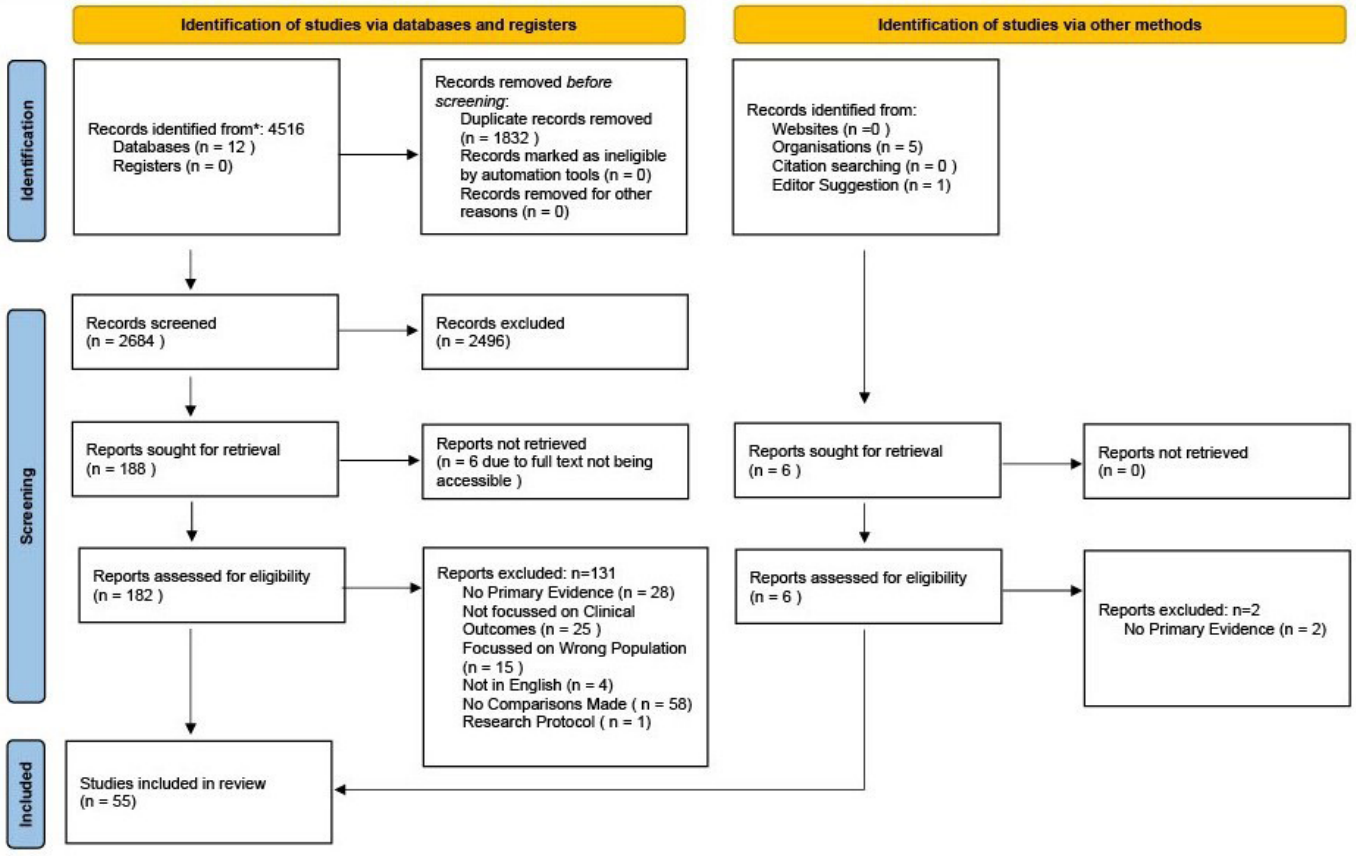

Figure 1 Preferred Reporting Items for Systematic Reviews and Meta-Analyses chart of included studies.

Although the incidence of COVID-19 was greater among PEI than in the community, some subgroups of incarcerated residents were at greater risk of seropositivity and COVID-19 incidence. Risk factors for contracting COVID-19 in PEI included Hispanic ethnicity,[36 45–47] being of non-Hispanic black ethnicity,[36 38 44 46–48] Asian ethnicity,[38] partaking in prison labour,[44 49] being in high occupancy prisons,[32] unstable housing prior to incarceration[44] shared meal consumption[44] and older age.[47 50] Higher security prisons had lower per capita rates of infection.[37] There was conflicting evidence about type of accommodation and risk factors for COVID-19. Some studies found dormitory housing was a risk factor,[32 45 49] while another found no differences compared with single cells.[44] Working or residing in a prison also increased the risk of secondary detection of COVID-19, 90 days after primary infection, by almost five times compared with the public.[51]

Correlations were seen between case rates in staff, incarcerated residents and in the wider community.[34 37 52] A US study demonstrated that once community rates reached a threshold case rate of >50 per 100 000, there was an immediate increase in the COVID-19 case rate in prisons by 118.55 cases per 100 000 (95% CI −3.71 to 240.81).[34] A rise in staff cases was associated with a rise in cases among PEI.[52] Areas of rurality and with higher economic distress scores had higher rates of COVID-19 outbreaks in local prisons.[48] One study noted time lagged an average of 1–2 weeks between peaks of infection rates in the general population and the prison population.[40]

The overall quality of evidence about infection rates of COVID-19 in the prison population was low. See table 2 for a summary of key papers comparing outcomes of PEI versus the general population.

Testing for COVID-19 in PEI

Testing for COVID-19 in prisons varied, even within countries. In the USA and Canada prisons tested on average more than the general population, but this varied between states and provinces.[29 31 53] Blair *et al* presented conflicting Canadian data relating to comparatively high testing rates in a few prisons with COVID-19 outbreaks.[29] Some facilities had no access to testing early in the pandemic, but this improved as the pandemic continued.[29 53] One study in Lombardy, Italy noted higher mean weekly testing rates per 1000 individuals in PEI compared with the general population through both first and second waves (61.09 vs 6.11 and 258.43 vs 19.73, respectively).[35] Conflicting data was found in a whole population Danish study which noted lower testing rates in PEI compared with the general population (OR 0.47 95% CI 0.46 to 0.48, p<.0001).[42]

Older PEI (age ≥55 years) had higher testing rates than younger counterparts.[50] Screening of people newly experiencing incarceration increased during the pandemic.[46] Test positivity (percentage of tests that were positive) was

Table 2 Key papers comparing infection rates of COVID-19/SARS-CoV-2 in PEI versus the general population

Study	Key results	Overall assessment of the quality of evidence	Infection rates in PEI vs general population
A large outbreak of COVID-19 in a UK prison, October 2020 to April 2021. Adamson *et al*[41]	Crude attack rate in residents 12% (95% CI 9% to 15%). Period-incidence of 60.4 cases per 1000 population for residents, lower than that of general population	Low	↓
A study of SARS-CoV-2 outbreaks in US federal prisons: the linkage between staff, incarcerated populations and community transmission. Towers *et al*[37]	Incarcerated population showed a comparative 4.32 risk ratio of per capita COVID-19 rates vs the general population (p≤.001). Significant correlation demonstrated between per capita rates in the outbreaks among the incarcerated population and the community, despite stoppage of visitation over the time period of the study. Significant difference in per capita rate demonstrated between levels of facility security level: high<minimum<medium<low Decarceration was significantly associated with a decrease in incarcerated per capita rates during the winter wave (p=.015) but not during the summer wave	Medium	↑
A time-series analysis of testing and COVID-19 outbreaks in Canadian federal prisons to inform prevention and surveillance efforts. Blair *et al*[29]	3% prevalence COVID-19 of total incarcerated population in comparison to 0.2% in general population	Low	↑
Adverse SARS-CoV-2-associated outcomes among people experiencing social marginalisation and psychiatric vulnerability: a population-based cohort study among 4,4 million people. Nilsson *et al*[42]	Reduced risk of positive SARS-CoV-2 PCR test in PEI vs general population: aIRR 0.84 (95% CI 0.80 to 0.88) p<.0001. Reduced rate of testing in PEI OR 0.47 (0.46–0.48) p<.0001	Medium	↓
Association between prison crowding and COVID-19 incidence rates in Massachusetts prisons, April 2020–January 2021. Leibowitz *et al*[32]	COVID-19 incidence rate in incarceration facilities was 965/100 000 compared with 150/100 0000 person weeks in general population during study period, incidence lower in facilities that were less full and had higher percentage of people in single cells	Low	↑
Characteristics of persons with secondary detection of severe acute respiratory syndrome coronavirus ≥90 days after first detection, New Mexico. Hicks *et al*[51]	When adjusted in multivariable model, staff or residents of incarceration facilities had higher rates of secondary SARS-CoV-2 detection (aOR 4.7 CI 1.8 to 12.1)	Low	↑
COVID-19 case and mortality rates in the Federal Bureau of Prisons. Toblin and Hagan[26]	Crude case rate for BOP 11 710 per 100 000 and 2484 for general USA. Ratio of 4.7× more cases in incarceration facilities	Medium	↑
COVID-19 cases and deaths in federal and state prisons. Saloner *et al*[27]	Case rate for PEI was 5.5× higher than in general population	Low	↑
COVID-19 cases and testing in 53 prison systems. Lemasters *et al*[31]	34 prison systems had higher case rates per thousand than general population	Low	↑

