# **Risk factors for suicide in prisons: an updated systematic review and meta-analysis**

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**ABSTRACT**

BACKGROUND Rates of suicide among people in prison are elevated compared to people of similar age and gender who are living in the community, and improving assessments and interventions to reduce risk requires updated evidence on risk factors. We aimed to examine risk factors associated with suicide in prisoners.

METHODS We conducted an updated systematic review and meta-analysis of risk factors for suicide among people in prison. We searched six bibliographic databases until 13 AUG 2020. Eligible studies reported risk factors in individuals who died by suicide while in prison and controls from the general prison population. We calculated random-effects pooled odds ratios for the association of suicide with demographic, clinical, criminological, and institutional risk factors, and investigated heterogeneity using subgroup and meta-regression analyses. This review was registered in PROSPERO (CRD42020137979).

FINDINGS We identified 77 eligible studies from 27 countries that included 35,351 suicides. The strongest clinical factors associated with suicide were suicidal ideation (odds ratio [OR]: 15.2 [95% CI 8.5-27.0]), a history of attempted suicide (OR: 8.2 [4.4-15.3]), and current psychiatric diagnosis (OR: 6.4 [3.6-11.1]). Institutional factors associated with suicide included occupation of a single cell (OR: 6.8 [2.3-19.8]) and having no social visits (OR: 1.9 [1.5-2.4]). Criminological factors included remand status (OR: 3.6 [3.1-4.1]), serving a life sentence (OR: 2.4 [1.3-4.6]) and being convicted of a violent offence, in particular murder/manslaughter (OR: 3.1 [2.2-4.2]).

INTERPRETATION A number of modifiable risk factors, such as psychiatric diagnosis, suicidal ideation, and single cell occupancy, are associated with suicide in people in prison. Preventive interventions should target these risk factors and include improved access to evidence-based mental health care. Other factors associated with suicide may improve risk stratification and resource allocation in prison services.

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**RESEARCH IN CONTEXT**

**Evidence before this study**

One previous systematic review of studies has synthesised evidence on risk factors associated with suicide in prisons but its search for relevant publications ended in 2007. Since this review, several studies have been published and worldwide prison populations have increased, with the likelihood that prisoners with different background risks are now entering prisons. To identify other reviews on prison suicide, we searched EMBASE, MEDLINE, PsycINFO, CINAHL, and Global Health from 1 January 2006 until 13 August 2020, with no language restrictions. We used a combination of search terms related to suicide (i.e. suicid\*) and people in prison (prison\* or felon\* or detain\* or jail or custod\* or [her majesty's prison] or remand\* or offender\* or institution or panel or inmate\* or correction\* or sentenced or incarcerat\* or gaol\*). We did not identify any other systematic reviews quantitatively examining risk factors for suicide in prisoners. One narrative review summarised studies of near-lethal suicide attempts in prison, and outlined potential intervention strategies.

**Added value of this study**

In this meta-analysis of 77 studies, we provide an updated synthesis of the range and magnitude of risk factors associated with suicide in prisons. This review provided more precise results than previous work, and clarified the direction of effects for a number of factors where there was uncertainty. In addition to previous suicidal attempts, psychiatric diagnosis, occupation of a single cell, lack of social visits, and alcohol misuse were associated with suicide. In addition, sexual offence was associated with a higher risk of suicide, which may inform risk assessment on arrival to prison.

**Implications of all the available evidence**

Preventative interventions should target potentially modifiable risk factors where there is ongoing unmet need, such as the identification and treatment of mental health problems and alcohol misuse. Many factors are associated with small relative risks, therefore suicide risk assessment should combine multiple risk factors with appropriate weighting and be informed by clinical decision-making. Universal interventions will be an important component of suicide prevention strategies in light of challenges involved in predicting individual risk.

