



# Worldwide incidence of suicides in prison: a systematic review with meta-regression analyses



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## Summary

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**Background** Suicide is a leading cause of death during imprisonment. This systematic review aimed to synthesise available evidence of prison suicide incidence worldwide.

**Methods** We systematically searched the scientific literature, data repositories, and prison system reports, supplemented by correspondence with prison administrations. We included reports on people living in prison but excluded studies in preselected groups (by age or offence type). Absolute numbers and incidence rates of suicide mortality per 100 000 person-years by sex and country were extracted from 2000 to 2021. IQRs were used to describe the suicide incidence in different world regions. Incidence rate ratios comparing suicides of people living in prison with age-standardised general populations were calculated. We conducted meta-regression analyses on national-level and prison-level factors to examine heterogeneity. The study protocol was pre-registered with PROSPERO, CRD42021296819.

**Findings** We included three scientific studies, 124 official reports, and 11 datasets from email correspondence. Between 2000 and 2021, there were 29711 reported suicides during 91·2 million person-years of imprisonment in 82 jurisdictions worldwide (sex-specific data available for 13 289 individuals: 12 544 [94·4%] male and 745 [5·6%] female individuals). There were large variations between countries, with most studies reporting suicide rates in the range of 24–89 per 100 000 person-years in both sexes (22–86 in male individuals and 25–107 in female individuals). In meta-regression analyses, Europe (*vs* other regions), high-income countries (*vs* low-income and middle-income countries), and countries with lower incarceration rates (*vs* those with higher incarceration rates) had higher suicide rates. Incidence rate ratios between people who are incarcerated and age-standardised general populations in the same jurisdictions were typically in the range of 1·9–6·0 in male and 10·4–32·4 in female individuals.

**Interpretation** Prison services worldwide, and particularly in Europe, should prioritise suicide prevention. Assessment and management of suicide risk in female individuals living in prison need particular attention due to excess mortality relative to community-based populations. Interpretation of synthesised data needs to be done with caution due to high heterogeneity between jurisdictions.

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## Introduction

People living in prison are under the state's care, and governments are responsible for their safety. Despite this, suicides are a leading cause of death among people living in prison.<sup>1</sup> Furthermore, approximately one in ten people make at least one suicide attempt during their prison term.<sup>2</sup> Individual and institutional risk factors for prison suicide have been identified, which include modifiable clinical factors,<sup>3,4</sup> single-cell occupancy, and a lack of social visits.<sup>5</sup>

There are effective prevention interventions for suicidal behaviours for people who are incarcerated.<sup>6,7</sup> However, more research is needed—especially from low-income and middle-income countries (LMICs)—to examine suicide prevention at individual and system levels, such as public health initiatives before, during, and after incarceration.<sup>8</sup> Suicide incidence data can inform policy and treatment, and can be used to monitor outcomes of prevention initiatives. Prison suicide incidence has been reported in specific jurisdictions. One systematic review reported data

up to 2000 from several European countries, New Zealand, and the USA.<sup>9</sup> Other studies have examined European countries,<sup>10</sup> high-income countries in Oceania and North America,<sup>11</sup> and South America until 2017.<sup>12</sup> However, comparisons between world regions are absent, including none for Asia or Africa, which together hold 62% of incarcerated people worldwide.<sup>13</sup> The primary aim of this study was to systematically review the evidence on suicide incidence in prisons worldwide. Secondary objectives were to describe differences in suicide incidence by prison and country characteristics, which can contribute to suicide prevention, policy measures, and service development for people living in prison.

## Methods

### Search strategy and selection criteria

This review followed the PPRISMA.<sup>14</sup> We searched PsycInfo, Global Health, Web of Science, PubMed, National Criminal Justice Reference Service, Google Scholar, Global Index Medicus, Embase, Scopus, and

## Research in context

### Evidence before this study

We searched PsycInfo, Global Health, MEDLINE, and Embase databases from Jan 1, 2000, to Dec 4, 2023, using search terms suicide\* AND (prison\* OR inmate OR jail OR offend\* OR “criminal justice” OR imprison\* OR remand OR detain\* OR detention OR probat\* OR sentenced) AND (incidence OR prevalence OR mortality OR death) AND (review OR “meta-analysis”) without language restrictions. We found one previous systematic review with data from 1947 to 2000 without quantitative synthesis. We identified three additional studies reporting prison suicide incidence in different jurisdictions. One study surveyed 12 European countries from 2003 to 2007. Another reported data from 24 high-income countries in Europe, North America, and Oceania from 2011–14. A third study, from ten South American countries, included data from 2000–17. Together, these investigations showed higher suicide rates in prison compared with general populations, with rate ratios of typically more than three in male individuals and nine in female individuals. We did not identify comparisons involving lower income countries or between world regions.

