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# The association between health and prison overcrowding, a scoping review

Maha Aon<sup>1,2</sup>, Simon Oberconz<sup>1</sup> and Marie Brasholt<sup>1\*</sup>

## Abstract

It is estimated that the majority of prisons globally are overcrowded. There is consensus that overcrowding leads to negative health outcomes, however quantitative research of this association appears limited. This scoping review aimed to identify literature examining the association between prison overcrowding and health outcomes, and to summarize these associations. Two databases and a grey literature site were searched for quantitative studies where overcrowding was an independent variable, and the outcome was any physical or mental health issue. This yielded 34 records from 16 mostly high-income countries in addition to three multi-country studies. Studies applied a range of definitions of overcrowding with the most common being occupancy rates. Studies mostly concluded that overcrowding had a positive association on the outcome under study, i.e., as overcrowding increased so did the prevalence of the disease under study. When methodological limitations were taken into consideration, we found that in eighteen articles prison overcrowding was independently and positively associated with tuberculosis, COVID-19, self-harm, depression, overall prison mortality, and injuries due to violence respectively. Prison overcrowding was not found to be independently associated with suicide in four of the five studies where it featured.

**Keywords** Prisons, Crowding, Scoping review, Tuberculosis, COVID-19, Self-harm, Depression, Suicide

## Background

With 11.5 million people incarcerated, the number of people in prison today is greater than at any time in history [1]. People in prison are generally in poorer health compared to those who have never been incarcerated [2–7]. For example, rates of infectious diseases like human immunodeficiency virus (HIV), tuberculosis (TB) and scabies are higher in prison compared to the general community, as are rates of mental health problems and behaviors including suicide and self-harm [5, 8–11]. People who experience incarceration are often already at higher risk of negative health outcomes due to poverty

and marginalization. The incarceration experience amplifies this risk [12].

People experiencing incarceration continue to suffer negative health outcomes post release. Suicide rates are higher among people released from prisons compared to the general community, and mortality due to alcohol and other drug poisoning as well as cardiovascular disease may be particularly pronounced within the first week post release [12, 13]. Social re-integration and work may be hindered either directly because of the consequences of poor physical or mental health or because of prison-related stigma [14].

Prisons are dynamic facilities with daily incoming and outgoing traffic, including staff, people starting and ending prison sentences and others going to court or external medical appointments, as well as visitors. Infectious disease outbreaks in prison pose a risk for the outside community. For example, decreasing jail populations has been associated with reductions in COVID-19 growth rates in the general community [15].

\*Correspondence:

Marie Brasholt  
mbr@dignity.dk

<sup>1</sup> Prevention and Accountability Department, DIGNITY - Danish Institute against Torture, Copenhagen, Denmark

<sup>2</sup> Epidemiology and Population Health Department, Faculty of Health Sciences, American University of Beirut, Beirut, Lebanon



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The effect of incarceration also spreads beyond the individuals to their families. Children who experience the incarceration of a household member have higher odds of adult risk behavior such as smoking and heavy drinking as well as a range of mental health and behavioral problems [16, 17].

Comparing occupancy levels to official capacity, it is estimated that about 60% of global prisons are overcrowded [18]. A total of 59 countries report levels of overcrowding at 150% or more, and in the countries reporting the highest occupancy levels (the Republic of Congo, Cambodia, Uganda, the Philippines, and Sao Tome and Principe) the occupancy rates exceed 300% and go as high as 600%. A small number of countries – notably Russia, the Netherlands and Estonia—have seen a decrease in prison populations over the last years, but the general global trend is the opposite with increasing populations. Drivers of this phenomenon include harsh drug policies, overuse of pre-trial detention, lack of non-custodial measures and extreme sentencing [1].

While it is common to use occupancy rates to measure prison overcrowding, there is no consensus on a definition of prison overcrowding rendering comparative research a challenge [19, 20]. Overcrowding has been linked to negative health outcomes including infectious diseases and mental health illnesses, while the US Supreme Court has ruled that it hinders access to adequate health care [10, 20–22]. There is general consensus that overcrowding worsens sanitation, violence, and overall well-being [23, 24].

Despite the general agreement that prison overcrowding is a problem, its effect on health is often expressed in nebulous and general terms with little quantitative data on associations or quantification of pathways between prison overcrowding and health outcomes.

The purpose of this scoping review is to summarize quantitative evidence and identify key knowledge gaps in relation to the association between the health of people in prison and prison overcrowding. We aim to understand the health conditions studied in the literature in relation to prison overcrowding, and the associations between prison overcrowding and both mental and physical health of people in prison. A scoping review modality was found most relevant for the broad research questions [25].

## Methodology

This scoping review was conducted in line with a priori prepared protocol in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Scoping Reviews checklist and Explanation (PRISMA-ScR) (Supplementary Material 1) [26]. We searched two databases (Embase and Pubmed) and the

Grey Matters website for grey literature from inception to November 20th 2024. We conducted citation searching for quantitative studies of any design published in any language addressing any individuals in any prison or jail in any country (Supplementary Material 2). Studies were included if overcrowding was an independent variable (regardless of definition used) and the outcome was any physical or mental health issue. Article selection took place in two stages, at title and full text. In both stages, a calibration exercise was conducted by two reviewers and screening was performed in duplicate. We used Rayyan for screening and Zotero for reference management [27, 28].