**INTRODUCTION**

Suicides among people in prison have long been shown to occur at higher rates than general populations of similar ages. In a study of 24 high-income countries during 2013-2017, suicide rates in male prisoners were 3-8 times higher than the general population, while in female prisoners the relative risk was typically more than 10.1 Approaches to reduce suicide risk in prisons include risk assessment and management for individual prisoners, and targeting modifiable risk factors.2,3

A previous systematic review suggested that some modifiable environmental and clinical factors were associated with suicide in prison, while some potentially important risk factors required more replication.4 However, the search for this review ended in 2007. Since that time, a number of new studies have been conducted, particularly on the contribution of mental health. In addition, prison populations have increased in size in many countries, and this may have altered the contribution of risk factors.

Therefore, we have conducted an updated systematic review and meta-analysis in order to update the evidence on prison suicide, investigate new associations, and improve the precision of estimated effect sizes of previously identified risk factors. We aimed to provide a quantitative synthesis of evidence from case-control and case-cohort studies comparing prisoners who died by suicide to those who did not.

**METHOD**

We followed the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) guidelines5 and the Meta-analyses of Observational Studies in Epidemiology (MOOSE) proposal6 and the review was registered prospectively (CRD42020137979) on 1 June 2020 and published on 29 June 2020.

**Search strategy**

For the update, we searched five bibliographic databases: EMBASE (1 January 2006-13 August 2020), MEDLINE (1 January 2006-13 August 2020), PsycINFO (1 January 2006-13 August 2020), CINAHL (1 January 2006-13 August 2020), and Global Health (from inception to 13 August 2020). In the original systematic review, which was conducted by senior author SF,4 the first four of these databases was searched from their inception to February 2007, with the search strategy outlined. For this update, we used the same strategy - a combination of two search terms: suicide (i.e. suicid\*) and prisoners (prison\* or felon\* or detain\* or jail or custod\* or [her majesty's prison] or remand\* or offender\* or institution or panel or inmate\* or correction\* or sentenced or incarcerat\* or gaol\*), we scanned bibliographies of included articles in the updated review and studies that cited in the previous review. We also searched for grey literature (e.g. reports, government document, dissertation and thesis, and conference abstracts) using Google Scholar (see Appendix pp 1-5 for full search strategies and results).

**Eligibility assessment**

We included studies from all countries and in all languages. Inclusion criteria for studies were: (1) quantitative studies that identified risk factors of suicide in prison compared to matched or randomly selected controls or the total/average prison population; (2) absolute numbers of suicide cases were provided or could be extracted from data provided. We excluded investigations in selected samples (e.g. individuals with mental disorders or drug users), selected outcomes (e.g. hanging), studies which compared suicides with the general population, and those with an outcome of suicide risk rather than death by suicide(e.g. outcomes of deliberate self-harm or attempted suicide). We also excluded case reports, case series, reviews, and qualitative studies. For studies reporting on a comprehensive sample of suicides without a control group, we searched for information on the general prison population for the same variables from government reports for the time period. A primary study was excluded if a control group could not be identified. To avoid duplicate samples, when cases came from overlapping populations we included the study with the largest sample or with the longest period. Two researchers (SZ and MS) conducted the initial screening of abstracts and full-text publications for eligibility. Any uncertainties between two researchers discussed with a third author (RY), and consensus reached.

**Design of studies and data extraction**

A standardised form was used to independently extract data on geographical location, study design, the period of study, the definition of suicide (suicide only, suicide and open verdicts, or not reported), the absolute number of suicide cases, average age and sex. Two reviewers (SZ and MS) independently extracted data for each study. For suicide cases and controls, we extracted data on demographics, criminological and clinical variables examined in the previous review.4

We classified included studies into two groups by the type of control group: group 1 studies compared those who had died from suicide in prison with a randomly selected or matched control group; group 2 studies compared characteristics of prisoners who died of suicide with those of the total/average prison population during a matched period. Similar to the original review, we calculated the sample size of the control group to be proportional to that of the case group to avoid bias.