### Added value of this study

Using prison suicide incidence data from 82 jurisdictions and over 20 years; we provide comparisons across world regions, and show that prison suicide rates in Europe were typically considerably higher than those in Africa (based on three jurisdictions), Asia, and the Americas. We outline country and prison characteristics associated with higher rates: high income, higher democracy levels, lower incarceration rates, and lower prison occupation levels. We report incidence rate ratios (comparing suicide rates in prison with the general populations) stratified by sex, allowing worldwide comparisons of the excess suicide mortality in prison.

### Implications of all the available evidence

Our findings underscore the importance of including imprisoned people in national suicide prevention strategies. High incidence rate ratios between the female prison population and the female general population suggest unmet health needs and that suicide assessment and management could be prioritised in the female prison population. Higher quality publicly available data registries are needed, especially in low-income and middle-income regions.

CINAHL Plus Database (Cumulative Index to Nursing and Allied Health) from Jan 1, 2000, to Dec 4, 2023, using search terms suicide\* AND (prison\* OR inmate OR jail OR offend\* OR “criminal justice” OR imprison\* OR remand OR detain\* OR detention OR probat\* OR sentenced) AND (incidence OR prevalence OR mortality OR death) without language restrictions. Precise search strings for different databases are shown in the appendix (pp 2–4). Database searches were imported and managed with Endnote. PAC-G also searched websites of prison administrations for public documents, registries, and annual reports. Contact information of prison administrations was retrieved from the World Prison Brief, with whom PAC-G and APM corresponded requesting incidence data. Emails were sent at least twice with at least 2 weeks between these attempts. The World Prison Brief holds basic statistics on 223 jurisdictions worldwide. For completeness of reporting periods, data registries in the public domain were preferred over data reported in the scientific articles.

### Eligibility assessment

Observational studies reporting suicide incidence in general prison populations were examined. We included studies, suicide registries, reports, and datasets published or provided by prison administrations, from all jurisdictions internationally and in any language. We excluded studies that examined suicide attempts or other suicidal or self-harm behaviours and those that reported suicide incidence in any limited non-representative age groups or otherwise selected populations (eg, violent offences or ethnic minority status), as preselected

subgroups might differ substantially in suicide risk from the general prison population. PAC-G and ENU (see Acknowledgments) independently conducted title and abstract screening of scientific articles, and applied inclusion and exclusion criteria to retained full texts without using automation tools. During the study selection process, unselected prison populations were identified. APM and GB trained and supervised screeners in regular meetings. PAC-G conducted screening of prison administration websites for reports and registries under the supervision of APM and further corresponded for additional data. Most reports were searchable for keywords such as “suicide”. Relevant articles and reports were translated as necessary with Google Translate. PAC-G, GB, and APM discussed and resolved uncertainties during screening and data extraction processes until consensus.

### Data extraction

Using a predefined template, PAC-G extracted the data from included studies, registries, and reports. GB replicated 20% of the data extraction to ascertain quality. Variables were the study period (from 2000 to 2021), annual numbers of suicides, number of people living in prison for corresponding years, country, jurisdiction, and sex (male, female, all).

For European jurisdictions, suicide data were reported uniformly by the Council of Europe Annual Penal Statistics, facilitating data extraction. A previous publication in ten South American countries reported incidence uniformly. Several other countries had official reports that covered all included years. For other jurisdictions, data were extracted individually from

See Online for appendix

For more on the **World Prison Brief** see [www.prisonstudies.org](http://www.prisonstudies.org)

official governmental reports, publications, or email correspondence for each year within the study duration.

**External data**

From the country, we inferred the UN geographical region<sup>15</sup> and World Bank income group<sup>16</sup> at the last data point. Prison occupancy and incarceration rates were retrieved from the World Prison Brief for each year. We retrieved the age-standardised annual suicide incidence in the general population from the WHO database<sup>17</sup> and the total population counts for each year from the World Bank.<sup>18</sup> We accessed the Democracy Index from the Economist Intelligence Unit for 2021.<sup>19</sup>

**Data analysis**

We added the number of suicides from all years with available data for each country in the numerator. We also added the person-years of imprisonment as estimates based on the annual incarceration rates from all corresponding years from each jurisdiction in the denominator (proportion of suicides). We estimated suicide incidence rate for each jurisdiction per 100 000 person-years of imprisonment for the observation period (multiplied the numerator by 100 000). For the USA, suicides in jails, state prisons, and federal prisons were summed. Similar to previous research,<sup>11</sup> jurisdictions with fewer than five suicides during the entire observation period were excluded from data synthesis and further analysis, to focus on more stable

estimates. Similarly, based on visual inspection of forest plots, outliers with more than 250 suicides per 100 000 person-years over the whole observation period were excluded from data synthesis, which amounted to three small jurisdictions (these were included in sensitivity analyses).

