Substance use disorders in prisoners: an updated systematic review and meta-regression analysis in recently incarcerated men and women

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ABSTRACT

Aims The aims were to (1) estimate the prevalence of alcohol and drug use disorders in prisoners on reception to prison and (2) estimate and test sources of between study heterogeneity. Methods Studies reporting the 12-month prevalence of alcohol and drug use disorders in prisoners on reception to prison from 1 January 1966 to 11 August 2015 were identified from seven bibliographic indexes. Primary studies involving clinical interviews or validated instruments leading to DSM or ICD diagnoses were included; self-report surveys and investigations that assessed individuals more than 3 months after arrival to prison were not. Random-effects meta-analysis and subgroup and meta-regression analyses were conducted. Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines were followed. Results In total, 24 studies with a total of 18,388 prisoners across 10 countries were identified. The random-effects pooled prevalence estimate of alcohol use disorder was 24% [95% confidence interval (CI) = 21–27], with very high heterogeneity ($I^2 = 94$%). These ranged from 16 to 51% in male and 10–30% in female prisoners. For drug use disorders, there was evidence of heterogeneity by sex, and the pooled prevalence estimate in male prisoners was 30% (95% CI = 22–38; $I^2 = 98$%; 13 studies; range 10–61%) and, in female prisoners, was 51% (95% CI = 43–58; $I^2 = 95$%; 10 studies; range 30–69%). On meta-regression, sources of heterogeneity included higher prevalence of drug use disorders in women, increasing rates of drug use disorders in recent decades, and participation rate. Conclusions Substance use disorders are highly prevalent in prisoners. Approximately a quarter of newly incarcerated prisoners of both sexes had an alcohol use disorder, and the prevalence of a drug use disorder was at least as high in men, and higher in women.

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INTRODUCTION

Prisons around the world detain large numbers of individuals with substance use problems, which increase the risk of mortality after prison release [1–3] and repeat offending [4,5]. In addition, alcohol use disorders (AUD) are associated with suicide inside prison [6] and of perpetrating violence and being victimized inside custody [7,8].

The treatment gap for substance use disorders (SUD) inside prison has been reported in many studies [9,10]. Estimates of the prevalence of these disorders in prisoners can assist in planning service provision effectively, targeting scarce resources and developing and evaluating initiatives to reduce the gap between health needs and interventions. A previous systematic review reported ranges for drug abuse and dependence of 10–48% in men and 30–60% in women on reception or arrival to prison. For alcohol abuse and dependence, ranges of 18–30% for men and 10–24% for women were reported [11]. There were very high rates of heterogeneity between these included studies (with $I^2$ values of more than 80%), which were investigated in subgroup analyses. Lower prevalences were associated with studies where psychiatrists acted as interviewers and higher prevalences for drug use disorders in remand prisoners. However, this review is now dated, with its search for primary studies ending in 2004, and a number of relevant investigations have been published subsequently. In addition, subgroup analyses were the limited number of primary studies by sex, and an updated review will allow for further investigation of sources of between-study variation.

The aim of the current paper is to provide an update of prevalence estimates of alcohol and drug use disorders in...
prisoners and estimate sources of between-study heterogeneity. As part of this, we have used the term ‘substance use disorder’, which does not distinguish between ‘abuse’ and ‘dependence’. In this update, we have also conducted meta-analyses to report pooled prevalence estimates and meta-regression to examine sources of variation between included studies.

**METHODS**

Search strategy
We identified surveys of alcohol and drug use disorder in general prison populations (defined as remand/detainee and/or sentenced prisoners who are sampled from the whole population of a correctional institution) published between January 1966 and August 2015. For the period January 1966 and January 2004, methods have been described in a previous systematic review conducted by one of the authors (S.F.) [11]. For this update, we searched the following databases from 1 January 2004 to 11 August 2015: PsycINFO, MEDLINE, Global Health, PubMed, CINAHL, National Criminal Justice Reference Service and EMBASE. We used a combination of search terms relating to substance use disorder (i.e. substance*, alcohol, drug*, misuse, dependen*, abuse) and prisoners (i.e. inmate*, sentenced, remand, detainee*, felon*, prison*, incarcerat*), which are same search terms used in the previous review except for the addition of ‘incarcerat*’. Additional targeted searches covered relevant reference lists, and non-English papers were translated. We corresponded with authors to clarify data when necessary. We followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines [12] (Supporting information, Appendix S1) and registered the protocol for this review with PROSPERO (registration code CRD42016036416) [13].