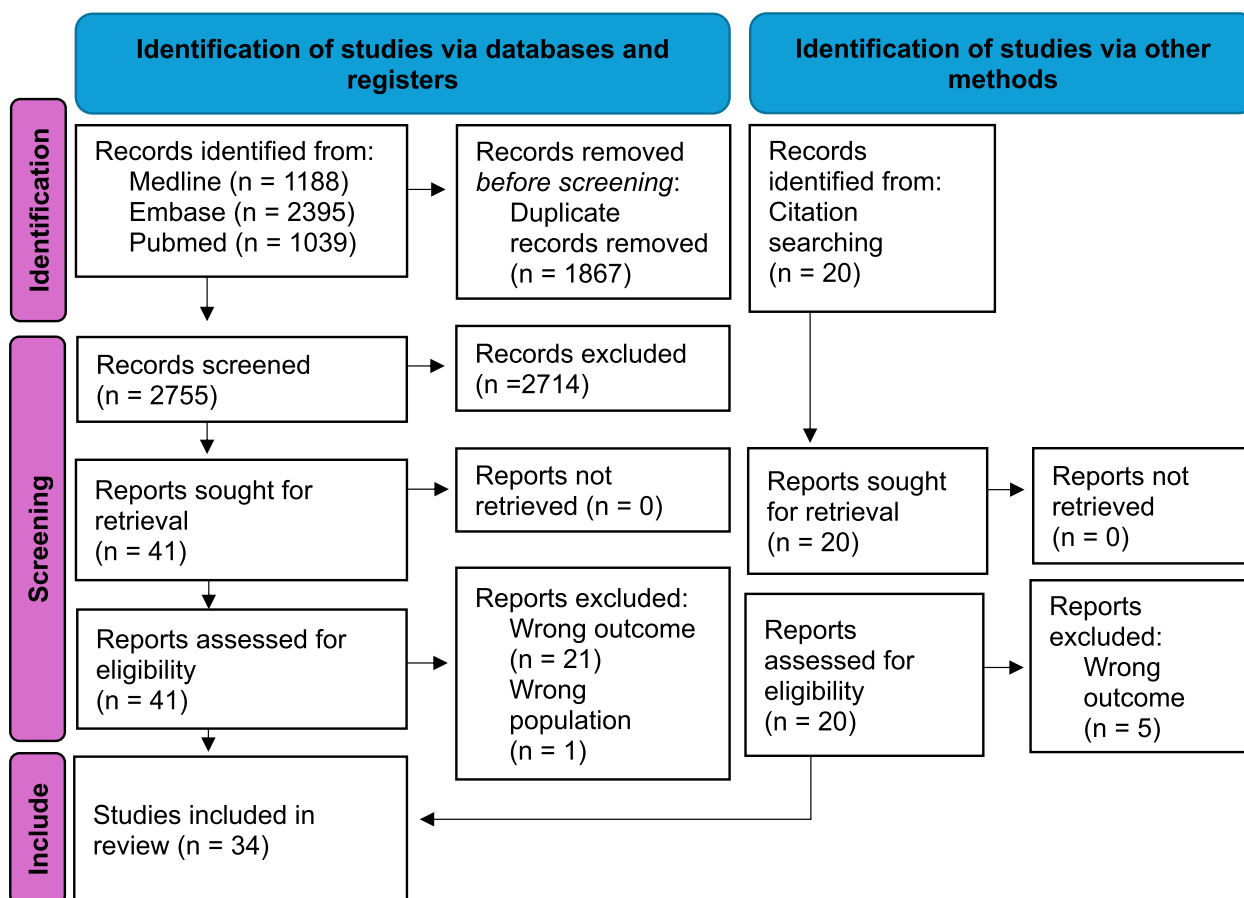
Data extraction took place in duplicate after a calibration exercise and utilizing a pre-prepared form. Extracted data consisted of study design, data collection period, sample size and characteristics, setting characteristics, overcrowding definition, health outcome, statistical methods and its results. Authors were contacted as needed. Critical appraisal of case-control and cohort studies was based on the Newcastle-Ottawa Quality Assessment Scale (NOS), cross-sectional studies were appraised using the Joanna Briggs Initiative (JBI) checklists for prevalence and a tool was designed for other study designs [29, 30].

## Results

### Included records

The search yielded 4,622 records of which 41 remained after de-duplication and title screening (Fig. 1). No relevant grey literature was found. We identified 20 additional records through citation searching. Subsequently, twenty-seven records were excluded because they studied the wrong outcome or population. We extracted data from 34 records. Two articles reported on the same dataset.