In proportions close to zero, we stabilised variances with the Freeman–Tukey double arcsine transformation to approximate normal distribution before pooling the data. Random-effects models were fitted via the restricted maximum likelihood method to estimate heterogeneity variance. Heterogeneity between studies was assessed with the *I*<sup>2</sup> statistic. Due to the non-randomised study designs and the very large samples in several jurisdictions, especially for the male population, *I*<sup>2</sup> values could be substantial, and pooled data need to be interpreted with caution. Therefore, we focused the reporting on IQRs for all jurisdictions and subgroups by region and income group. We also calculated the median and IQRs separately for male and female populations living in prison in those jurisdictions that reported the sex and at least five suicide deaths over the observation period for comparative analyses. Random-effects pooled estimates by region with corresponding heterogeneity estimates were calculated (appendix pp 25–27). We explored sources of heterogeneity with random-effects meta-regression analyses using models fitted via the restricted maximum likelihood method. Prespecified independent variables were sex (male or female,

For more on the Democracy Index see ourworldindata.org

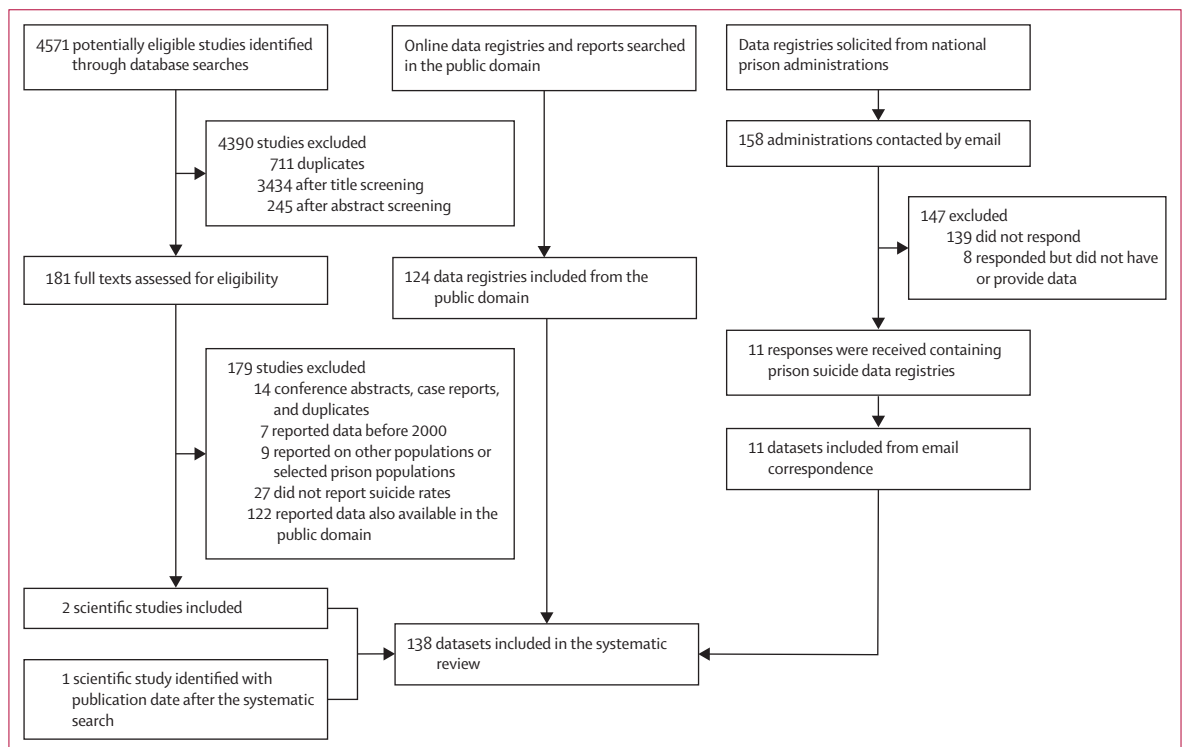


Figure 1: Flow chart based on the PRISMA

dichotomous), WHO region (Africa, Americas, Asia, Europe, and Oceania, with Europe as reference category), income group (LMIC versus high-income country [HIC]), prison occupancy (continuous), incarceration rate (continuous), and suicide incidence in the general population (continuous). We retained significant variables for multivariable regression. Post hoc, we also tested one ecological factor—Democracy Index—on the recommendation of peer review. Given the very high heterogeneity, findings from meta-regression analyses need to be interpreted with caution. Incidence rate ratios (IRRs) were calculated between each country's suicide incidence in prison and the age-standardised general population. IRRs were described using the median and IQRs. Sensitivity analyses were conducted, including all outliers and jurisdictions with fewer than five but at least one suicide.

Although international registries and studies were included, bias was assessed on the level of jurisdictions, as each submits their data with corresponding risk of bias. Bias was assessed with funnel plots. Funnel plots visualise suicide rates against standard errors, and their asymmetry is assessed with Egger's test. We modified a risk of bias tool for prevalence studies to evaluate study quality.<sup>20</sup> One point was assigned to each of the eight items, and a total score was calculated for each jurisdiction. Scores of zero to four points were considered low quality, five to six points moderate quality, and seven to eight points high quality.

Analyses were conducted with the meta esize, meta regress, meta funnelplot, and meta bias commands in Stata version 18. The study protocol was registered in PROSPERO, CRD42021296819.