Continued

Table 2 Continued

Study	Key results	Overall assessment of the quality of evidence	Infection rates in PEI vs general population
COVID-19 community spread and consequences for prison case rates. LeMasters *et al*[34]	Mean active case rate of 427 per 100 000 in the incarcerated population compared with a rate of 215 per 100 000 in the general population. When community rates reached the threshold case rate of at least 50 per 100 000, there was an immediate increase in the COVID-19 case rate in incarceration facilities by 118.55 cases per 100 000 (95% CI –3.71 to 240.81). No significant difference between community COVID-19 rates in counties with and without an incarceration facility	Low	↑
COVID-19 in prisons: state health care contracting and the pandemic behind bars. Smith and Glidden[39]	Lower mean COVID-19 diagnoses per 10 000 (333.20, range 0–1640) compared with the general population (COVID-19 diagnoses per 100 000 1255.32, range, 74.48–20 617.31). Incarcerated residents in states who provide at least some healthcare from Department of Correction staff (as opposed to purely privately contracted healthcare) showed significantly reduced COVID-19 diagnosis rate per 10 000 (b=–448.70, p=.01). Average expenditure on healthcare per incarcerated resident had no significant effect on COVID-19 rates or mortality	Low	↓
COVID-19 incidence and mortality in federal and state prisons compared with the US population, April 5, 2020, to April 3, 2021. Marquez *et al*[28]	Crude case rate was 30 780/100 000 for PEI and 9350/100 000 for general population, incident ratio of 3.3 (95% CI 3.3 to 3.3) for incarcerated population	Low	↑
COVID-19 infection among incarcerated individuals and prison staff in Lombardy, Italy, March 2020 to February 2021. Mazzilli *et al*[35]	The study demonstrated a higher relative risk of COVID-19 infection in incarcerated residents than the general population (first wave: RR 1.30; 95% CI 1.06 to 1.58 second wave RR 3.91; 95% CI 3.73 to 4.09). A lower average weekly positivity rate per 100 individuals was noted in incarcerated individuals vs the general population however (first wave: 1.76 range, 0.00–10.68 vs 9.55 range, 1.21–37.50 second wave: 4.46 range, 0.00–17.92 vs 8.71 range, 1.16–20.71	Low	↑
COVID-19 outbreak in a large penitentiary complex, April-June 2020, Brazil. Gouvea-Reis *et al*[33]	Higher COVID-19 incidence rate in the case study incarcerated population vs the general population of the Brasilia region (1832 cases/100 000 persons vs 47 cases/100 000) Shorter mean serial case interval at 2.51 days (SD 1.21) in case study facility vs general Brazil population (figures for comparison not documented)	Low	↑
Epidemiology of coronavirus disease 2019 at a County Jail-Alameda County, California, March 2020–March 2021. Marusinec *et al*[36]	Total incidence rate during the investigation period was 280/1000 which was 5.29× (95% CI 4.87 to 5.75) higher than Alameda county, younger, Hispanic/Latino and black people had higher percentage of positive tests	Low	↑
Epidemiology of COVID-19 among incarcerated individuals and staff in Massachusetts jails and prisons. Jiménez *et al*[80]	Incidence of COVID-19 was 44.3/1000 for PEI, 2.91 times higher than Massachusetts general population and 4.8 times greater than USA general population, systems with higher testing rates had higher case rates, case incidents were higher among systems that released a lower proportion of their baseline population	Low	↑

Continued

Table 2 Continued

Study	Key results	Overall assessment of the quality of evidence	Infection rates in PEI vs general population
Epidemiology of COVID-19 in prisons, England, 2020. Rice *et al*[38]	Crude incidence in PEI in England was 988/100 000, compared with 935/100 000 in general population (not statistically different). Higher percentage of positive tests for black (6.4% vs 3.3%) and Asian (7.8% vs 7.5%) ethnic groups compared with the general population	Low	⇆
Health management in Italian prisons during COVID-19 outbreak: a focus on the second and third wave. Vella *et al*[40]	Prevalence of SARS-CoV-2 infection among PEIranging from 0.19% to 1.94% (mean 1.02%, SD 0.51%). Authors state lower prevalence than Italian general population but data supporting this not presented. Time lag on average of 1–2 weeks between peaks of infection rates in the general population and the incarcerated population on cross-correlation time lag plot	Low	↓
SARS-CoV-2 seroprevalence in the adult detainees of the Paris area in 2021: a multicenter cross-sectional study. Mellon *et al*[43]	18.2% (95% CI 16.9 to 19.4) of incarcerated population, adjusted for age/sex, were seropositive over the entire study period. Over the week 08–14 February 2021 incarcerated population seropositivity was 18.4% (95% CI 16.8 to 20.1) compared with 20.6% (95% CI 16.6 to 24.9) in the general Paris population. Statistically significant factors independently associated with seropositivity in males=lower number of cigarettes per day (p<.0001) and higher number of inmates per cell (p=.0008. In females=younger age (p=.0002) and lower number of cigarettes per day (p=.0216)	Low	↓
Seroprevalence and risk factors for SARS-CoV-2 among incarcerated adult men in Quebec, Canada 2021: a cross-sectional study. Kronfli *et al*[44]	22% of participants were seropositive over the study period. This compared with 13.75% in the comparative general population sample of Montreal blood donors. Factors with a statistically significant association with seropositivity=time spent incarcerated ('most time': aPR, 1.47; 95% CI 1.01 to 2.12; 'all time': aPR, 2.17; 95% CI 1.53 to 3.07), employment during incarceration (aPR, 1.64; 95% CI 1.28 to 2.11), shared meal consumption during incarceration ('with cellmates': aPR, 1.46; 95% CI 1.08 to 1.97; 'with sector': aPR, 1.34; 95% CI 1.03 to 1.74), and incarceration post in-prison outbreak (aPR, 2.32; 95% CI 1.69 to 3.18)	Low	↑
Testing lags and emerging COVID-19 outbreaks in federal penitentiaries: a view from Canada. Blair *et al*[53]	COVID-19 prevalence was 1.2% in incarceration facilities compared with 0.1% in general population, COVID-19 prevalence higher among women's incarceration facilities	Low	↑

aIRR, adjusted Incidence Rate Ratio; aOR, adjusted Odds Ratio; aPR, adjusted prevalence ratio; BOP, Bureau of Prisons; PCR, Polymerase Chain Reaction; PEI, people experiencing incarceration.

also greater in prisons than public settings.[31 46] Thus the more testing was undertaken, the more COVID-19 cases were identified, with higher incidence rates.[30 53] Testing strategies (eg, asymptomatic testing at defined intervals vs symptomatic testing) were generally not documented so results should be interpreted with caution.

Evidence was graded low-quality or medium-quality, with most studies reporting retrospective publicly available data, with comment on testing strategies limited. See table 3 for a summary of key papers comparing outcomes of PEI versus the general population.