Study eligibility
Inclusion criteria were studies: (a) reporting diagnoses of substance use disorder (i.e. substance abuse and/or dependence) based on clinical examination or by interviews using validated diagnostic instruments [based on DSM (versions III to IV-R; codes 303.90, 304.00–90, 305.00–90, excluding nicotine-related disorders) and ICD versions 9 and 10 (ICD-9: 303–305; ICD-10 codes: F10–19.1–2 except F17)]; (b) with diagnoses based on the previous 12 months from the time when participants were interviewed/examined; and (c) that sampled the general prison population within 3 months of arrival to prison. We excluded studies that selected subgroups for interview (e.g. prisoners referred for treatment, specific categories of offenders), as the aim was to provide a prevalence estimate for the whole prison population [14–16]. After correspondence with authors, if studies reported combined prevalence for alcohol and drug [17,18] or combined male and female prevalence, these were excluded [19], as we aimed to report estimates separately by sex and by drug and alcohol use disorder. Studies that reported specific drugs [20,21], self-screening measures [22,23] or solely life-time prevalence were also excluded [24].

Publications in any language were included in the search: studies from low- and middle-income (LMI) countries were reported separately, given high heterogeneity [25,26]. Similarly, studies with juvenile/youth prisoners were analysed separately [27–31].

Data extraction and analysis
Two researchers (I.Y. and A.H.) extracted independently information on year of publication, geographical location, total sample, sex, prisoner status (remand/sentenced), average age, method of sampling, sample size, participation rate, type of interviewer, diagnostic instrument, diagnostic criteria (ICD versus DSM) and number diagnosed with substance use disorders. If older studies reported dependence prevalence, this was prioritized over abuse, as we considered that these had higher diagnostic validity [32,33] (except when only combined prevalence for abuse and dependence was available). Eligible studies were assessed for quality using the JBI Critical Appraisal Checklist for Studies Reporting Prevalence Data, which uses nine criteria including sample size, sampling, sample description, appropriate statistical analysis and response rates (Supporting information, Appendix S2) [34].

We conducted a random-effects analysis, which assigns similar weights to all studies included in the meta-analysis regardless of sample size [35]. If there were high levels of overall heterogeneity (I² > 75%), we also reported estimate ranges as an alternative. Meta-regression analysis was performed to examine sources of between-study heterogeneity on a range of study pre-specified characteristics [i.e. sex, age, publication year, country (United States versus other countries), prisoner status (sentenced versus remand/detainee/unsentenced), participation rate, sample size, diagnostic criteria (ICD versus DSM) and psychiatric interviewer]. Univariable analysis was conducted for both dichotomous and continuous definitions of a variable (e.g. publication year: continuous versus before or after 2000). Multivariable analyses were not conducted due to the limited number of primary studies. If there were fewer than 10 studies that reported an explanatory variable, it was excluded from the meta-regression [36]. Selected continuous variables (study year and proportion sentenced) were converted to dichotomous variables for reporting of pooled prevalence estimates of subgroups. Accordingly, in the meta-regression, studies that combined both remand and sentenced prisoners were excluded if: (1) prisoner type
In addition, pooled prevalence estimates of the subgroups that did not have more than one study in each relevant category were not reported, even if they had significant results on meta-regression. Further, we conducted subgroup analyses stratified on pre-specified variables based on our previous review—sex, whether or not the country of origin was United States, remand/detainee versus sentenced prisoner status and whether or not the assessment was conducted by a psychiatrist. We added a new subgroup analysis based on the date of publication (2000, which was approximately the median date). To test for publication bias, funnel plot analysis and Egger’s test were conducted on all studies stratified by disorder (i.e. AUD and SUD) and also by sex and disorder [43]. Thus, six separate Egger’s tests were performed. Studies with juvenile prisoners or LMI countries were not included, as they were clinically heterogeneous and limited in number. The Egger test quantifies bias captured in the funnel plot analysis with linear regression using the value of effect sizes and their precision [standard error (SE)] and assumes that the quality of study conduct is independent of study size [35]. All analyses were conducted in Stata (STATA-IC) version 14 using the following.