One record was in Spanish while all the rest ( $n = 33$ ) were in English [31]. Articles reported data from 16 countries and three covered multiple countries (Table 1). The majority ( $n = 20$ ) were from high-income countries with most from the United States ( $n = 8$ ) while ten articles were from middle-income countries and three from low-income countries [5, 31–61]. One article covered 10 countries of which three were high-income, one low-income and six upper-middle income [62]. The United States and Europe represented 18 articles (55%), Africa six articles (18%), Latin America six articles (18%), and four articles were from Asia (12%). Study years ranged from 1978 to 2024 with most ( $n = 26$ ; 79%) taking place since the year 2000. The most common study design was cross-sectional ( $n = 21$ ) followed by (records-based) cohort ( $n = 6$ ), ecological ( $n = 5$ ), and case-control ( $n = 2$ ). Sample sizes ranged



**Fig. 1** PRISMA Chart. Source: Page MJ, et al. BMJ 2021;372:n71. <https://doi.org/10.1136/bmj.n71>

from 66 to 818,126 (median = 609, interquartile range 250, 6,876) (Table 1). Many (n = 16; 47%) samples consisted of both men and women, seven (21%) consisted only of men, and eleven (32%) missed this information.

Study quality varied but was generally acceptable. Both case–control studies scored high on NOS for this study design (average 8.5 out of 9) and the six cohort studies scored on average 7 out of 9 on NOS for this study design with the most common weakness being lack of adjustment for confounders in the analysis. This was also the most common weakness in cross-sectional studies as assessed by the JBI checklist (which does not generate a numerical score). Other common issues with cross-sectional studies were unclarity about the sampling approach and limited description of the setting and population. Other methodological weaknesses included not recognizing and/or accounting for ecological fallacy in the ecological studies.

**Outcome 1: definition of overcrowding**

Most (n = 30; 88%) studies used a spatial density definition for prison overcrowding either by measuring prison

occupancy rate (n = 20), cell occupancy rate (n = 3) or physical space per person (n = 7). Occupancy rate was measured as a percentage of design capacity although a definition of capacity was not consistently provided. Most considered a prison overcrowded when the occupancy exceeded 100%, however three studies applied different thresholds [35, 44, 47]. Thresholds for physical space per person varied greatly and depended either on areal measurements or persons per cell (Table 2). One study applied two definitions, the classic occupancy rate in addition to the percentage of people housed in single cells [39].

Three studies went beyond spatial density in their definition of overcrowding [39, 41, 49, 52]. One created a standardized overcrowding index consisting of measures of population size, occupancy rate, and the difference between the number of people in prison and correctional staff [52]. In another article, the authors applied the same index after excluding population size [49]. In one study, the authors measured overcrowding by assessing not only spatial density (square feet per individual) but also social density (defined as the number of occupants per living

**Table 1** Overview of articles included in the present scoping review

Author & Year	Study design	Country	Sample
Aguilera et al., 2016 [32]	Prospective cohort	Chile	336
Baggio et al., 2018 [33]	Retrospective cohort	Switzerland	Missing
Baggio et al., 2020 [34]	Retrospective cohort	Switzerland	Missing
Bailo et al. 2023 [35]	Retrospective cohort	Italy	Missing
Borquez et al., 2017 [48]	Cross-sectional	Chile	140
Edgemon and Clay-Warner, 2019 [49]	Cross-sectional	USA	5,552
Fazel et al., 2017 [5]	Ecological	24 high-income countries	3,906
Fritz et al., 2021 [62]	Retrospective cohort	10 countries in South America	1,324 suicides, population average 818,126 / year
Gebrecherkos et al., 2016 [50]	Cross-sectional	Ethiopia	282
Gétaz et al., 2023 [36]	Cross-sectional	Switzerland	177
Hoge et al., 1994 [63]	Case-control	USA	6700
Huey & McNulty, 2005 [52]	Cross-sectional	USA	Missing (1,118 facilities)
Hussain et al, 2003 [53]	Cross-sectional	Pakistan	425
Johnstone-Robertson, et al., 2015 [54]	Cross-sectional	South Africa	Missing
Kalonji et al., 2016 [37]	Cross-sectional	Democratic Republic of Congo	733
Kuruwila et al., 2002 [55]	Cross-sectional	India	225
Leese et al., 2006 [38]	Cross-sectional	England & Wales	Missing
Leibowitz et al., 2021 [39]	Ecological	USA (Mass)	Average 6,876 during study period
Lobacheva et al., 2007 [56]	Case-control	Russia	114 (57 cases 57 controls)
López et al., 2022 [31]	Ecological	Colombia	977
MacIntyre et al., 1997 [40]	Retrospective cohort	USA (MD)	1,289
Mahawan et al., 2024 [57]	Cross-sectional	Thailand	985 prison cells
Martin et al., 2012 [58]	Cross-sectional	USA (AL)	66 prison staff
McCain et al., 1980 [41]	Cross-sectional	USA	1400
Moges et al., 2012 [59]	Cross-sectional	Ethiopia	250
Naning et al., 2018 [42]	Cross-sectional	Malaysia	Missing
Oninla & Onanyemi, 2012 [61]	Cross-sectional	Nigeria	305
Oninla et al., 2013 [60]	Cross-sectional	Nigeria	305
Rabe, 2012 [43]	Ecological	European Union member states	Average 524,000 / year
Reyes et al, 2020 [64]	Cross-sectional	Chile	140
Salazar-De La Cuba et al., 2019 [44]	Cross-sectional	Peru	69,890
van Ginneken et al., 2017 [45]	Ecological	England & Wales	Average 609.35 during study period
Vest et al., 2020 [46]	Cross-sectional	USA (TX)	130,610 people in prison; 37,201 staff
Wolff et al., 2016 [47]	Cross-sectional	Switzerland	Missing

unit) in addition to individual perceptions of overcrowding dubbed *crowding tolerance* [41] (Table 2).