### Role of the funding source

The funders of the study had no role in study design, data collection, data analysis, data interpretation, or writing of the report.

### Results

We included data from three different sources: three scientific studies,<sup>12,21,22</sup> 124 data registries and reports retrieved online in the public domain, and 11 data registries provided directly from national prison administrations (figure 1, appendix pp 5–12).

There was a total of 29711 suicides during 91·3 million person-years of imprisonment in 82 jurisdictions corresponding to 78 countries worldwide (table 1). For 13289 suicides in 71 countries, sex was reported, with 12544 (94·4%) in male and 745 (5·6%) in female individuals.

Quality assessment of included studies and registries showed moderate to high scores ranging from five to eight points. Most studies were representative of all people imprisoned in a jurisdiction, and data collection and reporting were adequate. One issue was several studies and registries not defining suicide (ie, not discriminating

	Years of data availability	Number of prison suicides	Person-years of imprisonment	Suicide incidence per 100 000 person-years of imprisonment
<b>Africa</b>				
Morocco <sup>22*</sup>	4	29	333 101	9 (6–12)
South Africa†	5	124	788 569	16 (13–19)
Tunisia‡	22	21	524 336	4 (3–6)
<b>Americas</b>				
Argentina†	21	145	210 866	69 (58–81)
Bermuda‡	22	3	5227	57 (20–169)
Bolivia (Palmasola prison) <sup>12*</sup>	17	277	62 601	442 (393–498)
Brazil†	6	881	4 157 578	21 (20–230)
Canada†	21	183	283 957	64 (56–74)
Chile <sup>22*</sup>	18	313	760 012	41 (37–46)
Colombia‡	10	172	1 139 623	15 (13–18)
Costa Rica†	6	18	47 938	38 (24–59)
Dominica‡	20	2	4904	41 (11–149)
Ecuador <sup>12*</sup>	12	41	251 966	16 (12–22)
Guatemala‡	22	51	329 739	15 (12–20)
Guyana <sup>12*</sup>	16	3	29 343	10 (3–30)
Honduras‡	14	63	224 220	28 (22–36)
Mexico‡	22	1147	4 662 463	25 (23–26)
Nicaragua†	5	7	32 511	22 (10–44)
Paraguay <sup>12*</sup>	5	12	58 813	20 (12–36)
Peru <sup>12*</sup>	8	65	610 407	11 (8–14)
Saint Vincent and the Grenadines‡	21	1	8515	12 (2–66)
Uruguay†	16	139	156 568	89 (75–105)
USA†	19	10 453	42 726 150	24 (24–25)
<b>Asia</b>				
Armenia†	18	46	72 606	63 (48–84)
Azerbaijan†	15	73	324 420	23 (18–28)
Cyprus†	19	7	12 506	56 (27–116)
Georgia†	13	52	158 418	33 (25–43)
Hong Kong†	6	11	47 633	23 (13–41)
India†	21	1556	8 129 842	19 (18–20)
Phillipines‡	11	37	1 170 951	3 (2–4)
South Korea†	13	100	666 927	15 (12–18)
Thailand <sup>23*</sup>	4	64	758 770	9 (7–11)
Türkiye†	18	659	2 115 357	31 (29–34)
<b>Europe</b>				
Albania†	14	26	59 541	44 (30–64)
Andorra†	16	2	767	261 (72–945)
Austria†	16	166	136 95	122 (105–142)
Belgium‡	16	234	182 247	128 (113–146)
Bosnia and Herzegovina (Federation)†	7	4	10 869	37 (14–95)
Bosnia and Herzegovina (Republika Srpska)†	16	8	15 173	53 (27–104)
Bulgaria†	19	59	182 574	32 (25–42)
Croatia†	17	20	63 796	31 (20–48)
Czech Republic†	19	200	367 739	54 (47–62)
Denmark†	19	94	69 684	135 (110–165)

(Table 1 continues on next page)