To assess risk of bias, we considered the Newcastle-Ottawa Quality Assessment Scale. However, two items- the ascertainment of exposure and non-response rate - were not applicable and did not vary across studies. Thus, we used the OHAT (Office of Health Assessment and Translation) tool, which can be applied to case-control studies and cross-sectional studies. The mean quality score of the included case-control studies was around 5 out of 9 (range 4 to 6), indicating overall medium quality. All case-control studies used controls groups from the same prison. In addition, all studies used the same methods to ascertain risk factors for suicide cases and controls. However, all studies used prison or medical records for information on risk factors. This introduces a higher risk of bias than other data sources such as structured interviews.

**Statistical Analysis**

There were no deviations from the review protocol. We combined included studies from this update with the original review for analysis. For a given risk factor, we combined number of cases with the risk factor and the total number of each study for both case and control group. We generated pooled odds ratios (ORs) with 95% confidence intervals (CIs) for risk factors reported in two or more studies using random-effects models. In the analyses, we excluded studies when the explored risk factors (e.g. age, gender, sentence) were matched in the control group for group 1 studies. We investigated sources of heterogeneity using Cochran Q and the *I*2 statistics. *I*2 is reported as a percentage out of 100%, where 0-40% denotes the heterogeneity might not be important, 20-60% may present moderate heterogeneity, 50-90% refers to substantial heterogeneity, and 75% to 100% indicates considerable heterogeneity.7 We conducted subgroup analyses to examine whether there were differences in outcomes on the basis of study design (group 1 vs. group 2), type of publication (peer-reviewed paper vs. grey literature) and country (US vs. other countries). For the heterogeneity analysis, we examined risk factors where the number of primary studies was greater than ten: gender, race/ethnicity, marital status, age group, detainee/remand status and type of offence.8 Further, we conducted meta-regression for those risk factors where there was considerable heterogeneity (≥75%). All analyses were conducted using R (version 3.6.0)9 and R package “meta” (version 4.9-9).10

**Role of the funding source**

The funder of the study had no role in study design, data collection, data analysis or interpretation, or the writing of the report. SZ and MS had full access to the data and all authors had final responsibility for the decision to submit for publication.

**RESULTS**

We identified 8041 relevant studies in the database search and eight additional records through other sources for the updated review, of which 43 met eligibility (Figure 1).1,11–52 The total number of identified publications for the main analysis was 75, of which 34 were from the original review53–86 (see Appendix Tables 1 and 2 pp 7-13 for characteristics of studies). After the update, the total number of prisoner suicides was 35,351.

Studies were from 27 different countries: 28 investigations (n=14,650 cases or 41.4% of prison suicides) from the US, 14 (n=4,854 cases, 13.7%) England and Wales, 8 (n=3,465 cases, 9.8%) Germany,4 (n=210 cases, 0.6%) Australia, 4 (n=1,487, 4.2%) Italy, 3 (n=556 cases, 1.6%) France, 3 Scotland (n=224 cases, 0.6%), 2 Canada (n=101 cases, 0.3%), 1 included 10 countries in South American (n=1,324, 3.7%), and 10 were based in other high-income countries.

A number of static and dynamic risk factors reported in more than one study are presented in Tables 1 and 2 (with factors reported in one study in Appendix Table 3 pp 14-15).

We first examined demographic factors. Factors most strongly associated with suicide risk included white race/ethnicity (OR: 2.0 [1.4-2.7]), being married (OR: 1.5 [1.2-1.7]) and male gender (OR: 1.2 [1.0-1.5]). In addition, in the 10 studies that investigated nationality, not being a citizen of the country of incarceration was inversely linked to suicide risk (OR: 0.7 [0.6-1.0, p=0.02]). There were no clear associations with ages greater than 25 (OR: 1.2 [0.9-1.7]), 30 (OR: 1.3 [0.8-1.9]), or 45 (OR: 0.8 [0.6-1.1]). There was no clear association with homelessness (OR: 2.4 [0.3-19.8]) or level of education (OR 0.9 [0.4-2.4] (Appendix Figure 1 p 6).