### Outcome 2: studied health issues

The majority ( $n = 23$ ; 68%) of articles reported on the association between overcrowding and a physical health issue, most commonly TB ( $n = 12$ ; 35%) including both latent and active as diagnosed by a range of methods, typically sputum smear microscopy ( $n = 3$ ) and tuberculin test ( $n = 3$ ) (Table 3). Other respiratory illnesses studied are COVID-19 ( $n = 3$ ; 9%) and Pneumococcal disease ( $n = 1$ ; 3%). Three articles (9%) assessed skin conditions in general, another two (6%) sexually transmitted

infections including *N. gonorrhoeae*, syphilis, hepatitis B virus (HBV) and human immunodeficiency virus (HIV). One article examined injuries due to violence and one studied self-reported “illnesses” and blood pressure. Ten articles (29%) addressed the association between overcrowding and mental health, most commonly suicide (7; 21%) followed by self-harm ( $n = 2$ ; 6%), depression ( $n = 1$ ; 3%) and stress ( $n = 1$ ; 3%). Two studies (6%) included prison staff in their sample but the information was used to learn about the effect on incarcerated persons in relation to stress and COVID-19 infection and death [46, 58].

**Table 2** Definition of prison overcrowding employed in included articles

Overcrowding definition	Study	Overcrowding Threshold
Occupancy rate: Prison population / Prison capacity* ( <i>n</i> = 20)	Baggio et al., 2018 [33]; Baggio et al., 2020 [34]; Bailo et al. 2023 [35]; Fazel et al., 2017 [5]; Fritz et al., 2021 [62]; Hoge et al., 1994 [63]; Gétaz et al., 2023 [36]; Johnstone-Robertson, et al., 2015 [54]; Kuruvila et al., 2002 [55]; Lobacheva et al., 2007 [56]; Leese et al., 2006 [38]; López et al., 2022 [31]; Mahawan et al., 2024 [57]; Martin et al., 2012 [58]; Nanning et al., 2018 [42]; Rabe, 2012 [43]; Salazar-De La Cuba et al., 2019 [44]; van Ginneken et al., 2017 [45]; Vest et al., 2021 [46]; Wolff et al., 2016 [47]	Prison holding 34 prisoners over its designated capacity (Bailo et al., 2023 [35]) Occupancy rate >200% (Wolff et al., 2016 [47]) Occupancy rate >120% (Salazar-De La Cuba et al., 2019 [44]) Other studies considered >100% as overcrowding.
Occupancy rate: Cell population / Cell capacity ( <i>n</i> = 3)	Borquez et al., 2017 [48]; Gebrecherkos et al., 2016 [50]; Reyes et al., 2020 [64]	>100 persons per cell (Gebrecherkos et al., 2016 [50]) Individual cell occupied by >1 person (Borquez et al., 2017 [48]; Reyes et al., 2020 [64])
Physical space: Area per person in m <sup>2</sup> / ft <sup>2</sup> or per cell ( <i>n</i> = 7)	Aguilera et al., 2016 [32]; Hussain et al., 2003 [53]; Kalonji et al., 2016 [37]; MacIntyre et al., 1997 [40]; Moges et al., 2012 [59]; Oninla et al., 2013 [60]; Oninla & Onanyemi, 2012 [61]	>50 persons per 40 m <sup>2</sup> cell = 0.8 m <sup>2</sup> per person (Kalonji et al., 2016 [37]) >9 persons per 1000 ft <sup>2</sup> = 10.3 m <sup>2</sup> per person (MacIntyre et al., 1997 [40]) <60 ft <sup>2</sup> per person = 5.6 m <sup>2</sup> per person (Hussain et al., 2003 [53]) Single cell ((9.5 ft <sup>2</sup> per person = 0.9 m <sup>2</sup> ) vs dormitory (26 ft <sup>2</sup> per person = 2.4 m <sup>2</sup> )) (Oninla et al., 2013 [60]; Oninla & Onanyemi, 2012 [61]) No threshold defined (Aguilera et al., 2016 [32]; Moges et al., 2012 [59])
Index or multiple definitions: ( <i>n</i> = 4) Standardized index of (a) the total size of the inmate population, (b) the difference between the total number of inmates and the design capacity of the prison, and (c) the difference between the number of inmates and the number of correctional staff. Standardized index of (a) the ratio of the total number of inmates to the design capacity of the prison and (b) the ratio of the number of inmates to the number of correctional staff in the prison. Spatial density = ft <sup>2</sup> per individual; Social density = Nr occupants/living unit. Crowding tolerance (perceived crowding by individuals). Occupancy rate and % housed in single cell as opposed to group cells	Huey & McNulty, 2005 [52] Edgemon and Clay-Warner, 2019 [49] McCain et al., 1980 [41] Leibowitz et al., 2021 [39]	No threshold set. No threshold set. No threshold set. >100% occupancy rate and comparison between single vs. group cells

### Associations between overcrowding and health outcomes

Notwithstanding the specific outcome or study quality, most (*n* = 25; 74%) articles found a negative association between prison overcrowding and good health, i.e., that overcrowding is associated with worse health. However, the number of studies per outcome is limited. With the exception of TB and suicide, other outcomes are studied in less than four articles each, with five outcomes only featuring in one study each (Table 3).