	Years of data availability	Number of prison suicides	Person-years of imprisonment	Suicide incidence per 100 000 person-years of imprisonment
(Continued from previous page)				
Estonia†	19	40	69 683	57 (42–78)
Finland†	19	72	61 907	116 (92–146)
France†	18	1875	1 144 386	164 (157–171)
Germany†	19	1328	1 370 900	97 (92–102)
Greece†	12	56	119 077	47 (36–61)
Greenland†	10	8	1484	539 (273–1060)
Hungary†	18	112	301 507	37 (31–45)
Iceland†	18	6	2366	254 (116–552)
Ireland†	15	26	54 393	48 (33–70)
Italy†	19	1002	1 089 305	92 (86–98)
Latvia†	19	94	125 034	75 (61–92)
Liechtenstein†	17	0	193	0 (0–1957)
Lithuania†	19	171	171 159	100 (86–116)
Luxembourg†	18	23	11 299	204 (136–305)
Malta†	12	4	5411	74 (29–190)
Moldova†	18	97	163 576	59 (49–72)
Monaco†	14	1	413	242 (43–1359)
Montenegro†	10	6	11 432	52 (24–114)
Netherlands†	19	244	270 910	90 (79–102)
North Macedonia†	19	24	43 711	55 (37–82)
Norway†	18	72	58 397	123 (98–155)
Poland†	18	576	1 429 440	40 (37–44)
Portugal†	19	241	247 321	97 (86–111)
Serbia†	16	127	155 640	82 (69–97)
Romania†	19	186	648 659	29 (25–33)
Russia†	8	2408	5 820 848	41 (40–43)
San Marino†	18	0	30	0 (0–11351)
Slovakia†	19	104	177 091	59 (48–71)
Slovenia†	19	36	24 447	147 (106–204)
Spain†	19	606	1 183 541	51 (47–55)
Sweden†	19	98	122 513	80 (66–97)
Switzerland†	16	125	101 351	123 (104–147)
UK (England and Wales)†	18	1383	1 442 526	96 (91–101)
UK (Northern Ireland)†	10	14	13 685	102 (61–172)
UK (Scotland)†	14	94	102 891	91 (75–112)
Ukraine†	11	432	1 946 287	22 (20–24)
<b>Oceania</b>				
Australia†	22	368	688 657	53 (48–59)
New Zealand†	21	82	134 322	61 (49–76)
Solomon Islands‡	22	2	6505	31 (8–112)

Data shown are n or incidence rate (95% CI). \*Data from the scientific literature †Data available in the public domain (ie, Council of Europe Annual Penal Statistics and web pages of prison administrations). ‡Data sent to us by emails from prison administrations.

**Table 1: Numbers and rates of suicides in prison by region**

it from other causes of death), increasing the risk of misclassification or non-classification. Several registries covered less than 10 years during the observation period. There was a lower score for jurisdictions for which we collected data by correspondence versus publication in publicly available sources.

We excluded 11 small jurisdictions (Bermuda, Dominica, Guyana, Saint Vincent and the Grenadines, Andorra, Bosnia and Herzegovina—Federation, Liechtenstein, Malta, Monaco, San Marino, and Solomon Islands) from analyses because they reported fewer than five suicides over the observation period. Similarly, three outliers (Bolivia, Greenland, and Iceland) were excluded before data synthesis as they had incidences higher than 250 per 100 000 person-years. In Bolivia, the suicide incidence was only available for one large prison, which might not be representative of the national prison system. Greenland and Iceland are small jurisdictions; over the entire period, there were eight suicide cases in Greenland and six in Iceland, leading to very imprecise estimates. Greenland also runs an unusually open prison system that cannot restrict access to means as in other jurisdictions. People in prison with high security needs are typically transferred to mainland Denmark.

Using random-effects meta-analyses, the worldwide suicide incidence in prisons, pooled from 68 jurisdictions with at least five events, was 50 (95% CI 42–60;  $I^2 > 99%$ ) per 100 000 person-years of imprisonment. For the jurisdictions with sex-specific information and at least five cases for a specific sex, the pooled rates were 49 (40–60; 99%) per 100 000 person-years of imprisonment in male and 59 (39–82; 97%) in female individuals, with largely overlapping CIs (appendix pp 25–27). There was no clear difference in suicide rates between male and female populations in prison. Given the very high heterogeneity between jurisdictions, descriptive statistics were preferred to represent the data. Prison suicide incidence ranged from 3 per 100 000 person-years in the Philippines to 204 per 100 000 person-years in Luxembourg. The IQR for suicide incidence worldwide was 22–86 for male and 25–107 for female individuals in prison. The median prison suicide incidence and IQRs for country groups by region, sex and income level are shown (table 2).

In Europe, which had typically higher suicide rates, suicide incidence ranged from 22 per 100 000 person-years in Ukraine to 204 in Luxembourg, in the Americas it ranged from 11 per 100 000 person-years in Peru to 89 in Uruguay, and in Asia it ranged from 3 per 100 000 person-years in the Philippines to 63 in Armenia (table 1). Box plots visualising regional differences and differences between income groups are shown in the appendix (p 28).

Lower occupancy, lower incarceration rates, and being in a European and HIC prison were associated with higher suicide incidence in prisons (table 3). On multivariable meta-regression, HICs and lower incarceration rates retained significance with higher incidence.