Hospitalisation from COVID-19 in PEI

PEI had worse hospitalisation outcomes than the general population. A whole population Danish study found that PEI were nearly two times as likely to be hospitalised with COVID-19 (adjusted incidence rate ratio (aIRR) of hospitalisation within 14 days diagnosis 1.99, 1.64–2.40) and over twice as likely to be admitted to intensive care (aIRR of intensive care admission within 14 days 2.41, 1.56–3.72).[42] A large US study also found higher rates of hospitalisation, mechanical ventilation requirement, readmission for

Table 3 Key papers comparing testing of COVID-19/SARS-CoV-2 in people experiencing incarceration (PEI) versus the general population

Study	Key results	Overall assessment of the quality of evidence	Testing rates vs general population
A time-series analysis of testing and COVID-19 outbreaks in Canadian federal prisons to inform prevention and surveillance efforts. Blair *et al*[29]	On average, incarceration facilities tested more than the general population (88 per 1000 population compared with 40 per 1000 in public) however figures may be affected by six facilities which experienced outbreaks and far higher testing rates over the study period—64% of facilities recorded fewer tests per 1000 compared with general population. Six facilities recorded no testing at all	Low	↑
Adverse SARS-CoV-2-associated outcomes among people experiencing social marginalisation and psychiatric vulnerability: a population-based cohort study among 4,4 million people. Nilsson *et al*[42]	Reduced rate of testing in PEI vs Danish national population OR 0.47 (0.46–0.48) p<.0001	Medium	↓
COVID-19 cases and testing in 53 prison systems. Lemasters *et al*[31]	10 states and Puerto Rico reported no testing information, testing numbers varied across states from 6/1000 to 1531/1000 incarcerated people. Majority of prison systems tested more than the public, test positivity on average higher in prison systems	Low	↑
COVID-19 infection among incarcerated individuals and prison staff in Lombardy, Italy, March 2020 to February 2021. Mazzilli *et al*[35]	The study demonstrated a higher mean weekly testing rate per 1000 individuals vs the general population (first wave: 61.09 range, 0–115.44 vs 6.11 range, 1.16–10.41 second wave: 258.43 range, 123.92–573.08 vs 19.73 range, 11.68–30.09)	Low	↑
Testing lags and emerging COVID-19 outbreaks in federal penitentiaries: a view from Canada. Blair *et al*[53]	12/50 had no testing at all, 36/50 had fewer tests than the general population, those with higher testing levels tended to be those who had a high COVID-19 prevalence. Overall, number of tests in incarceration facilities 34/1000 compared with 16/1000 in general population	Low	↓

OR, Odds Ratio.

COVID-19 within 30 days of hospital discharge and longer stays following admission for COVID-19.[54] Overall, PEI presented later with more severe disease than the general population.[14]

However, two US studies found conflicting results with no significant differences in admission to intensive care or intubation rates.[14 55] This evidence was weaker, though, with a combined sample size of approximately 800 individuals from three hospital sites for both studies, compared with a total cohort of 4 412 382 individuals encompassing the entirety of the general population and prison population in the Danish study and a total cohort of 1 257 250 encompassing 3415 incarcerated people in the US study.[42 54] There was conflicting evidence on whether COVID-19 positive PEI required greater use of vasopressors than the general population.[14 55]

Certain subgroups of PEI were more likely to be admitted to hospital. Risk factors for being hospitalised with COVID-19 in PEI included heart disease[53] and older age.[45 54 56] Risk factors for admission to intensive care included autoimmune diseases and older age.[45]

Access to healthcare for PEI potentially decreased during the pandemic, with fewer admissions to hospital than usual.[57] The reduction in elective procedures was greater among PEI than in the public, widening health inequalities.[57] Only urgent cases in PEI, such as cancer and dialysis, were prioritised, potentially leading to a backlog in other medical problems.[57]

Evidence was graded low-quality or medium-quality, with most studies reporting retrospective publicly available observational data prone to inaccuracy.

Table 4 Key papers comparing hospitalisation from COVID-19 in PEI versus the general population

Study	Key results	Overall assessment of the quality of evidence	Severity of hospital related outcomes vs general population
Adverse SARS-CoV-2-associated outcomes among people experiencing social marginalisation and psychiatric vulnerability: a population-based cohort study among 4,4 million people. Nilsson *et al*[42]	aIRR (vs general population) hospitalisation within 14 days of COVID-19 diagnosis 1.99 (1.65–2.40 p≤.0001), intensive care admission within 14 days of COVID-19 diagnosis 2.41 (1.56–3.72, p=.00050)	Medium	↑
Characteristics and comparative clinical outcomes of prisoner vs non-prisoner populations hospitalized with COVID-19. Altibi *et al*[14]	PEI significantly more likely to require high flow nasal cannula O2, require vasopressor therapy and have a respiratory rate >24 on admission (p<.001) and require intubation (p=.01) vs general population	Low	↑
Characteristics and outcomes of prisoners hospitalized due to COVID-19 disease. Abdalbary *et al*[55]	No difference in need for ICU care/vasopressors/ inotropes/mechanical ventilation/ECMO support	Low	⇆
Hospitalizations for COVID-19 among US people experiencing incarceration or homelessness. Montgomery *et al*[54]	People experiencing incarceration vs general population: higher rate of hospitalisation (63.5% versus 49.7%; p<.001), more likely to be hospitalised at a younger age (median age: 56 years (IQR, 44–65) versus 65 years (IQR 52-77), more likely to require invasive mechanical ventilation (aRR 1.16; 95% CI 1.04 to 1.30), more likely to be readmitted to hospital for COVID-19 within 30 days of hospital discharge (aRR 1.45; 95% CI 1.18 to 1.78), more likely to have a longer stay in hospital following admission (aRR 1.11; 95% CI 1.06 to 1.16)	Medium	↑

aIRR, adjusted Incidence Rate Ratio; aRR, adjusted risk ratio; ECMO, Extra Corporeal Membrane Oxygenation; ICU, Intensive Care Unit; PEI, people experiencing incarceration.

See table 4 for a summary of key papers comparing outcomes of PEI versus the general population.

Mortality from COVID-19 in PEI

Standardised morality rates (SMR) from COVID-19 were higher in PEI than in the public, though this varied between and within countries.[13 26–28 58] In England and Wales, PEI had an SMR of 3.3, that is, a 3.3 times increase in COVID-19 deaths in prisoners compared with the public.[13] Two US studies noted SMRs of 4.45 and 2.89 in PEI.[59 60] Death within 60 days of COVID-19 diagnosis was over three times more likely in the Danish prison population population compared with the general population (aIRR 3.11, 95% CI 1.93 to 5.03).[42] COVID-19 contributed to a reduced life expectancy among PEI,[61 62] quantified at 4.2 years versus 1.5 years in the general population in one US study.[59]

PEI admitted to hospital had a higher in-hospital mortality rate compared with the general population.[14 54] Crude mortality rates in prisons were often equal to, or less than the community,[26 29 38 39 53 55 58 63] although these were not standardised (eg, for age). Deaths from COVID-19 disproportionately affected non-Hispanic black, Hispanic and older PEI.[45 50 62 64] All-cause mortality in PEI increased compared to pre-pandemic.[61 62]

Evidence was graded as low-quality or medium-quality, due to many reporting crude mortality rates, rather than standardised rates. See table 5 for a summary of key papers comparing outcomes of PEI versus the general population.

Vaccine uptake among PEI

Evidence regarding vaccination uptake was conflicting. A large US study of 126 413 PEI reported a slightly higher rate of full vaccination (33.4%) compared with the general population (29.5%).[65] Incarcerated residents also had more time eligible for vaccination in the community (79 days, IQR: 41–183) than in jail (14 days IQR: 3–31) and were 12.5 times (95% CI 10.2 to 15.3) more likely to consent to and receive vaccination while incarcerated than before incarceration.[66] Conversely, a Public Health Scotland report found that uptake of a full course of COVID-19 vaccine in PEI was lower than in the public.[67] This finding was

Table 5 Key papers comparing mortality from COVID-19 in PEI versus the general population