Zooming in on studies that assessed overcrowding directly through multivariable analysis, the conclusion still stands that most found a negative association between prison overcrowding and good health. Studies

examining the association between overcrowding and infectious respiratory illnesses (TB and COVID-19), self-harm, violence, depression and all-cause mortality found a positive association, i.e. that these adverse outcomes worsened as overcrowding increased [33, 34, 37, 39, 40, 42–44, 47, 49, 50, 53, 54, 56]. However, an association was not found between overcrowding and suicide in two of the five studies where multivariable analysis was conducted [5, 43] while the two studies that found an association between suicide and overcrowding, saw this association disappear when the prison type/security regime was included in the analytic model [38, 52]. One study yielded a result in the opposite direction finding

**Table 3** The association of prison overcrowding with health outcomes in included studies

Article	Studied conditions	Measure (95% confidence interval)	Conclusion	Adjusted analysis + direct overcrowding definition
McCain et al., 1980 [41]	"Illness complaint rate" (self-report in 2 prisons) + Blood pressure (in 4 prisons)	Illness Complaint Rate across housing types: Texarkana prison: $F = 3.62, p < 0.01$ ; La Tuna prison: $F = 4.91, p < 0.01$ // Diastolic blood pressure El Reno prison: $F = 3.07, p < 0.05$ ; Texarkana: $F = 2.4; p < 0.05$ // Systolic blood pressure El Reno: $F = 2.45; p < 0.06$ ; La Tuna $F = 9.68, p < 0.003$ // Blood pressure Atlanta prison: $F = 5.3, p < 0.001$	"There is a progressive and measurable increase in negative effects with an increase in housing density."	No
Leese et al., 2006 [38]	Suicide ("Self-inflicted death" defined as "all deaths that appear to have been the result of an individual's own actions, irrespective of the inquest verdict")	Risk Ratio Model 1 = 2.00 (1.38-2.9); Model 2 = 1.61 (1.09-2.36); Model 3 = 1.32 (0.87-2)	Overcrowding is independently associated with suicide.	Yes
Fritz et al., 2021 [62]	Suicide (prison data)	$\beta = -57.8 (108.5, 7.1; p < 0.03)$	"High occupancies of prisons were associated with lower incidence of suicide."	Yes
Leibowitz et al., 2021 [39]	COVID-19 (based on government reports)	Incidence Rate Ratio Model 1 = 1.14 (1.03, 1.27); Model 2 = 4.86 (1.37, 17.27)	COVID-19 incidence is significantly higher in prisons with higher occupancy rates.	Yes
Géataz et al., 2023 [36]	COVID-19 (ELISA test)	Missing	"During the first wave, despite overcrowding and interaction with the community, the prison was not a hotspot of SARS-CoV-2 infection."	No
Vest et al., 2020 [46]	COVID-19 (online public data)	Profile 1: low-outbreak facilities = low nr of cases & deaths // Profile 2: high-death facilities = moderate nr of cases & very high level of deaths. // Profile 3: high-outbreak facilities = very high nr of cases & moderate level of deaths.	"Current prison population and level of employee staffing predicted membership in the high-outbreak and high-death profiles when compared with the low-outbreak profile."	No
Edgemon and Clay-Warner, 2019 [49]	Depression (online public data)	$\beta = 0.02; p < 0.01$	"Prison overcrowding and punitiveness are positively related to both depression and hostility"	Yes
Oninla et al., 2013 [60]	Dermatoses (clinical exam)	$\chi^2 = 4.925; p = 0.026$	"Overcrowding is a significant factor resulting in dermatoses."	No
Oninla & Onanyemi, 2012 [61]	Infectious skin conditions (clinical exam)	$\chi^2 = 13.013; p = 0.0001$	Infectious skin conditions "were found to be more common among inmates living in cells than those in the dormitories due to greater exposure to overcrowding."	No
Hussain et al., 2003 [53]	Latent TB (tuberculin test)	Adjusted Odds Ratio = 2.6 (1.6, 4.9)	Overcrowding is independently associated with latent TB.	Yes
Aguilera et al., 2016 [32]	Latent TB among contacts of TB-cases (in vitro interferon gamma release assay)	t for TB 0.78 ± 0.27; t for No TB 0.91 ± 0.38; $p = 0.022$	Overcrowding is independently associated with latent TB.	No
Reyes et al., 2020 [64]	Gonorrhoea (urethral test)	$\chi^2; p = 0.159$	Overcrowding is not independently associated with gonorrhoea.	No