**Figure 1** Flow diagram of search strategy for update (2004–15)

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commands: metan (for random-effects meta-analysis), metareg (for meta-regression), metabias (for publication bias analysis) and heterogi (for calculation of confidence intervals for heterogeneity level).

RESULTS

Study characteristics

We identified 24 publications for the main analysis (Fig. 1), 13 of which were from the previous review [37–39,44–53], and 11 new studies from 2004 [40–42,54–61]. Two additional studies in LMI countries (Chile [26] and Brazil [25]) and five studies on juvenile prisoners (mean age = 16.7 years) were examined separately (Supporting information, Appendix S3) [27–31].

Studies in the main analysis were from 10 different countries (Australia [40], Austria [61], England [48], France [42], Germany [56], Iceland [39,41,51,55], the Netherlands [57], New Zealand [37] and United States [38,44–47,49,50,52,54,59]), with 40.5% (7456 prisoners) of the adult combined sample from the United States. Participants were 18388 prisoners, both sentenced and remand/detainee, 64% of whom were male. The mean age was 30.2 years (range = 17–67 years). Of the 5835 prisoners with criminal history information reported, 924 prisoners (15.8%) were charged or convicted with a violent offence. There were more sentences (11 065; 60.2%) than remand/detainee/unsentenced prisoners (2975; 16.2%), and 11 investigations included both sentenced and remand prisoners (4348; 23.6%) (‘mixed’ studies) [38–40,42,51,55–57]. Apart from two studies based on clinical interviews [48,51], the others involved trained interviewers using validated, structured diagnostic instruments (Table 1 for details). Prevalence of drug use disorder were based on all drugs excluding alcohol and tobacco (i.e. cannabis, opioids, cocaine, amphetamine, hallucinogens, inhalants, other stimulants and tranquillizers). The individual prevalence estimates of substance use disorders are summarized in Table 2. In terms of quality of the included studies, we determined that nine of 24 studies were of high quality, as they met all nine criteria in the quality checklist, including a sufficient sample size (> 250), low refusal rate (< 20%) and detailed description of study subjects and setting [38,41,42,44,46,49,53,54,59] (see Supporting information, Appendix S2 for full criteria).

Alcohol use disorder

The overall pooled prevalence estimate of alcohol use disorder was 24% [95% confidence interval (CI) = 21–27], with very high levels of between-study heterogeneity ($I^2 = 94$%; 95% CI = 92–95). Fifteen studies of alcohol use disorder in men were identified in 12739 prisoners [37,38,40–42,44,48,50–52,57,58,60,61]. Pooled prevalence estimate for males was 26% (95% CI = 23–30), with substantial heterogeneity between studies ($I^2 = 94$%; 95% CI = 92–96) and a range of 16–51% in individual studies. We identified 10 investigations that measured alcohol use disorder in female prisoners [38–40,45,46,49,53–56], and pooled prevalence estimate was 20% (95% CI = 16–24) with high heterogeneity ($I^2 = 88$%; 95% CI = 80–93). Primary studies provided estimates that varied from 10 to 30% (Figure 2).

Two investigations in LMI countries reported prevalences of 43% [25] and 30% [26]. There were four investigations of alcohol use disorder in juvenile men, and prevalences ranged from 16 to 25% [27–29,31].

Drug use disorder

There was evidence of heterogeneity by sex in univariable meta-regression, and prevalence estimates for drug use disorder are stratified accordingly.