Study	Key results	Overall assessment of the quality of evidence	Mortality outcomes in PEI vs general population
A time-series analysis of testing and COVID-19 outbreaks in Canadian federal prisons to inform prevention and surveillance efforts. Blair *et al*[29]	Case fatality was 0.6% in prisons compared with estimated 10% in general population	Low	↓
Adverse SARS-CoV-2-associated outcomes among people experiencing social marginalisation and psychiatric vulnerability: a population-based cohort study among 4,4 million people. Nilsson *et al*[42]	aIRR Death within 60 days of COVID-19 diagnosis 3.11 (95% CI 1.93 to 5.03, p≤.0001). Rate of all cause mortality rate ratio over study period 9.44 (95% CI 6.43 to 13.88, p≤.0001) in prison residents with COVID-19 infection vs 4.00 (95% CI 3.87 to 4.13, p≤.0001) in the general population with COVID-19 infection	Medium	↑
Age and COVID-19 mortality in the United States: a comparison of the prison and general population. Nowotny *et al*[60]	Increased standardised mortality ratio of 2.89 (95% CI 2.78 to 3.00) in the prison population vs general population. Prison residents died at younger ages than the general population	Low	↑
Assessing the mortality impact of the COVID-19 pandemic in Florida state prisons. Marquez *et al*[61]	Increase in mortality in 2020 when compared with 2019 for prisoners (aRR 1.56 (95% CI 1.39 to 1.76) compared to 2019 when using bootstrapping), Monthly median posterior estimates of excess mortality were found to be strongly and significantly correlated with monthly reported deaths related to COVID-19 (80.4%, p<.01), life expectancy decreased by 4.12 years between 2019 and 2020	Medium	↑
Characteristics and comparative clinical outcomes of prisoner vs non-prisoner populations hospitalized with COVID-19. Altibi *et al*[14]	In-hospital mortality was higher for prisoners with an adjusted OR of 2.32 (95% CI 1.33 to 4.05 statistically significant) (adjusted for age, sex, race, CCI and obesity)	Medium	↑
Characteristics and outcomes of prisoners hospitalized due to COVID-19 disease. Abdalbary *et al*[55]	No significant difference in mortality of hospitalised patients with kidney involvement compared with the general population	Low	⇆
COVID-19 case and mortality rates in the Federal Bureau of Prisons. Toblin and Hagan[26]	SMR for age and sex was 2.6 for prisoners compared with general population	Medium	↑
COVID-19 cases and deaths in federal and state prisons. Saloner *et al*[27]	Crude death rate not statistically different, SMR in PEI adjusted for age and sex = 3.0 versus general population	Low	↑
COVID-19 in prisons: state health care contracting and the pandemic behind bars. Smith and Glidden[39]	Lower mean COVID-19 deaths per 10 000 (3.67, range 0–25) in the incarcerated population compared with the general population (COVID-19 deaths per 100 000 66.04 1.34–1646.11) Incarcerated residents in states who provide at least some healthcare from Department of Correction staff (as opposed to purely privately contracted healthcare) showed significantly reduced COVID-19 deaths per 100 000 (b=–3.47, p=.04) Average expenditure on healthcare per incarcerated resident had no significant effect on COVID-19 rates or mortality	Low	↓
COVID-19 incidence and mortality in federal and state prisons compared with the US population, April 5, 2020 to April 3, 2021. Marquez *et al*[28]	SMR was 2.5 (95% CI, 2.3 to 2.7) in PEI versus general population	Medium	↑

Continued

Table 5 Continued

Study	Key results	Overall assessment of the quality of evidence	Mortality outcomes in PEI vs general population
Disparities in COVID-19 related mortality in U.S. prisons and the general population. Nowotny *et al*[58]	adjusted SMR (for age and sex) was 2.75 in comparison to the general public, crude mortality rate of 50/10 000 in prisons compared with 40/10 000 in general public, SMR varied hugely between states, with some states going up to 10.56 that of the general population	Low	↑
Epidemiology of COVID-19 in prisons, England. 2020 Rice *et al*[38]	CFR= 3.13% (95% CI 2 to 4.67) in prisons compared with in 8% in England over study time, CFR for over 66 in prison was 15.5% but no comparison to the over 66s in the general public	Low	↓
Hospitalizations for COVID-19 among US people experiencing incarceration or homelessness. Montgomery *et al*[54]	People experiencing incarceration more likely to die in hospital than general population following COVID-19 related admission (aRR, 1.28; 95% CI 1.11 to 1.47)	Medium	↑
Indirect age- and sex-standardisation of COVID-19-related mortality rates for the prison population of England and Wales. Braithwaite *et al*[13]	SMR = 3.3 (95% CI 2.77 to 3.98) in PEI versus general population	Medium	↑
Life expectancy and COVID-19 in Florida state prisons. Marquez *et al*[59]	Standardised COVID-19 mortality rate for the incarcerated population was 4.45 times that of the general population (203.9 deaths per 100 000—IRR=4.45, 95% CI 3.85 to 5.15, p<.001). COVID-19 contributed to a reduction of life expectancy in the incarcerated population of 4.2 years vs 1.5 years in the general population. In 2020, the standardised mortality rate of the incarcerated population was 626.9 deaths per 100 000 individuals vs 597.3 deaths per 100 000 individuals in the general population	Low	↑
SARS-CoV-2 among inmates aged over 60 during a COVID-19 outbreak in a penitentiary complex in Brazil: positive health outcomes despite high prevalence. Gouvea-Reis *et al*[63]	0% mortality rate in the sampled population (159 residents with 90.6% test positivity rate). Per reported general population data for the Federal District of Brazil, mortality rate is lower than expected—per reported positive test numbers in the penitentiary, the following numbers of deaths per age group would be expected: 60–69=6.032 deaths, 70–79=2.875 deaths, 80+=1.38 deaths	Low	↓
Testing lags and emerging COVID-19 outbreaks in federal penitentiaries: a view from Canada. Blair *et al*[53]	Case fatality estimates of 0.5% in prisons compared with 0.3% in general population	Low	↑

aIRR, adjusted incidence rate ratio; aRR, adjusted risk ratio; CCI, Charlson Comorbidity Index; CFR, Case Fatality Ratio ; IRR, incidence rate ratio; PEI, people experiencing incarceration; RR, risk ratio; SMR, standardised morality rates.

echoed by a Danish whole population study demonstrating that PEI during 2020 in Denmark were half as likely to complete a full course of COVID-19 vaccination as the general population (aIRR 0.5 95% CI 0.5 to 0.5).[68]

Two studies highlighted the importance of re-offering vaccines to PEI with significant numbers accepting the second time, after having previously declined a dose.[69 70] PEI were more likely to accept vaccination if they were older, had comorbidities associated with severe COVID-19 illness, a higher level of education, identified as white or Hispanic ethnicity, were not born in the USA, had experienced prior SARS-CoV-2 infection, were involved in working activities in the prison or resided in shared rooms.[50 65 69–71]

Factors correlating with lower vaccine uptake included declining additional information about COVID-19 vaccine, non-Hispanic black or Asian ethnicity.[65 71] Worrying about side-effects and wanting more information were reasons why vaccines were not accepted by some.[72]

Table 6 Key papers comparing COVID-19 vaccine uptake among PEI versus the general population

Study	Key results	Overall assessment of the quality of evidence	Vaccination uptake in PEI vs general population
Association of state COVID-19 vaccination prioritization with vaccination rates among incarcerated persons. Biondi *et al*[73]	21 of the sampled states prioritised vaccination of incarcerated residents. States with policies that prioritised vaccination of incarcerated people had significant increases in vaccination rates compared with other states over time. In states with no prioritisation policy, vaccination rates in the general population were higher than in incarcerated people	Low	↓
COVID-19 vaccination in the Federal Bureau of Prisons, December 2020—April 2021. Hagan *et al*[65]	Median of 33.4% (range 12.6%–59.3%) of incarcerated residents and staff had received a full course of vaccinations by the end of the study vs a median of 29.5% (range 20.3%–37.8%) of the general adult population. COVID-19 vaccination was offered to 100% of staff and 69.8% of incarcerated residents over the study period. Acceptance rates were 50.2% for staff and 64.2% for residents. Factors increasing odds of vaccine acceptance include: Increasing age compared with the <40 years age group (≥75 years aOR=2.71, 95% CI 2.09 to 3.52), higher number of medical conditions associated with severe COVID-19 illness (six conditions aOR=2.99, 95% CI 2.46 to 3.63), having a prior SARS-CoV-2 infection (aOR=1.08, 95% CI 1.05 to 1.12), place of birth outside of the USA (aOR=1.42, 95% CI 1.34 to 1.51), unknown country of birth (aOR=1.42, 95% CI 1.14 to 1.77). Factors decreasing odds of vaccine acceptance include: female sex vs male (aOR=0.60, 95% CI 0.53 to 0.67) non-Hispanic black race (aOR=0.43, 95% CI 0.41 to 0.44) or Asian race (aOR=0.79, 95% CI 0.68 to 0.91) vs non-Hispanic white race	Low	↑
Vaccination against SARS-CoV-2 infection among vulnerable and marginalised population groups in Denmark: a nationwide population-based study. Nilsson *et al*[68]	Incarcerated population half as likely to complete full course of COVID-19 vaccination than the general population (aIRR 0.5 95% CI 0.5 to 0.5)	Medium	↓
Vaccination for SARS-CoV-2 and risk of COVID disease among those in prison care in Scotland, public health Scotland. Unpublished work Wilkinson *et al*[67]	74% of PEI had first dose compared with 72% in general population, 63% of PEI had two doses of the vaccine compared with 68% in the general population, 31% PEI had booster compared with 38% in general population	Medium	↓

aIRR, adjusted incidence rate ratio; aOR, adjusted OR; PEI, people experiencing incarceration.