We found substantial heterogeneity between country groups, with Africa (three included countries;  $p < 0.0001$ ), the Americas ( $p < 0.0001$ ), and Asia ( $p = 0.0002$ ) having lower incidence than Europe (table 3). Due to high heterogeneity within regions, those findings need to be interpreted with caution.

cEgger's tests indicated significant asymmetry ( $p < 0.0001$ ; appendix pp 29–30). IRRs between people in prison and community-based populations for all countries by region and sex are reported (figure 2). The IRR in male individuals ranged from 0.7 in the Philippines to 12.2 in Armenia, and the IQRs ranged from 1.9 to 6.0. In the male prison population, only one country (India) had a significantly lower prison suicide incidence relative to the general population. In seven jurisdictions (Ecuador, Guatemala, Tunisia, the Philippines, Croatia, Poland, and Ukraine), the suicide incidence in the prison population was similar to the male general population. All other 46 jurisdictions had significantly higher suicide incidence in the male prison population than the male general population. The raw data for each country are provided in the appendix (pp 19–23). There was one country, Russia, where the female prison population had suicide rates that were not different to the female general population. In all other jurisdictions with available data, suicide incidence was significantly higher in the female prison population than the general female population (figure 2). The IRRs in female individuals ranged from 1.2 in Russia to 53.3 in Azerbaijan. The IQR of the IRRs ranged from 10.4 to 32.4. Typically, these IRRs were higher in female than male individuals.

In sensitivity analyses, data from jurisdictions with at least one suicide were included. All outliers with more than 250 suicide incidents per 100 000 person-years of imprisonment were also included. The pooled prison suicide rate, including the outliers and small jurisdictions, was 56 per 100 000 person-years ( $I^2 > 99\%$ ). The IQRs were 25–92 (all), 22–87 (male), and 26–110 (female; appendix p 18). On univariate meta-regression, Democracy Index was associated with heterogeneity ( $b = 15.3$ ; 95% CI 10.2–20.4), which was retained in multivariable meta-regression.

## Discussion

In this systematic review of 29 711 suicides in 82 jurisdictions from 2000 to 2021, most studies reported suicide rates in the range of 24–89 per 100 000 person-years. We examined some explanations for differences, which were higher suicide incidence in prison systems with lower occupancy, with lower incarceration rates, and in HICs. Furthermore, prison suicide rates were typically more than 10 times higher in the female population and twice as high in the male population relative to the age-standardised general population.

This study provides an overview of the suicide incidence during imprisonment and the IRR across numerous jurisdictions worldwide, including many LMICs. International comparisons might facilitate efforts to understand and implement more effective prevention.<sup>6,23</sup> Suicide prevention could involve addressing modifiable risk factors on an institutional level, such as appropriate single-cell use and removing

	Both sexes		Male		Female	
	Number of jurisdictions	Median (IQR)	Number of jurisdictions	Median (IQR)	Number of jurisdictions	Median (IQR)
Africa	3	9 (4–16)	2	6 (4–8)	..	..
Americas	15	24 (16–41)	12	25 (16–38)	8	26 (21–99)
Asia	9	23 (15–31)	6	21 (16–33)	3	44 (22–87)
Europe	39	75 (48–102)	33	70 (45–95)	11	67 (51–155)
Oceania	2	57 (53–61)	..	..	..	..
LMICs	31	25 (16–44)	24	26 (16–41)	10	36 (17–87)
HICs	37	80 (51–102)	29	83 (48–102)	12	86 (54–147)

HIC=high-income country. LMIC=low-income and middle-income country.

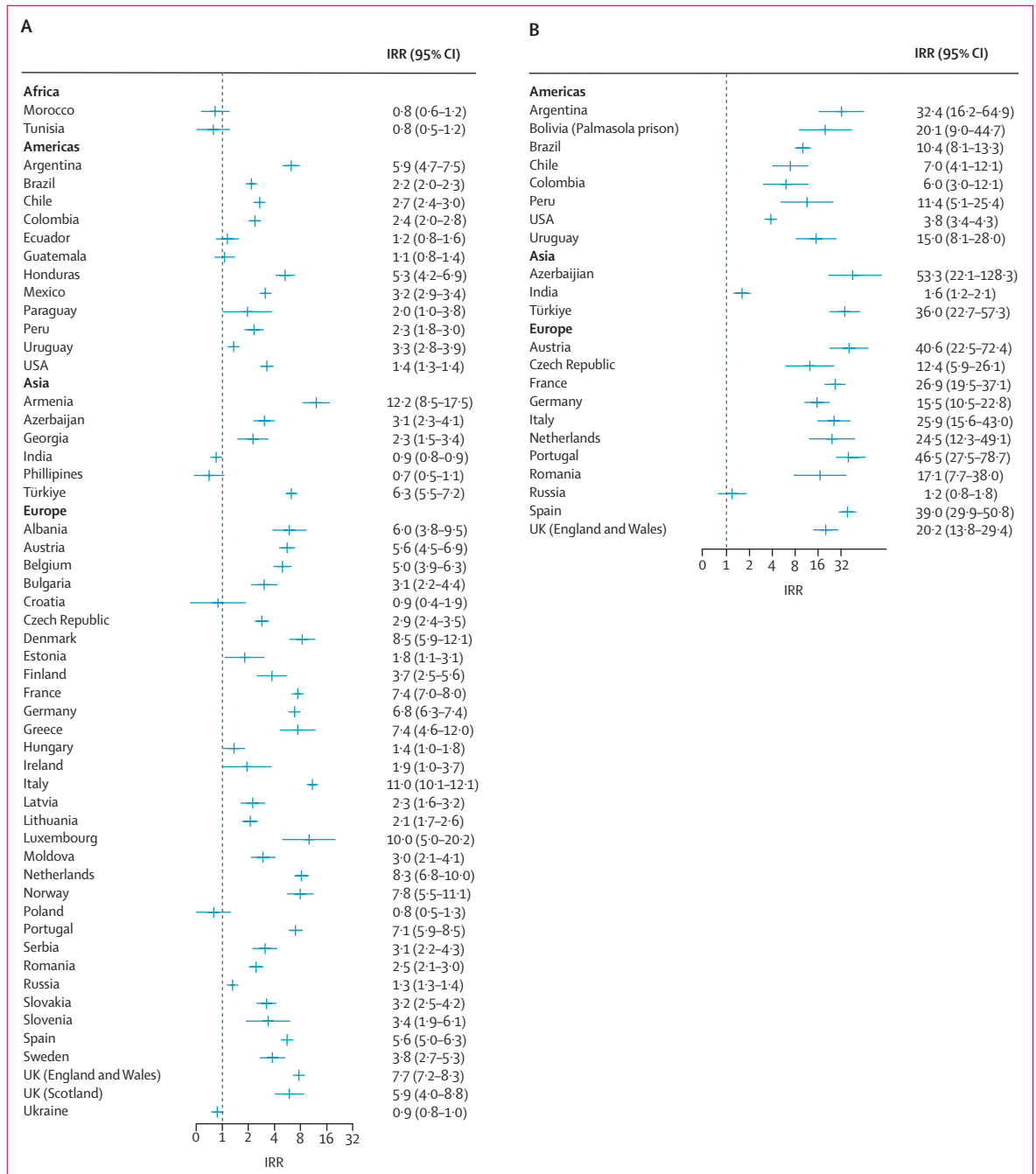
**Table 2: Median prison suicide incidence and IQRs for country groups by region, sex, and income level**