With respect to criminological factors, the following were associated with risk of prison suicide: being a detainee or on remand (OR: 3.6 [95% CI: 3.1-4.1]), and serving a life sentence (OR: 2.4 [1.3-4.6]). In relation to offence categories, being convicted of murder/manslaughter (OR: 3.1 [2.2-4.2]) and sexual offences (OR: 1.4 [1.1-1.9) were associated with an increased risk of suicide (Figure 2). In addition, violent offences (excluding murder/manslaughter/sexual offences) were associated with suicide (OR: 2.1 [1.4-3.0), but there was substantial heterogeneity between studies (I2=83%). Conversely, individuals convicted of a drug offence were less likely to die by suicide when compared with other offence types (OR: 0.4 [0.3-0.5]).

Clinical factors associated with suicide included suicidal ideation during their current period in prison (OR: 15.2 [95% CI: 8.5-27.0]), having a history of attempted suicide (OR: 8.2 [4.4-15.3]), and a history of self-harm (OR: 7.1 [4.4-11.5]) (Figure 3). Regarding individual disorders, having alcohol use problems (OR: 2.5 [1.4-4.3]), a current psychiatric diagnosis (OR: 6.4 [3.6-11.1]), and a depression diagnosis (OR: 4.9 [1.6-14.8]) were each associated with increased risk. There was insufficient data on poor physical health, which was non-significantly associated with suicide (OR: 2.0 [0.7-5.9]).

We examined institutional factors and found that occupation of a single cell (OR: 6.8 [95% CI: 2.3-19.8]) and having no social visits (OR: 1.9 [1.5-2.4]) were associated with an increased risk of suicide.

We examined sources of heterogeneity by studying four possible explanations for the differences in the effects of risk factors between studies: country group, study design, type of publication, and gender. On meta-regression, for the variable of age greater than 50 years, some heterogeneity was explained by differences between studies from US (OR:1.4 [95% CI:1.2-1.6]) compared to other countries (OR:1.0 [0.9-1.2]) (Q=5.0, df=1, p=.003). No clear differences by country group were found in the association between other risk factors and suicides. We found no differences in odds ratios by study design (group 1 vs. group 2). In relation to gender, there were only two studies that examined risk factors in specifically female prisoners.34,40 A study from England and Wales examined risk factors among female prison suicide cases with a control group of female prisoners. The study reported associations between remand status (OR: 3.0 [1.5-5.9]), violent offending (OR: 2.4 [1.2-5.2]), white race/ethnicity (OR: 3.1 [1.4-7.3]) and suicide.40 Associations by age-bands were not clear, and there was only one suicide case in the over 50s in this study population.40 In another study of 30 suicides of female prisoners in Germany, 7 had a psychiatric diagnosis, 8 a previous suicide attempt, and 7 had shown evidence of drug withdrawal.32 Information on these risk factors was not reported from a female control group, but when compared with men who died from suicide in prison, drug withdrawal was more common among female suicide cases than male (27% vs 10%, *p*=.01), but rates were similar for psychiatric disorder (27% vs 20%) and history of suicide attempt (33% vs 26%). As 75 of 77 included studies did not report adjusted ORs, we presented the differences between adjusted and crude odds ratio on risk factors (see Appendix Table 5 p 18).

**DISCUSSION**

This updated systematic review and meta-analysis was based on 35,351 suicides among people in prison from 77 studies in 27 countries, and synthesised risk factors for suicide by clinical, criminological, demographic and institutional domains. The five strongest factors associated with suicide risk were suicidal ideation, previous suicide attempt, history of self-harm, single cell occupancy, and current psychiatric diagnosis. Our results suggest that several criminological variables are also associated with suicide risk, including remand status and offence type, particularly murder and manslaughter.

This update provides new evidence in three ways. It adds precision to the associations reported in the previous systematic reviews,4,87,88 which is important for modifiable risk factors that can guide the development of preventative interventions. Second, it has provided new data on two factors - lack of social visits and depression diagnosis – that were not identified in the previous review. Third, for some risk factors where there was uncertainty, this update has clarified the direction of effects. Specifically, we have shown that an index sexual offence is associated with increased risk. Also, the lack of a clear association between pre-incarceration employment and suicide has been confirmed. A further finding is methodological, in that we identified only one new case-control study published since 2006. The paucity of recent research is notable and suggests that facilitating prison research should be a central part of any strategy to reduce deaths in custody.