Conflicting evidence was noted around the role of female sex in vaccine uptake: one study[71] reporting increased uptake of vaccination but another US study noting lower uptake.[65]

Vaccination policy, which varied significantly between US states, appeared to affect uptake.[72] Facilities with similar risk factors, such as long-term care facilities, were prioritised in 'phase 1' in all vaccine plans. State plans did not usually specify in which phase PEI should be vaccinated, and only 22% of plans included them in 'phase 1'.[72] One study showed that US states with policies that prioritised vaccination for PEI had higher vaccination rates compared with other states over time. In states with no prioritisation policy, vaccination rates were lower among PEI than for the general population.[73]

Evidence on vaccine uptake was low-quality, with limited comparisons to the general population and may not be generalisable to other prison populations. See table 6 for a summary of key papers comparing outcomes of PEI versus the general population.

Mental health outcomes of PEI during the COVID-19 pandemic

Overall, deteriorating mental health of PEI during the pandemic was reported. Depression and anxiety scores worsened from pre-pandemic comparisons.[10 74 75] There was a significant increase in suicide attempts and self-harm events in a Swiss prison comparing 2020 to 2016–2019.[76] One study from China noted worsening levels of anxiety in those with no pre-pandemic mental health diagnoses but an improvement in anxiety scores in those with a pre-pandemic diagnosis.[77] An Ethiopian study reported high rates of major depressive disorder (66.4% vs 41.9%–56.4%) and generalised anxiety disorder (66.9% vs 36.1%) among PEI compared with pre-pandemic studies.[75]

Evidence about the mental health was low-quality, due to small sample sizes with limited demographics noted. Instruments to measure mental health outcomes were often heterogeneous between studies and self-reported. Studies lacked general population comparison groups. See table 7 for a summary of key

Table 7 Key papers comparing mental health outcomes among people experiencing incarceration (PEI) during the COVID-19 pandemic

Study	Key results	Overall assessment of the quality of evidence	Mental health outcomes in PEI pre-/post-pandemic
Older incarcerated persons' mental health before and during the COVID-19 pandemic. DePalma *et al*[10]	PHQ-8 depression scores (5.5±6.0 vs 8.1±6.5; p<.001) and GAD-7 scores (6.4±5.7 vs 7.8±6.6; p<.001) both increased (more severe symptoms) during the COVID-19 pandemic compared with prior to it. A greater proportion of respondents scored a clinically significant PHQ-8 score (≥10) during the COVID-19 pandemic compared with prior (38.2% vs 22.4%). Average SRH score worsened by −0.31 (p<.001). Causal mediation model results demonstrated that worsening PHQ-8 scores predicted worsening SRH rating (β=−0.040; p<.05)	Low	↑
Suicide attempts and COVID-19 in prison: empirical findings from 2016 to 2020 in a Swiss prison. Gétaz *et al*[76]	57% statistically significant increase in suicides RR 1.57 (95% CI 1.10 to 2.04 $p < .001$) and self-harm events RR 1.57 (95% CI 1.23 to 1.92 $p < .001$) during the pandemic compared with pre-pandemic	Low	↑
Anxiety during the COVID-19 pandemic in prisoners who had high risks to suffer from mood disorders: a longitudinal study before and during the COVID-19. Zhang *et al*[77]	Significant trend of anxiety scores improving during the pandemic compared with prior to it (p≤.001). Significantly worsened anxiety scores during the pandemic in those who did not have anxiety prior to the pandemic (p≤.001, n=480). Improved anxiety scores for those who were suffering from anxiety pre-pandemic (p≤.001, n = 323)	Low	↑
County jails' responses to COVID-19: practices, procedures, and provisions of behavioural health services. Comartin *et al*[74]	Rates of significant mental illness in residents significantly higher during the early pandemic 'spring' period (40.5%, n=34) compared with the pre-pandemic 'winter' period (29.7%, n=33), with the lowest proportion found in summer (22.5%, n=43) (p<.01). The same relationship was noted in the proportion of residents who confirmed having taken psychotropic medication in the last year—highest during the spring (40.5%, n=34), compared with winter (36.7%, n=40) and summer (18.8%, n=36; p<.001)	Low	↑
Depressive, anxiety symptom frequency and related factors among prisoners during the COVID-19 pandemic in Northeastern Ethiopia, a cross-sectional study. Birkie *et al*[75]	279 (66.4%; 95% CI 61.4 to 70.6) of incarcerated residents met the threshold score for major depressive disorder (PHQ-9 score ≥10). 281 (66.9%; 95% CI 61.9 to 71.9) met the threshold for generalised anxiety disorder (GAD-7 score >10). This contrasts with pre-pandemic studies in the Ethiopian incarcerated population quoted by the authors where depression prevalence rates ranged from 41.9% to 56.4% and anxiety prevalence rate was 36.1%	Low	↑

GAD-7, Generalised Anxiety Disorder 7-item Questionnaire; PHQ-9, Patient Health Questionnaire 9; RR, Relative Risk; SRH, Self Rated Health.

papers comparing outcomes of PEI versus the general population.

DISCUSSION

Principal findings

PEI had higher infection rates and worse COVID-19 clinical outcomes, including hospitalisation, mortality and mental health outcomes, compared with the general population. People with black and Hispanic ethnicity had worse COVID-19 outcomes overall compared with their white counterparts. Older PEI showed poorer outcomes across several domains including higher COVID-19 incidence, testing rates, hospitalisation and mortality related to COVID-19. Testing rates varied greatly between institutions and countries.

Evidence regarding vaccine uptake was conflicting. Prioritisation of incarcerated populations for vaccination varied between countries and regions. Poorer access to healthcare and not always being prioritised for vaccination contributed to widening of health inequalities in an already under-served population.[57 72]

Significant health inequalities have been demonstrated. There is a suggestion that health inequalities may have widened—several studies demonstrated worsened mental health outcomes and all-cause mortality rates compared with pre-pandemic data in PEI.[10 61 62 74–77] However, there are insufficient longitudinal studies comparing outcomes pre-/post-pandemic with the general population to confidently determine whether pre-existing inequalities between PEI and the general population widened during the pandemic.

Context of other literature

This review supports other literature showing that PEI have poor outcomes and high transmission rates from infectious disease, and specifically COVID-19. Incarceration facilities and pre-existing conditions suffered by many PEI facilitate spread of infectious diseases.[2] The pre-pandemic infectious disease burden in prisons was high including tuberculosis, hepatitis and other communicable disease, now exacerbated by COVID-19.[78 79]

The reasons behind poorer outcomes from COVID-19 in PEI are likely to be complex and multi-factorial. Evidence suggests an interplay of overcrowding, limited healthcare access, pre-existing health conditions and higher respiratory illness risk factors, lack of continuity of care and reduced preventative measures such as lower vaccination rates and poorer health education.[1 40 49 62 80–85]

Prevalence of long COVID in PEI remains a notable absence from published literature. A lack of long-duration longitudinal/cohort studies is a contributory reason for this. A systematic review of long COVID prevalence in the general population noted a pooled estimate of prevalence between 13.6% and 43.9%, depending on definition and method of measurement.[86] The review also noted increased prevalence in hospitalised patients.[86] Given the increased hospitalisation rates and poorer COVID-19 outcomes evident in PEI, long COVID burden in PEI is likely to be substantial.