Men

Thirteen studies reported drug use disorder in male prisoners [37,38,40–42,44,47,48,50–52,57,60]. The pooled prevalence estimate was 30% (95% CI = 22–38), with very high heterogeneity ($I^2 = 98$%; 95% CI = 98–99). These varied from 10 to 61%. In LMI countries, reported prevalences were 30% [25] and 56% [26].

Women

Ten relevant studies on drug use disorder in female prisoners were identified [38–40,46,47,49,53–56]. The pooled prevalence estimate was 51% (95% CI = 43–58) with substantial heterogeneity ($I^2 = 95$%; 95% CI = 93–97). Prevalences ranged from 30 to 69%.

Sources of heterogeneity

In univariable meta-regression (n = 23 studies), factors associated with heterogeneity included: females reported higher drug use disorder than males ($\beta = 0.21; 95\% CI = 0.33–0.10; P = 0.001$), more recent studies (published after 2000) reported higher rates of drug use disorder ($\beta = 0.15; 95\% CI = 0.12–0.28; P = 0.03$), and participation rate was associated negatively with drug use disorder ($\beta = -0.37; 95\% CI = 0.73, -0.01; P = 0.045$). No significant associations were reported with alcohol use disorder, although there was a non-significant link with publication year as a continuous variable ($\beta = 0.004; 95\% CI = -0.00002, 0.008; P = 0.051$).

Using subgroup analysis, we also investigated possible explanations for between-study variation (Table 3). This found that there were higher estimates for drug use...
Table 1 Study characteristics of newly included studies of substance use disorder in prisoners on arrival into custody (by study year).

| Study          | Country | Population                              | Sampling strategy                                                                 | Sampling method       | Instrument criteria | Diagnostic criteria | Mean age (years) | Age range | Psychiatric interviewer | Mean duration in prison | Type of prisoner | % male | No. committed violent offences | No. not consenting |
|----------------|---------|-----------------------------------------|-----------------------------------------------------------------------------------|-----------------------|---------------------|---------------------|-------------------|-----------|--------------------------|------------------------|-------------------|--------|-----------------------------|------------------|
| Collins 1988   | USA     | North Carolina prisons                 | Consecutive new arrivals at reception                                            | DIS                  | DSM-III             | 27.6                | Not reported      | N         | Not reported              | Not reported          | Sentenced       | 100%   | 157                         | 117               |
| Daniel 1988    | USA     | Missouri Correctional Classification Center | Consecutive arrivals over 7 months                                                | DIS                  | DSM-III             | 29                  | SD 8.2            | N         | Not reported              | Not reported          | Sentenced       | 0%     | 21                          | 0                 |
| Teplin 1994    | USA     | Cook County Department of Corrections, Chicago | All remands 1983–84                                                              | Stratified random sampling | DIS              | DSM-III-R          | Not reported      | Not reported | Not reported              | Not reported          | Remand          | 100%   | Not reported                | 35                |
| Jordan 1996    | USA     | Correctional Institution for Women, Raleigh, NC | Combined consecutive and random sampling                                         | CIDII                | DSM-III-R           | 31.5                | 18–65             | Y         | 5–10 days                | Sentenced             | 0%               | 98     | 42                          |                   |
| Smith 1996     | Ireland | Mountjoy Prison, Dublin                 | Simple random sampling                                                             | Clinical interview   | DSM-III-R           | Not reported      | Not reported      | Y         | 1 day                     | Mixed                 | 100%             | Not reported | 201               | 59                |
| Teplin 1996    | USA     | Cook County Department of Corrections, Chicago | All remands 1991–93                                                              | Stratified random sampling | DIS              | DSM-III-R           | 28                 | 17–67     | Not reported              | Remand                | 0%               | 0      | 2                          |                   |
| Mason 1997     | England | Durham Remand prison for men            | Consecutive sampling at reception                                                  | Clinical interview   | DSM-IV             | Not reported      | Not reported      | Y         | Not reported              | Remand                | 100%             | Not reported | 0                 |                   |
| McClellan 1997 | USA     | Prison unit for men and reception centre for women, Texas | All newly admitted inmates                                                        | DIS                  | DSM-III             | 32.8                | Not reported      | N         | Not reported              | Mixed                 | 67%              | Not reported | 202               |                   |
| Mohan 1997     | Ireland | Mountjoy Prison, Dublin                 | Simple random sampling                                                             | SCANII               | DSM-IV             | 25.8                | 17–48             | Y         | Not reported              | Mixed                 | 0%               | 0      | 0                           |                   |