**Table 3** (continued)

Article	Studied conditions	Measure (95% confidence interval)	Conclusion	Adjusted analysis + direct overcrowding definition
Hoge et al., 1994 [63]	Pneumococcal disease (specimen culture)	Attack rate, 0 vs. 4.7 per 1000; $p=0.03$	"Inmates housed in areas with 80 ft <sup>2</sup> or more ( $\geq 7.4\text{m}^2$ ) per person...had significantly fewer cases of disease than all other inmates."	No
Rabe, 2012 [43]	Prison mortality rate + Prison suicide rate (Council of Europe Annual Penal Statistics)	Suicide Rate: $\beta = \text{Model 1: } -0.06, p=0.53$ . Model 2: $0.00, p=0.10$ , Mortality Rate: $\beta = \text{Model 3: } 0.20, p=0.04$ , Model 4: $0.23, p=0.01$ .	Overcrowding is not independently associated with suicide. Overcrowding is independently associated with all-cause prison mortality.	Yes
Wolff et al., 2016 [47]	Self-harm (prison medical files)	Self-Strangulation/hanging Incidence Rate Ratio = $2.28 (1.73, 3.01)$ $p<0.001$ ; All other self-harm events Incidence Rate Ratio = $1.01 (0.91, 1.12)$ ; $p = 0.85$	Overcrowding is independently associated with self-strangulation/hangings but not with all self-harm events.	Yes
Baggio et al., 2018 [33]	Self-harm requiring medical attention (both suicidal (self-strangulation & self-hanging) and non-suicidal (self-injury))	$\beta = 0.068$ ; $p<0.001$	Overcrowding is independently associated with self-harm.	Yes
Kuruva et al., 2002 [55]	Skin infections (clinical exam)	$r=0.62$ ; $p>0.05$	"Barracks with overcrowding showed a high percentage of infection"	No
Borquez et al., 2017 [48]	STIs (Syphilis, HBV & HIV) (Blood tests)	Missing	Overcrowding was not associated with STIs in bivariate analysis.	No
Martin et al., 2012 [58]	Stress (self-reported by officers for themselves and inmates)	Officer stress: $64.4\%$	Officers find overcrowding an occupational stressor.	No
Bailo et al., 2023 [35]	Suicide (online public data)	Inmate stress according to officers: $73.8\%$	Prison overcrowding was not a risk factor for suicide.	No
Fazel et al., 2017 [5]	Suicide (online public data)	Missing	Overcrowding is not independently associated with suicide in prisons.	Yes
van Ginneken et al., 2017 [45]	Suicide (online public data)	$\beta = 0.987 (-0.449, 2.414)$	Overcrowding is not independently associated with suicide.	Yes
Huey & McNulty, 2005 [52]	Suicide (US census data)	Incidence Rate Ratio = 1; Standard Error = $0.003$	Overcrowding is not independently associated with suicide.	Yes
Lobacheva et al., 2007 [56]	TB (X-ray or symptoms)	$\beta$ Model 1 = $0.182$ ; Model 2 = $0.145$ ; Model 3 = $0.954$ ; $p<0.01$	Overcrowding is independently associated with suicide.	Yes
Kalonji et al., 2016 [37]	TB (microscopy)	Adjusted Odds Ratio = $4.0 (1.1, 15)$	Overcrowding is independently associated with TB.	Yes
Gebrecherkos et al., 2016 [50]	TB (microscopy)	Adjusted Odds Ratio = $9.8 (3.1, 31.6)$	Overcrowding is independently associated with TB.	Yes
Moges et al., 2012 [59]	TB (microscopy)	Adjusted Odds Ratio = $3.32 (3.29, 8.51)$	Overcrowding is independently associated with TB.	Yes
MacIntyre et al., 1997 [40]	TB (tuberculin test)	Adjusted Odds Ratio = $1.249 (0.802, 1.946)$	Overcrowding is not independently associated with TB.	Yes
López et al., 2022 [31]	TB cases notified in monitoring system	Risk Ratio Model 1 = $2.22 (1.4, 3.6)$ ; Model 2 = $1.4 (0.6, 3.2)$	Overcrowding is independently associated with TB.	Yes
		Linear regression slope comparing incidence across OC levels: $R^2=0.5798$ ; "index of health concentration" = $-0.121$	TB incidence is concentrated in the groups with highest overcrowding.	No

**Table 3** (continued)

Article	Studied conditions	Measure (95% confidence interval)	Conclusion	Adjusted analysis + direct overcrowding definition
Salazar-De La Cuba et al., 2019 [44]	TB (self-reporting of diagnosis given by prison health professional)	Multilevel modeling variance of the intercept = 3.25 (1.37, 7.71)	"Demographic factors, individual clinical features and overcrowding increases the likelihood of self-reported TB."	Yes
Mahawan et al., 2024 [57]	TB (medical files)	--	m <sup>2</sup> per person identified as high-impact parameter in one of the models (Applied Susceptible-Exposed-infected-Recovered (SEIR) model).	No
Naning et al., 2018 [42]	TB (diagnostic method unclear)	Reducing occupancy from 6 to 4 inmates/cell + improved ventilation from 2 to 12 air changes/hour with isoniazid preventive therapy + anti-TB treatment for a 3-year average sentence would reduce prevalence to 0.98% (0.83-1.17) compared to 7.08% (3.21,12.52) at baseline.	Reduced occupancy and improved ventilation would reduce TB prevalence in prisons (Applied SEIR model).	Yes
Johnstone-Robertson, et al., 2015 [54]	TB (diagnostic method unclear)	Transmission probability (%)	Levels of overcrowding (230%) in communal cells & poor TB case finding result in annual TB transmission risks of 90% per annum using the Wells-Riley equation. Implementing current national or international cell occupancy recommendations would reduce TB transmission probabilities by 30% and 50%, respectively.	Yes
Baggio et al., 2020 [34]	Violent assaults requiring immediate medical attention	$\beta = 0.001$ ; $p < 0.001$	1% increase in overcrowding = 0.1% increase in violence.	Yes