Our results highlight potentially modifiable risk factors which can be targeted by interventions as part of prevention efforts. The importance of recognition and treatment of mental health problems among prisoners is underscored by this review,88 and the strong associations reported should be considered in health care service development and prison policy. Beyond introducing mental health services, these need to be adequately resourced, and be linked to effective interventions in order to address the higher prevalence of mental health diagnoses among prisoners than community-residing peers.39,89,90 Many countries screen individuals for mental health problems on arrival in prison.91 People identified as at risk of suicide should be assessed promptly by a mental health professional,91  and access to mental health services during incarceration should be comparable to what is available for the general population.92 This should include access to psychological therapies with an evidence base in other settings, such as dialectical behavioural therapy for people with frequent self-harm.93 However, despite these recommended standards, access to mental health care for people in prison is inconsistent and frequently delayed.93 Any unmet mental health needs are likely to contribute to high rates of suicide among prisoners. Alongside provision of mental health care, prison staff require adequate training in recognising and responding to self-harm and other mental health needs to improve access to appropriate care.95,96

Apart from clinical risk factors, we report associations between suicide and some modifiable institutional risk factors in prisoners. One identified factor is a lack of social visits.12,42 Absence of visits may reflect a poor supportive social network, consistent with findings of previous work that male prisoners who have been involved in near-lethal suicide attempts have reduced social support compared to controls.94 This might reflect a complex combination of psychosocial needs for some prisoners, for whom pre-existing impulsivity and aggression could act as a shared risk factor for suicidality, criminal behaviour and a lack of social connections. On the other hand, it is possible that prison policies contribute to a lack of social visits, such as restrictive visiting practices or locating prisoners far from their homes. If this is the case, reducing such practices may contribute to suicide prevention. Ensuring families and friends can visit regularly could involve more third-sector organizations. Addressing issues of social connectedness requires a context-specific approach for people in prison. An example is the increased risk of suicide in married prisoners,12,52 which contrasts with findings in the general population.98 Another institutional risk factor associated with suicide was being in a single cell. This highlights the importance of careful risk planning for all prisoners who express suicidal thoughts, and may reflect the possibility that those at higher risk, including presenting with acute mental health problems, are placed in single cells.

Several non-modifiable risk factors, such as offence type and ethnicity, were also found to be associated with suicide. Previous studies have highlighted a positive association between white ethnicity and suicide in prison, a finding which was supported in our meta-analysis.13,52 This association is likely to be driven by background differences in suicide rates observed in the general population,99 and may also be affected by confounding factors in some countries, including age and length of imprisonment.12,13

Another implication of these findings is that non-modifiable risk factors, such as ethnicity and offence type, may assist suicide prevention by facilitating identification of high-risk individuals using structured instruments that incorporate these factors. Screening for suicide risk, despite being recommended in many jurisdictions,91,95,96 tends to be based on one or two questions during a wider healthcare assessment on arrival to prison.100,101 Where structured tools are used, they have not incorporated multiple weighted risk factors based on sufficiently large samples, or externally validated102. Future research needs to investigate whether stratification of risk can be accurately done. If so, safety planning can be supplemented with more resource-intensive suicide prevention therapies. Individual risk factors are not sufficient to identify individuals at high risk of suicide. We estimated the positive predictive value (PPV) of the risk factors identified in this review, applied to a prison population with an annual suicide rate of 83 per 100,000 prisoners (the average rate for England and Wales from 2011-2014).48 The positive predictive value of any particular single risk factor is low, for example current psychiatric diagnosis had a PPV of 0.3% and single-cell accommodation a PPV of 0.2%. Combining two risk factors can increase predictive performance: combining current psychiatric diagnosis and single cell accommodation gave a positive predictive value of 0.7% (assuming risk factors are independent). It is unclear whether this represents a clinically meaningful level of accuracy: the PPV is low, but may be useful in the context of a lower baseline prevalence of the outcome (which is less than 0.1% in England and Wales, for example).