Two prior systematic reviews assessed the impact of COVID-19 in PEI, with evidence up to October 2021,[17] and February 2022.[18] Findings from the more recently published data included in our review are consistent with those of the previous reviews, suggesting that the disparities in outcomes (infection rates, hospitalisation rates and outcomes and mortality) have persisted and not been mitigated. A prior scoping review specifically assessed mental health outcomes of PEI during the COVID-19 pandemic, also showing worsening mental health outcomes.[11] Data from a whole population Danish study, however, found comparable rates of self-harm among PEI who tested positive for SARS-CoV-2 compared with those who did not.[87]

The present review's findings appear consistent with other systematic reviews in minoritised groups. Ogbonna *et al* reviewed COVID-19 outcomes in people experiencing homelessness, demonstrating higher rates of hospitalisation, increased mortality rates, lower vaccination rates and poorer mental health outcomes compared with the general population.[88] Several authors have noted a higher COVID-19-related mortality rate in residents of long-term care facilities.[89 90] Though these two groups are clinically and epidemiologically distinct from PEI, there are multiple common factors evident. A whole population Danish study also demonstrated higher rates of adverse outcomes such as hospitalisation, intensive care admission and mortality in subjects with a low educational level, and those with a history of substance misuse, psychiatric admission or severe mental health illness.[42]

Implications for policy and practice

PEI are a vulnerable population who could benefit from implementation of mitigating interventions and better access to healthcare. Given the poorer outcomes shown, this vulnerable group should be prioritised in national policy in the event of further waves of COVID-19 or for different potential future pandemics. Where vaccines exist, vaccination is essential to improving COVID-19 outcomes in PEI. Prioritisation for vaccination in this vulnerable group significantly increased vaccine uptake to levels above that of the general population and should be integral to future vaccine policy.[73] Education about vaccine importance and re-offering vaccines to people who previously declined are also warranted.[69 70]

Certain minoritised groups including non-Hispanic black, black ethnic minority groups and older PEI had poorer outcomes following COVID-19 infection.[47 48 50 64] The burden of COVID-19 in prisons in rural and socioeconomically disadvantaged areas was also higher.[48] Mitigation strategies are required for these vulnerable groups and areas.

Mental health outcomes deteriorated during the COVID-19 pandemic for PEI. Further support is necessary, considering the high baseline psychiatric morbidity in prisoners, and the decline seen during the pandemic.[11]

Further research

High-quality evidence was lacking about the COVID-19 outcomes of PEI. Many studies were of low quality, relying on third-party observational data, and prone to bias. No research on longer-term outcomes such as long COVID was identified but this is needed to assess the full effect of the pandemic on PEI. Longer-term data will also help to quantify whether health inequalities have grown further as a result of the pandemic. Again, in the event of further waves of COVID-19 or for different potential future pandemics, higher quality evidence documenting incidence and testing rates/strategies together and further analysis of different prison subgroups is necessary. More international data are required to assess transferability of results from this systematic review to other incarceration systems. Higher-quality studies from nations with comparative incarceration and healthcare systems may have more generalisable and transferable findings.

Data assessing mental health outcomes in more detail with control groups from the general population should also be prioritised. The effectiveness of any mitigating interventions should be evaluated by high-quality randomised controlled trials. We recognise that performing such studies in the context of incarceration facilities is highly complex and potentially challenging. Quality of studies could be improved with better pandemic readiness allowing prison teams to immediately liaise with researchers so that prospective verifiable data could be collected rather than relying on third party (eg, governments/prisons, unconnected with the research teams themselves) retrospective data.

Strengths and limitations

Our review is the most current assessment of COVID-19 outcomes in PEI worldwide. The study focuses on objective data relating to clinical outcomes and makes comparisons, both within incarceration facilities and with the general population, highlighting significant health inequalities. The protocol was registered on PROSPERO and Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines were followed.[25] Comprehensive search terms generated evidence from both high-income and low/middle-income countries.

Incidence rates were often reported without testing rate documentation and outcomes without standardisation for age or comorbidity. Heterogenous testing strategies across countries, regions and institutions between the general population and PEI mean comparisons between data should be interpreted with caution. Crude mortality rates between the general and prison population were often reported and should also be interpreted with care. Other confounders, such as pre-existing conditions, which could impact mortality, were often not identified.

Study limitations include that only 10% of the eligibility assessment was duplicated. Studies were excluded if not published in English, potentially leading to some selection bias. Most studies (~65%) were based in the USA which may limit transferability of overall findings to other nations with different prison systems and COVID-19 burdens.

The included studies varied greatly in terms of their measured outcomes, testing strategies, data collection time, comorbidities of subjects (variably reported), vaccination coverage of subjects (often unreported) and epidemiology of COVID-19 conditions both within and between included countries. This heterogeneity was considered too great to allow for meaningful meta-analysis. The limitations of inappropriate use of random-effects model meta-analysis in systematic reviews of highly heterogeneous studies have been highlighted.[91–93] Nevertheless, the lack of meta-analysis is a limitation of this study and a common issue faced by systematic reviews looking to assess impacts of the COVID-19 pandemic on small population groups in differing regions/countries, for example, long-term care facility residents and people experiencing homelessness.[88 90]

CONCLUSION

PEI had poor COVID-19 clinical outcomes such as higher incidence and rates of hospitalisation, poorer hospital outcomes, higher mortality and worsening mental health outcomes. However, the true and lasting impact of COVID-19 on PEI cannot be assessed due to research gaps, low-quality evidence and heterogeneous results. Outcomes, especially the long-term effects of COVID-19, and the effectiveness of mitigating COVID-19 interventions should be assessed, so that management of this pandemic (if there are further waves) or any potential future pandemics, is evidence-based.

Acknowledgements The authors would like to thank Elizabeth Gillen (Wales Centre for Evidence Based Care) for assistance in designing the searching, Dr Stephanie Perrett (Public Health Wales) and Dr Jake Hard (Medical Director for prisons healthcare) for stakeholder advice.

Contributors AE and BS conceived the article. DBW, BS and FB performed the literature search. BS and DBW collected data from individual studies and interpreted the data. BS and DBW wrote the first draft of the paper. DBW, DW, AE and RL revised the first and subsequent drafts. All authors contributed to interpretation of the findings and revised the manuscript for important intellectual content. All authors meet all four criteria of ICMJE recommendations for authorship. DBW is the author acting as guarantor for this paper.

Funding Authors DBW, BS and FB have not received a specific grant for this research from any funding agency in the public, commercial or not-for-profit sectors. Authors DW, AE and RL are funded by the Wales COVID-19 Evidence Centre.

Competing interests None declared.

Patient and public involvement Patients and/or the public were not involved in the design, or conduct, or reporting, or dissemination plans of this research.

Patient consent for publication Not applicable.

Ethics approval Not applicable.

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement Data sharing not applicable as no datasets generated and/or analysed for this study.

ORCID iDs
Darius Benedict Williams http://orcid.org/0009-0003-7804-8805
Ruth Lewis http://orcid.org/0000-0003-0745-995X
Adrian Edwards http://orcid.org/0000-0002-6228-4446