	Number of jurisdictions	Unstandardised coefficient ( $\beta$ )	95% CI	p value
<b>Univariable meta-regression</b>				
Suicide incidence (per 100 000 general population)	68	1.12	-0.26 to 2.51	0.11
Sex				
Male	53	..	..	..
Female	22	4.87	-14.68 to 24.43	0.63
Income group				
LMIC	31	..	..	..
HIC	37	48.06	33.34 to 62.78	<0.0001
Prison occupancy (%)	65	-0.36	-0.56 to -0.16	0.0004
Incarceration rate (per 100 000)	67	-0.17	-0.27 to -0.07	0.0009
Region				
Europe	39	..	..	..
Americas	15	-53.10	-75.12 to -31.09	<0.0001
Asia	9	-67.52	-102.68 to -32.36	0.0002
Africa	3	-44.05	-62.24 to -25.85	<0.0001
Oceania	2	-19.83	-62.87 to 23.20	0.37
<b>Multivariable meta-analysis (retaining the significant variables)</b>				
Income group				
LMIC	28	..	..	..
HIC	37	23.86	6.48 to 41.24	0.0071
Prison occupancy (%)	65	-0.15	-0.32 to -0.04	0.11
Incarceration rate (per 100 000)	65	-0.09	-0.17 to -0.002	0.045
Region				
Europe	39	..	..	..
Americas	15	-22.19	-42.30 to -2.08	0.031
Asia	9	-35.61	-58.32 to -12.90	0.0021
Africa	3	-36.27	-70.84 to -1.70	0.040

Meta-regression analyses with standardised  $\beta$  coefficients are shown in the appendix (p 17). HIC=high-income country. LMIC=low-income and middle-income country.

**Table 3: Meta-regression analyses examining possible explanations for differences in prison suicide incidence (per 100 000 person-years)**

access to means (eg, taking away ligature points or periodically checking for medication hoarding). In addition, individual-level measures, including assessing and treating mental illness, need review and adequate



**Figure 2: Suicide IRRs in prison compared with the age-standardised general population for male (A) and female (B) individuals**  
 IRRs of more than 1 indicate higher suicide incidence in the prison than in the general population. The vertical lines show the IRRs on a logarithmic scale. The horizontal lines show the 95% CI of the IRRs. Lines crossing 1 (dotted vertical line) indicate no significant difference between people living in prison and the general population. IRR=incidence rate ratio.

resourcing.<sup>24</sup> Diversion of people with severe mental illness from criminal justice to mental health and addiction services should be part of any comprehensive approach.<sup>25</sup> Countries and jurisdictions with very high suicide rates (ie, above 100 per 100 000 person-years of imprisonment) could prioritise criminal justice-related

and public health initiatives to reduce rates. The quality of most included registries was high. In comparison to other prevalence research, representativeness and non-response were not limitations. A relevant risk of bias could be related to the miscoding of suicides as other or unknown causes of death.