To maximize positive predictive values, screening and risk prediction tools should incorporate many risk factors with appropriate weighting, and it may be that such risk tools are used to screen out low risk persons. Even then, multiple weighted risk factors will be required and screening tools are likely to yield high numbers of false positive results. Considering the challenges involved in accurately assessing suicide risk, universal prevention strategies will continue to be an important complement to selective interventions. Examples of universal interventions include restriction of access to means, ensuring access to supportive social interactions, such as peer-support programmes,2,103 and promoting meaningful daytime activity.104

To assess the relevance of each potentially modifiable risk factor for suicide prevention, it is useful to consider both the effect size and prevalence of exposure in the prison population. The prevalence of rare risk factors (such as staying in a disciplinary cell [<1%]) may be too small to contribute to prevention initiatives. Among the controls, 47% had received no social visits, 13% had a history of self-harm or suicide attempt, and 12% had a current psychiatric diagnosis. These findings suggest that a substantial proportion of the prison population is exposed to these modifiable risk factors, underscoring their importance as targets for preventive interventions.

Risk factors for suicide may differ between male and female prisoners, but most included studies combined data for both sexes, or only included male prisoners, with the exception of two new studies.32,40 One showed similar associations between some non-modifiable factors, but differences in suicide risk by age groups were not clear.40 The other found that a higher proportion of female prisoners who died by suicide compared to male counterparts had evidence of drug withdrawal.32 This may reflect higher levels of drug dependence on arrival to prison.105 Differences in medical care or recognition of drug withdrawal in female prisoners may also contribute, which new research could investigate. Although the limited available evidence suggests several risk factors are shared for both male and female prisoners, there is a need to for future research to clarify differences by age and sex, and other risk factors, which may should assist in the lead to more tailored assessment of risk, treatment allocation, and the delivery of services.

One strength of the review is the large number of suicide cases (n=34,628). We identified 16 reports with 11,518 suicides (33% of suicides) from grey literature. There were a large number of suicides in group 2 studies, and we identified 67 studies reporting 33,682 prison suicides (97% of the total number of suicide cases) which used the average or total prison population as the control group. The inclusion of group 2 studies has implications for interpretation. First, it is possible that the methods used to measure risk factors in cases differed from those for control populations, which need to be considered in the 13 studies where the control group data came from an external source. However, these studies tended to report variables such as offence type, remand status or gender which are reliable. Second, in these studies the control group included prisoners who have died by suicide, which means that the effect sizes will be more conservative. However, because suicide is a rare outcome, this is unlikely to have a large influence on effect sizes. Third, combining case-control studies using matched controls with group 2 studies where the control group was unmatched may have limited the precision of the pooled effect estimates where matching was done. In other words, some group 1 studies did not contribute to risk estimates for selected socio-economic and criminal history factors. Our decision to pool these investigations with case-control ones was supported by subgroup and meta-regression analyses, which found little evidence of differences in odds ratio based on study design. This approach has allowed us to combine data on a large number of suicide cases despite finding few case-control studies. Nonetheless, the analysis was underpowered for some risk factors such as level of education, for which only three studies were identified.