REFERENCES

1 Novisky MA, Nowotny KM, Jackson DB, *et al*. Incarceration as a fundamental social cause of health inequalities: jails, prisons and vulnerability to COVID-19. *The British Journal of Criminology* 2021;61:1630–46.
2 de Viggiani N. Unhealthy prisons: exploring structural determinants of prison health. *Sociol Health Illn* 2007;29:115–35.
3 Scotland PH. What are health inequalities? [Internet]. 2021. Available: http://www.healthscotland.scot/health-inequalities/what-are-health-inequalities
4 Baybutt M, Dooris M, Farrier A. Growing health in UK prison settings. *Health Promotion International* 2019;34:792–802.
5 Ginn S. Promoting health in prison. *BMJ* 2013;346:bmj.f2216.
6 Yoon S, Ju YS, Yoon J, *et al*. Health inequalities of 57,541 prisoners in Korea: a comparison with the general population. *Epidemiol Health* 2021;43:e2021033.
7 Davies M, Keeble E. Covid-19 in prisons: fewer cases than feared but it's not the whole story [Internet]. 2020. Available: https://www.nuffieldtrust.org.uk/news-item/covid-19-in-prisons-fewer-cases-than-feared-but-it-s-not-the-whole-story
8 Novisky MA, Narvey CS, Semenza DC. Institutional responses to the COVID-19 pandemic in American prisons. *Victims & Offenders* 2020;15:1244–61.
9 Hewson T, Shepherd A, Hard J, *et al*. Effects of the COVID-19 pandemic on the mental health of prisoners. *Lancet Psychiatry* 2020;7:568–70.
10 DePalma A, Noujaim D, Coman E, *et al*. Older incarcerated persons' mental health before and during the COVID-19 pandemic. *Int J Prison Health* 2021;ahead-of-print.
11 Johnson L, Gutridge K, Parkes J, *et al*. Scoping review of mental health in prisons through the COVID-19 pandemic. *BMJ Open* 2021;11:e046547.
12 Brennan PK. Responses taken to mitigate COVID-19 in prisons in England and Wales. *Victims & Offenders* 2020;15:1215–33.
13 Braithwaite I, Edge C, Lewer D. Indirect age- and sex-standardisation of COVID-19-related mortality rates for the prison population of England and Wales. London, UK: UCL Collaborative Centre for Inclusion Health, 2021.
14 Altibi AM, Pallavi B, Liaqat H, *et al*. Characteristics and comparative clinical outcomes of prisoner versus non-prisoner populations hospitalized with COVID-19. *Sci Rep* 2021;11:6488.
15 NIHR. Living with Covid19 – second review [Internet]. 2021. Available: https://evidence.nihr.ac.uk/wp-content/uploads/2021/03/NIHR_COVID_REPORT_FINAL-150321-1_1_.pdf
16 Ayoubkhani D, Bermingham C, Pouwels KB, *et al*. Trajectory of long Covid symptoms after COVID-19 vaccination: community based cohort study. *BMJ* 2022;377:e069676.
17 Kim H, Hughes E, Cavanagh A, *et al*. The health impacts of the COVID-19 pandemic on adults who experience imprisonment globally: a mixed methods systematic review. 2022/05/21. *PLoS One [Internet]* 2022;17:E0268866.
18 Puglisi LB, Brinkley-Rubinstein L, Wang EA. COVID-19 in Carceral systems: A review. *Annu Rev Criminol* 2023;6:399–422.
19 Akers J, Aguiar-Ibáñez R, Baba-Akbari A. Systematic reviews: CRD's guidance for undertaking reviews in health care. York, UK: Centre for Reviews and Dissemination, University of York, 2009.
20 Team TE. EndNote. EndNote 20. Philidelphia, PA: Clarivate, 2013.
21 Munn Z, Moola S, Lisy K, *et al*. Methodological guidance for systematic reviews of observtional epidemiological studies reporting prevalence and incidence data. *Int J Evid Based Healthc* 2015;13:147–53.
22 Lockwood C, Munn Z, Porritt K. Qualitative research synthesis: methodological guidance for systematic reviewers utilizing meta-aggregation. *Int J Evid Based Healthc* 2015;13:179–87.
23 Moola S, Munn Z, Tufanaru C, *et al*. Aromataris E. In: Aromataris E, Munn Z, eds. *JBI manual for evidence synthesis*. JBI, 2020. Available: https://synthesismanual.jbi.global
24 Evans BC, Coon DW, Ume E. Use of theoretical frameworks as a pragmatic guide for mixed methods studies: a methodological necessity. *J Mix Methods Res* 2011;5:276–92.
25 Page MJ, McKenzie JE, Bossuyt PM, *et al*. n.d. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews [BMJ [Internet]. 2021;372:n71]. *BMJ*:71.
26 Toblin R, Hagan LMMPH. COVID-19 case and mortality rates in the Federal Bureau of prisons. *Am J Prev Med [Internet]* 2021;61. Available: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7905372/
27 Saloner B, Parish K, Ward JA, *et al*. COVID-19 cases and deaths in Federal and state prisons. *JAMA* 2020;324:602–3.
28 Marquez N, Ward JA, Parish K, *et al*. COVID-19 incidence and mortality in Federal and state prisons compared with the US population. *JAMA* 2021;326:1865.
29 Blair A, Parnia A, Siddiqi A. A time-series analysis of testing and COVID-19 outbreaks in Canadian federal prisons to inform prevention and surveillance efforts. *Can Commun Dis Rep* 2021;47:66–76.
30 Jiménez MC, Cowger TL, Simon LE, *et al*. Epidemiology of COVID-19 among incarcerated individuals and staff in Massachusetts jails and prisons. *JAMA Netw Open* 2020;3:e2018851.
31 Lemasters K, McCauley E, Nowotny K, *et al*. COVID-19 cases and testing in 53 prison systems. *Health Justice* 2020;8:24.
32 Leibowitz AI, Siedner MJ, Tsai AC, *et al*. Association between prison crowding and COVID-19 incidence rates in Massachusetts prisons. *JAMA Intern Med* 2021;181:1315.
33 Gouvea-Reis FA, Oliveira PD, Silva DCS, *et al*. COVID-19 outbreak in a large penitentiary complex, April–June 2020, Brazil. *Emerg Infect Dis* 2021;27:924–7.
34 LeMasters K, Ranapurwala S, Maner M, *et al*. 2022 COVID-19 community spread and consequences for prison case rates. *PLoS ONE*17:e0266772.
35 Mazzilli S, Tavoschi L, Soria A, *et al*. COVID-19 infection among incarcerated individuals and prison staff in Lombardy, Italy, March 2020 to February 2021. *JAMA Netw Open* 2022;5:e224862.
36 Marusinec R, Brodie D, Buhain S, *et al*. Epidemiology of coronavirus disease 2019 at a county jail-Alameda County, California, March 2020-March 2021. *J Public Health Manag Pract* 2022;28:50–9.
37 Towers S, Wallace D, Walker J, *et al*. A study of SARS-COV-2 outbreaks in US Federal prisons: the linkage between staff, incarcerated populations, and community transmission. *BMC Public Health* 2022;22:482.
38 Rice WM, Chudasama DY, Lewis J, *et al*. Epidemiology of COVID-19 in prisons, England, 2020. *Emerg Infect Dis* 2021;27:2183–6.
39 Smith M, Glidden MD. COVID-19 in prisons: state health care contracting and the pandemic behind bars. *J Correct Health Care* 2022;28:164–71.
40 Vella R, Giuga G, Piizzi G, *et al*. Health management in Italian prisons during COVID-19 outbreak: a focus on the second and third wave. *Healthcare (Basel)* 2022;10:282.
41 Adamson JP, Smith C, Pacchiarini N, *et al*. A large outbreak of COVID-19 in a UK prison, October 2020 to April 2021. *Epidemiol Infect* 2022;150:e134.
42 Nilsson SF, Laursen TM, Osler M, *et al*. Adverse SARS-Cov-2-associated outcomes among people experiencing social marginalisation and psychiatric vulnerability: a population-based cohort study among 4,4 million people. *Lancet Reg Health Eur* 2022;20:100421.
43 Mellon G, Rouquette A, Fac C, *et al*. SARS-Cov-2 seroprevalence in the adult detainees of the Paris area in 2021: a multicenter cross-sectional study. *J Infect* 2022;85:e40–3.
44 Kronfli N, Dussault C, Maheu-Giroux M, *et al*. Seroprevalence and risk factors for severe acute respiratory syndrome Coronavirus 2 among incarcerated adult men in Quebec, Canada, 2021. *Clin Infect Dis* 2022;75:e165–73.
45 Kennedy BS, Richeson RP, Houde AJ. Risk factors for SARS-Cov-2 in a statewide correctional system. *N Engl J Med* 2020;383:2479–80.
46 Gibson B. NCCHC survey yields insights into COVID-19 in U.S correctional facilities. *J Correct Health Care* 2020;26:204–6.
47 Qureshi N, Cardenas C, Tran ND, *et al*. Implementation of a COVID-19 infection control plan in a large urban jail system. *Public Health Rep* 2022;137:442–8.
48 Gu M, Pro G, Zaller N. Surveillance of COVID-19 outbreaks in prisons in the US south: the role of economic distress in the communities surrounding prison facilities. *J Clin Trans Sci* 2022;6.