We found that higher occupancy (ie, overcrowding) was associated with lower suicide incidence in between-country analyses. Although solitary confinement can be reduced, overcrowding in prison could be linked to other poor outcomes, such as infectious disease outbreaks and self-harm.<sup>26,27</sup> The higher suicide incidence in HIC prisons (which was also found in those with more democratic governments) could be explained by fewer people per cell and more common single-cell use than typically seen in prison facilities of LMICs.<sup>28</sup> The effect of this difference could outweigh the lower suicide screening and mental health treatment capacities in LMICs.<sup>29</sup> Dormitory and related sleeping arrangements common to LMIC prisons might protect against suicide attempts but lead to more violence between individuals.<sup>30</sup> Whether LMICs misclassify suicides as other causes is an empirical question that could be examined using techniques such as psychological autopsies. Relatedly, in some LMICs, suicide remains heavily stigmatised, which would increase the likelihood of coding self-inflicted deaths as accidents or from natural causes (eg, cardiovascular or respiratory if ligature involved or overdose), or more deaths classified as unknown cause or awaiting classification due to less capacity for investigation. The lower suicide incidence rate in LMIC regions might also be explained by a higher incidence of competing causes of death—ie, violence, infectious disease, or accidents.

High-income jurisdictions have more resources to promote social reintegration with more activities (eg, working) outside the prison. These opportunities can lead to more humane conditions of imprisonment and better outcomes, but less restriction to access suicide means. HICs and European jurisdictions (and possibly highly democratic ones) might also have higher turnover of people transitioning in and out of prison with shorter prison sentences on average. Suicide risk might be elevated at the beginning of a prison term and, thus, in places with high turnover. Restricting access to means is not enough; cultural change and collaborative work in prison services and governance have a role in preventing deaths.<sup>31</sup> Otherwise, suicide can be deferred to the period after release when the incidence is typically higher than during imprisonment.<sup>32</sup>

The estimated IRRs provide a systematic comparison of prison suicide rates with those in the community, and a measure of the excess suicide mortality as they account for sociocultural differences between societies in suicide risk. Relative to the community-based populations, female inmates have a much higher excess risk. This finding has been previously reported in Europe<sup>11</sup> and South America,<sup>12</sup> and in specific countries with high-quality data, such as in England and Wales.<sup>33</sup> The large difference in the IRRs between male and female individuals could be explained by male incarceration rates being on average about 15 times higher than female incarceration rates, leading to a relatively healthier male

prison population. In addition, there are higher relative rates of risk factors for suicide in female individuals who enter prison than equivalent risk factors in male individuals. For example, relative risks of drug use, post-traumatic stress disorder, and personality disorders are higher in the incarcerated female population (compared with the general female population) than the corresponding comparison in male individuals.<sup>34,35</sup> This difference is related to the high threshold for female individuals to be imprisoned, which means that those entering prison are more selected than male individuals entering prison. This selection effect is associated with suicide risk, and it might include the seriousness of the index offence or charged offence, and the number of life events associated with being in prison (such as separation from children).

This study has various limitations. The registries typically did not inform on the age of the suicide deaths. People living in prison and people living in the community have different age structures; however, this might not explain the large differences in suicide incidence. We did not have any information on the average length of prison sentences and turnover rates. Other limitations include that some countries might disproportionately misclassify suicides, and that the very high heterogeneity limits confidence in the pooled data. The small number of jurisdictions with available evidence from Africa precludes regional generalisations. Although useful, IRRs also have conceptual limitations, through comparing people transitioning through a setting against a population. Hence, suicide risk in periods before and after imprisonment also needs attention. A further limitation of the study is that we did not involve people with experience of being in custody or relatives of those who have died in prison.

This investigation allows public health and prison services in different countries to compare their national prison suicide rates with other jurisdictions separately in male and female prison populations. The study also allows for comparisons of national prison suicide rates with community-based people. The implementation of effective suicide prevention interventions needs to be informed by updated and consistently reported national incidence rates, between-country and regional comparisons. This report also identified institutional-level and national-level associations with prison suicide incidence, such as incarceration rate, occupancy level, and income group of the jurisdiction. Substantial regional differences in prison suicide incidence were found. Future research on near-lethal suicide attempts and using the psychological autopsy approach could inform the contribution of mental illnesses underlying prison suicides, since such data are unavailable in suicide registries.

In summary, countries with high suicide rates in prison should review their assessment and prevention of suicide risk, and prioritise evidence-based initiatives across the criminal justice system. Many LMICs do not



have registries or publicly report suicide numbers in the prison population. To promote research and prevention implementation, standardised registries and timely publication of prison suicide data are essential.

#### Contributors

APM, PAC-G, GB, and SF conceived of the study. PAC-G conducted the screening. PAC-G and GB conducted the data extraction. APM, PAC-G, GB, and SF had full access to all data and conducted the data analysis. APM drafted the manuscript. All authors critically revised the manuscript and approved the final version.

#### Declaration of interests

SF has provided expert evidence in coroner inquests for deaths in custody and is an expert member of the UK's Independent Advisory Panel on Deaths in Custody. All other authors declare no competing interests.

#### Data sharing

Data will be made available to investigators upon request by email to the corresponding author.

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