that high occupancy rate was associated with lower suicide incidence [62].

There were methodological concerns with respect to 15 studies (45%). Many of those did not employ a direct measure of prison overcrowding. For example, some studies compared the health outcome in cells versus dormitories without considering the number of people in either housing situation. In other cases, the threshold for overcrowding was not justified and appeared arbitrary. In some studies, overcrowding was defined in one way but analyzed in a different way. For example, one study defined overcrowding by occupancy as a percentage of capacity, but the analysis compared the health outcome across prison barracks without consideration for overcrowding. Where the analysis compared the health outcome across levels of overcrowding, this was only descriptive in many studies precluding conclusions of association. Finally, where analytic statistics were applied to explore the association between a health outcome and prison overcrowding, it did not adjust for important variables such as prison security, turnover, ventilation and so on (Table 3).

It is notable that all studies on skin conditions were from middle-income countries with none from high-income countries, and most studies on TB were from low- or middle-income countries (10 of the 13 studies on TB). With the exception of one multi-country study, all studies on mental health were from high-income countries as were studies on COVID-19. Apart from that, there were no clear differences between the studies from high-income countries compared to low- or middle-income countries regarding their definition of overcrowding or their findings about the association between overcrowding and health.

## Discussion

It is logical to assume that overcrowding, which is not coupled with increased budgets and mitigating actions, will lead to shortages in physical space, staffing and spending resulting in poor prison conditions expressed as compromised security, lesser healthcare access and quality, reduced contact with the outside world, and limited access to rehabilitation programs among other things [19]. It may be hypothesized that prison overcrowding creates a pathway to poor health. This would be in line with the deprivation theory which posits that incarceration has negative effects because it limits a person's control over their life, and reduces their access to social networks and programs thereby creating stress and negative outcomes [52]. The theory was first developed in the 1950's to describe prison culture as a result of the "pains of imprisonment" designed to assist those in prison in coping with the deprivations of prison such

as loss of liberty and autonomy [65]. Thus, overcrowding may condition the effects of deprivation, and it is often cited by prison staff as a source of stress both for them and for people in prison [58, 66]. This is supported by reviewed articles demonstrating how the effect of overcrowding is moderated by the prison regime and security level [38, 52].

Prison overcrowding complicates the application of the UN Standard Minimum Rules for the Treatment of Prisoners (Mandela Rules) [67]. In addition to the right to health, prison overcrowding risks the violation of other rights of people in prison. Specifically, the right to freedom from torture and other cruel, inhuman or degrading treatment or punishment is at stake. International, regional and national bodies including the UN Committee against Torture (CAT) concluded on several occasions that prison overcrowding combined with other prison conditions may amount to torture. Prison overcrowding may also violate the right to equality and non-discrimination as it complicates efforts to address the needs of the most vulnerable in prison; the right to privacy and family life as it complicates access to the outside world and private space; as well as the right to liberty and security as it has been associated with increased violence in prison [19].

Although overcrowding is often cited as a cause of health problems in prison by international organizations and in normative guidelines, we found few studies rigorously assessing this relationship. The evidence is strongest for TB where eight studies assessed the association while accounting for co-variables. This is in line with a systematic review on prison overcrowding and infectious diseases [22]. The number of studies for all other outcomes was limited and in relation to suicide even contradictory.

Research on the effect of prison overcrowding on the health of people in prison lends itself to ecological study design where upstream-level data on variables such as prison occupancy versus mortality rate can be compared. Such research provides valuable insight into the mega trends of incarceration and health outcomes. However, the absence of individual-level data curtails the study of important individual (or even prison)-level variables that may confound the relationship between overcrowding and health outcomes, i.e., ecological fallacy. Adjusting statistical analysis for variables such as ventilation, access to healthcare, turnover, the level of privacy or staff numbers is critical for better understanding of the relationship between overcrowding and health.

Thus, evidence establishing the association between prison overcrowding and health outcomes remains limited in both quantity and quality. We only searched two databases and a grey literature website, which may have

limited the number of records identified. However, we tried to mitigate this potential limitation with forward searches.

We also found a risk of information bias in studies where overcrowding was either not precisely defined or measured. Rather than measuring overcrowding directly, some studies effectively used a proxy such as housing style (cells versus dorms) or simply compared the outcome across prison barracks.