49 Chin ET, Ryckman T, Prince L, *et al*. COVID-19 in the California state prison system: an observational study of decarceration, ongoing risks, and risk factors. *J Gen Intern Med* 2021;36:3096–102.
50 Kwan A, Garcia-Grossman I, Sears D, *et al*. The impact of COVID-19 on the health of incarcerated older adults in California state prisons. *Health Affairs* 2022;41:1191–201.
51 Hicks JT, Das S, Matanock A, *et al*. Characteristics of persons with secondary detection of severe acute respiratory syndrome Coronavirus 2 ≥90 days after first detection, New Mexico 2020. *J Infect Dis* 2021;224:1684–9.
52 Wallace D, Eason JM, Walker J, *et al*. Is there a temporal relationship between COVID-19 infections among prison staff, incarcerated persons and the larger community in the United States *Int J Environ Res Public Health* 2021;18:6873.
53 Blair A, Parnia A, Siddiqi A. Testing lags and emerging COVID-19 outbreaks in federal penitentiaries: a view from Canada (Pre-Print). *Medrxiv* 2020.
54 Montgomery MP, Hong K, Clarke KEN, *et al*. Hospitalizations for COVID-19 among US people experiencing Incarceration or homelessness. *JAMA Netw Open* 2022;5:e2143407.
55 Abdalbary M, Kakani E, Ahmed Y, *et al*. Characteristics and outcomes of prisoners hospitalized due to COVID-19 disease. *CN* 2022;97:232–41.
56 Chan J, Burke K, Bedard R, *et al*. COVID-19 in the New York City jail system: epidemiology and health care response, March–April 2020. *Public Health Rep* 2021;136:375–83.
57 Davies M, Keeble E, Hutchings R, *et al*. Injustice? Towards a better understanding of health care access for prisoners. Nuffield Trust, 2021.
58 Nowotny KM, Cloud D, Wurcel AG, *et al*. Disparities in COVID-19 related mortality in U.S. *medRxiv [Internet]* 2020. Available: http://www.epistemonikos.org/documents/29224fe363d4734d1b78779e1a1b21a833437720
59 Marquez NM, Littman AM, Rossi VE, *et al*. Life expectancy and COVID-19 in Florida state prisons. *American Journal of Preventive Medicine* 2022;62:949–52.
60 Nowotny K, Metheny H, LeMasters K, *et al*. Age and COVID-19 mortality in the United States: a comparison of the prison and general population. *IJPH* 2023;19:35–46.
61 Marquez NM, Littman A, Rossi V, *et al*. Assessing the mortality impact of the COVID-19 pandemic in Florida state prisons. *medRxiv* 2021.:2021.04.14.21255512.
62 Marquez NM, Moreno D, Klonsky A, *et al*. Racial and ethnic inequalities in COVID-19 mortality within Carceral settings: an analysis of Texas prisons. *Health Affairs* 2022;41:1626–34.
63 Gouvea-Reis FA, Borja LS, Dias PO, *et al*. SARS-Cov-2 among inmates aged over 60 during a COVID-19 outbreak in a penitentiary complex in Brazil: positive health outcomes despite high prevalence. *Int J Infect Dis* 2021;S25–7.
64 Li MY, Grebbin S, Patil A, *et al*. Examining COVID-19 mortality rates by race and ethnicity among incarcerated people in 11 U.S. state prisons (March–October 2021). *SSM Popul Health* 2022;20:101299.
65 Hagan LM, Dusseau C, Crockett M, *et al*. COVID-19 vaccination in the Federal Bureau of prisons, December 2020—April 2021. *Vaccine* 2021;39:5883–90.
66 Lind ML, Kennedy BS, Nieto MD, *et al*. Covid-19 vaccine acceptance among individuals incarcerated in Connecticut state jails. *Health Justice* 2023;11:16.
67 Wilkinson M, Yeung A, Hutchinson S. Vaccination for SARS-CoV-2 and Risk of COVID disease among those in prison care in Scotland. Public Health Scotland, 2021.
68 Nilsson SF, Laursen TM, Osler M, *et al*. Vaccination against SARS-Cov-2 infection among vulnerable and Marginalised population groups in Denmark: A nationwide population-based study. *Lancet Reg Health Eur* 2022;16:100355.
69 Chin ET, Leidner D, Ryckman T, *et al*. Covid-19 vaccine acceptance in California state prisons. *N Engl J Med* 2021;385:374–6.
70 Liu YE, Oto J, Will J, *et al*. Factors associated with COVID-19 vaccine acceptance and hesitancy among residents of Northern California jails. *Prev Med Rep* 2022;27:101771.
71 Di Giuseppe G, Pelullo CP, Lanzano R, *et al*. 2022 COVID-19 vaccination uptake and related determinants in detained subjects in Italy. *Vaccines*10:673.
72 Strodel R, Dayton L, Garrison-Desany HM, *et al*. COVID-19 vaccine prioritization of incarcerated people relative to other vulnerable groups: an analysis of state plans. *PLoS One* 2021;16:e0253208.
73 Biondi BE, Leifheit KM, Mitchell CR, *et al*. Association of state COVID-19 vaccination Prioritization with vaccination rates among incarcerated persons. *JAMA Netw Open* 2022;5:e226960.
74 Comartin EB, Victor G, Ray B, *et al*. n.d. County jails' responses to COVID-19: practices, procedures, and provisions of behavioral health services. *Psychological Services*19:621–9.
75 Birkie M, Necho M, Tsehay M, *et al*. n.d. Depressive, anxiety symptom frequency and related factors among prisoners during the COVID-19 pandemic in northeastern Ethiopia, a cross-sectional study. *Front Psychiatry*13.
76 Gétaz L, Wolff H, Golay D, *et al*. Suicide attempts and COVID-19 in prison: empirical findings from 2016 to 2020 in a Swiss prison. *Psychiatry Res* 2021;303:114107.
77 Zhang S, He J, Yang Q, *et al*. Anxiety during the COVID-19 pandemic in prisoners who had high risks to suffer from mood disorders: A longitudinal study before and during the COVID-19. *Stress and Health* 2023;39:162–8.
78 Beaudry G, Zhong S, Whiting D, *et al*. Managing outbreaks of highly contagious diseases in prisons: a systematic review. *BMJ Glob Health* 2020;5:e003201.
79 Simpson PL, Simpson M, Adily A, *et al*. Prison cell spatial density and infectious and communicable diseases: a systematic review. *BMJ Open* 2019;9:e026806.
80 Jiménez MC, Cowger TL, Simon LE, *et al*. Epidemiology of covid-19 among incarcerated individuals and staff in massachusetts jails and prisons. *JAMA Netw Open* 2020;3:e2018851.
81 Wright NM, Hearty P, Allgar V. Prison primary care and non-communicable diseases: a data-linkage survey of prevalence and associated risk factors. *BJGP Open* 2019;3:bjgpopen19X101643.
82 Andrews JR, Liu YE, Croda J. Enduring injustice: infectious disease outbreaks in Carceral settings. *J Infect Dis* 2024;229:307–9.
83 ECDPC. Systematic Review on Active Case Finding of Communicable Diseases in Prison Settings: Prevention and Control of Communicable Diseases in Prison Settings. Stockholm, 2017.
84 Fazel S, Baillargeon J. The health of prisoners. *The Lancet* 2011;377:956–65.
85 Vest N, Johnson O, Nowotny K, *et al*. Prison population reductions and COVID-19: a latent profile analysis synthesizing recent evidence from the Texas state prison system. *J Urban Health* 2021;98:53–8.
86 Woodrow M, Carey C, Ziauddeen N, *et al*. Systematic review of the prevalence of long COVID. *Open Forum Infect Dis* 2023;10:ofad233.
87 Erlangsen A, Qin P, Madsen T, *et al*. Association between SARS-Cov-2 infection and self-harm: Danish nationwide register-based cohort study. *Br J Psychiatry* 2023;222:167–74.
88 Ogbonna O, Bull F, Spinks B, *et al*. The impact of being homeless on the clinical outcomes of COVID-19. *Int J Public Health* 2023;68:1605893.
89 Heneghan C, Dietrich M, Brassey J, *et al*. Effects of COVID-19 in care homes - a mixed methods review. *Public and Global Health* [Preprint] 2022.
90 Henriques HR, Sousa D, Faria J, *et al*. Learning from the COVID-19 outbreaks in long-term care facilities: a systematic review. *BMC Geriatr* 2023;23:618.
91 Guolo A, Varin C. Random-effects meta-analysis: the number of studies matters. *Stat Methods Med Res* 2017;26:1500–18.
92 Imrey PB. Limitations of meta-analyses of studies with high heterogeneity. *JAMA Netw Open* 2020;3:e1919325.
93 Cornell JE, Mulrow CD, Localio R, *et al*. Random-effects meta-analysis of inconsistent effects: a time for change. *Ann Intern Med* 2014;160:267–70.