Several limitations should be considered. Definitions of suicide varied between studies, and it was not possible to test whether this contributed to heterogeneity. For example, England and Wales included all self-inflicted deaths as cases,13 while other studies included only suicides as determined by official medical reports,27 or included suicides and open verdicts.26 However, many studies did not report the criteria used to define suicide deaths so we were unable to examine whether differences in definitions were linked to effect sizes. In addition, there was insufficient information to examine risk factors by specific groups of prisoners, such as those on remand, or according to the type of institution (eg. by security level). Consequently, it is uncertain what effect they have on the heterogeneity between studies, and future studies on prison suicide should provide more information on the nature of the custodial setting. Almost all studies did not adjust for potential confounds and we were therefore unable to account for the degree of bias that confounding could introduce in risk estimates for most studied risk factors. This is a key gap in the evidence to date. The effect and implications of confounding will likely depend on the population studied and analytic strategy. For the two included reports where we could investigate this issue, lack of adjustment for confounders resulted in overestimation of the effect of the studied risk factor (ranging from 7% to 85%). However, this comparison is limited by few relevant studies and does not account for possible interactions between confounds, particularly with age and gender. Future research should use multivariable models, which include sex,36,106 age,31,107 ethnicity,107 and remand status.50 In addition, unmeasured residual confounding from variables such as genetic factors and childhood adversity will likely contribute to bias in risk estimates. To address this, future work should improve measurement of these possible confounds. Quasi-experimental methods, which partly account for these residual confounds, such as using family-based designs, could provide more evidence. For these designs, proxy outcomes (such as self-harm) may be considered due to the low prevalence of suicide. Low statistical power for suicide outcomes will also be a challenge for trials, but trials could usefully examine service-related and institutional factors if cluster designs are considered. One possible limitation is that we did not specifically search criminology databases, although one of the included databases (PsycINFO) did contain criminological and legal journals and we searched citations in screen-positive papers.

It is likely that there are additional individual and institutional risk factors for suicide in prison which were not studied in the included papers. Studies of prisoners who have made near-lethal suicide attempts have found an association with psychosocial factors such as past trauma, childhood abuse and negative experiences of imprisonment including bullying.97,108 Individual-level characteristics may interact with institutional factors, such as access to health services and aspects of staff-prisoner interaction. Previous research has examined incarceration rates and prison overcrowding. Incarceration rates have previously been found to be inversely linked to suicide rates in prisons.1 Incarceration rates and sentencing practices lead to heterogeneity in prison populations and as a result could affect the distribution of individual-level suicide risk factors. Countries with low incarceration rates will lead to a higher proportion of people in prison for serious violent offences, whose background suicide risk is likely to be elevated. Findings on links with prison overcrowding have been inconsistent due to several factors influencing this relationship, including effects on staff-prisoner interactions and protective effects from double occupancy of single cells.109,110

Future research should examine risk factor variation in low- and middle-income countries (LMICs) and across different cultural settings. A large number of the studies included in this review were from a limited number of countries, particularly the US, UK and Germany, so does not take into account how risk factors may vary in different cultures. Some of the risk factors identified in this review such as psychiatric diagnosis and substance use disorders are highly prevalent among people in prison in LMICs.89 If there are differences in risk factors, this could inform the development of tailored prevention strategies.

Physical health problems need clarification. Frequent transitions between, into and out of criminal justice institutions may complicate access to primary care, which could be addressed. One other risk factor where evidence was lacking is childhood adversity, which is common in prisoners.97 Future research could examine the links between childhood adversity, mental illness, substance use and suicide in people in prison, as these factors frequently co-occur.98,99

**Conclusion**

In conclusion, we have reported a range of demographic, criminological, clinical and institutional risk factors associated with suicide in prisons. Our findings highlight modifiable risk factors and the importance of identifying high-risk groups, which could improve suicide prevention and intervention strategies. These strategies should in particular target those with previous suicidal behaviours, mental illness, and single cell occupancy, and should include universal screening for suicide risk and provision of psychological and pharmacological treatment for psychiatric disorders. For example, cognitive behavioural therapies have been found to be modestly effective for depression and anxiety outcomes in prisoners, which may mediate suicidal behaviour.114 Other interventions might include substitution therapies for opiate use disorders as observational evidence suggests an association with reduced suicidal behaviours.115

**Contributors**

SF conceived and designed the study. MS and SZ were responsible for data extraction. SF, RY and SZ designed the statistical analysis and SZ and RY did the analysis. MS and SZ drafted the manuscript and all authors contributed to the interpretation of findings and edits of the manuscript. SF provided overall supervision of the project.

**Declaration of interests**

SF and JS are panel members of the UK’s Independent Panel on Deaths in Custody. KH is a member of the National Suicide Prevention Advisory Group.

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**Data sharing**

Study data are available on request to the authors.

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