Even when overcrowding was defined as a percentage of capacity, definitions of capacity were not articulated. In fact, capacity may vary greatly subject to authorities' wish to either paint rosy or black pictures of the prison system. In two of the articles in this review, a seemingly arbitrary threshold was set for overcrowding such as 34 people above a prison capacity, or more than two people per bed. Such arbitrariness is not surprising. It is also not unusual for different authorities within the same country to issue different numbers regarding prison capacity. In addition, the threshold at which a prison was considered overcrowded varied. One study considered anything less than 10.3 m<sup>2</sup> per person as overcrowding while another set that limit at 0.8 m<sup>2</sup>—far below the standard set for European prisons by the European Committee for Prevention of Torture at 4 m<sup>2</sup> per person in multioccupancy cells [68]. Therefore, the conclusion of whether prison overcrowding was associated with a health outcome was highly dependent on these thresholds and definitions.

Another important aspect to keep in mind when assessing overcrowding is the fact that some authors who use occupancy vs. capacity as a measure actually describe *excess* crowding vs. capacity, thus effectively reducing the number with 100%. It is important to keep this potential difference in mind when trying to compare levels of overcrowding across countries. Taking all these factors into consideration, it is not surprising that to this day, no uniform definition of overcrowding exists, and in the articles included in this study, definitions varied greatly and for probably good reasons related to context.

There are huge differences between the world's prisons, and even within the same institution, the regime, prison conditions and levels of crowding may vary. Thus, some people may experience overcrowding even when others in the same institution do not. McCain et al. found that social density (number of people per living unit) was more strongly associated with people's health than spatial density (ft<sup>2</sup> per person) stressing the importance of privacy over physical space. They also found that people's mood was influenced more by the prison security level than by overcrowding [41]. Studies where multivariable analysis was conducted saw changes in the magnitude and statistical significance of the association between overcrowding and health outcomes. Aspects such as

prison turnover, security level, engagement in purposeful activity and quality of healthcare played an important role. Such studies demonstrate the importance of adopting more nuanced approaches to understanding the relationship between overcrowding and health. An example is the adoption of overcrowding indexes which combine different elements. One study combined occupancy rate, the overall population size and the ratio of staff to people in prison [52]. Creating an index that further integrates aspects such as social density and elements of privacy would enrich the characterization of overcrowding even further.

Our study was limited by the fact that we did not duplicate article screening at title stage though we assume a potential negative impact of this on the number of articles identified will have been mitigated by the forward searches. We restricted the search to health outcomes and did not explore other potential effects of overcrowding such as infractions and recidivism. This might be an interesting area of research but was beyond the scope of this review.

One of the most common approaches taken by governments to relieve prison overcrowding is to build more prisons, but this does not resolve the problem as prisons continue to fill up. Pre-trial detention is a driver of prison overcrowding with about a third of people in prison not convicted of a crime [1]. This proportion is substantially higher in many countries [18]. In addition, delayed judgement, limited implementation of alternative sentencing, long sentences, mandatory sentencing, delayed release, and overcriminalization all feed prison overcrowding [19]. Addressing these issues would likely reduce prison overcrowding but may not tackle its root cause.

Community-level determinants play an important role in public health beyond individual-level risk factors. Indeed, "individual pathology [is] a function of social dynamics" be that social networks, physical environments or national policies [69]. Prison overcrowding results from the power dynamics that led to over-criminalization which targets the poor and marginalized, and the political priorities that sustain overcrowding in prisons the world over. The poor and those with mental illnesses are over-represented in prisons [1, 70]. Prison overcrowding is one of the pathways that is both an expression of those disparities (the disproportionate incarceration of the poor and minorities), and a modifier of its effects (worsening the situation). It is a symptom rather than the cause. As such, we should not limit our analysis of health in overcrowded prisons to the technical problems of individual risk factors and institution-level determinants, instead we should recognize that prison overcrowding is at its root a political challenge [71].

## Conclusion

The present scoping review summarizes data from 34 articles on the association between prison overcrowding and health outcomes. The definition of overcrowding varied significantly across studies as did analytical approaches and study quality. Studies mostly concluded that overcrowding was positively associated with the outcome under study, i.e., that it increased it. When methodological limitations were taken into consideration, we found that in eighteen articles prison overcrowding was independently and positively associated with TB, COVID-19, self-harm, depression, overall prison mortality, and injuries due to violence respectively, i.e., that these outcomes increased with increased overcrowding. Prison overcrowding was not found to be independently associated with suicide.

## Supplementary Information

The online version contains supplementary material available at <https://doi.org/10.1186/s12889-025-23340-9>.

Supplementary Material 1.

## Authors' contributions

MA drafted the study protocol and the search strategies, designed the data extraction matrix, conducted data analysis and critical appraisal, and drafted the manuscript; MA and MB conducted full text screening and extracted data; MB contributed to the study protocol, data analysis and manuscript draft; SO conducted the database searches, title screening and manuscript formatting.

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## Data availability

No datasets were generated or analysed during the current study.

## Declarations

### Ethics approval and consent to participate

Not applicable.

### Consent for publication

Not applicable.

### Competing interests

The authors declare no competing interests.

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