(Continues)
| Study       | Country | Population                                                                 | Sampling strategy                          | Sampling method                      | Instrument criteria | Diagnostic criteria | Mean age (years) | Age range | Psychiatric interviewer | Main duration in prison | Type of prisoner | % male | No. committed violent offences | No. not consenting |
|------------|---------|----------------------------------------------------------------------------|---------------------------------------------|---------------------------------------|---------------------|---------------------|-------------------|-----------|--------------------------|------------------------|------------------|--------|-----------------------------|-------------------|
| Peters 1998 | USA     | Holliday Transfer Facility, Texas                                         | Consecutive new arrivals over 3 months     | Consecutive sampling at reception     | SCID IV             | DSM-IV              | 32.6              | SD 10.2  | Y                        | 14–60 days            | Sentenced       | 100%      | 61                           | 100                |
| Lo 2000    | USA     | Cuyahoga County Jail, Cleveland, USA                                       | All sentenced incoming prisoners in 1997–98| Consecutive sampling                 | DIS                 | DSM-IV              | 30                | 18–58   | N                        | Not reported           | Sentenced       | 76%      | Not reported                 | 29                 |
| Marquart 2001 | USA          | Texas Department of Criminal Justice, institutional division               | All female prisoners admitted in 1994     | Simple random sampling                | DIS                 | DSM-IV              | 32.3              | 17–63   | Y                        | Not reported           | Remand          | 0%       | Not reported                 | 0                 |
| Butler 2003 | Australia | Metropolitan Remand and Reception Centre, female Correctional Centre and remote reception sites | Consecutive convenience sample of admissions over 3 months | Convenience sample among those admitted over 3 months | CIDI                | DSM-IV and ICD-10   | Men 29.61, women 29.10 | Not reported         | Mental health nurses | Not reported           | Mixed            | 100%      | Not reported                 | Non-screened: 67.4% |
| Wright 2006 | Ireland | The Dochas Centre, female wing of Limerick Prison near Dublin              | Consecutive admissions in August 2003 and between April 2004 and May 2004 | All consenting prisoners interviewed at reception (10.7% of all committals) | SADS-L              | ICD-10              | 27.4              | Not reported         | Post-membership psychiatrists | Asembled to interview within 72 hours of reception | Mixed            | 0%       | 14/60 = 23.3%                | 30                 |
| Jones 2006 | England | HMP Grendon (therapeutic)                                                 | All consenting prisoners                   | All consenting prisoners              | CAAPI               | DSM-IV              | 30.7              | 18–66   | Psychological counsellor | Shortly after admission | Sentenced       | 100%      | Not reported                 | 0                 |
| Study          | Country        | Population                              | Sampling strategy                                                                 | Sampling method                                                                                   | Instrument criteria | Diagnostic criteria | Mean age (years) | Age range | Psychiatric interviewer\(^a\) | Mean duration in prison | Type of prisoner | % male | No. committed violent offences | No. not consenting |
|---------------|----------------|-----------------------------------------|-----------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------|---------------------|---------------------|-------------------|-----------|---------------------------------|------------------------|------------------|--------|---------------------------------|---------------------|
| Bulten 2009   | Netherlands    | community prison (Vught prison)         | Random sample of admissions to ‘general wards’ of prison                            | Random sample among new admissions                                                               | MINI\(^b\)          | DSM-III-R            | 30.4              | 18–59     | Trained psychologist            | First weeks of incarceration | Mixed            | 100%   | 73                              | 50                  |
| Curtin 2009   | Ireland        | Cloverhill, Limerick and Cork Prisons (remand), Mountjoy and Cork Prisons (sentenced) | Consecutive admissions, up to 10 per day                                           | All consenting prisoners interviewed at reception                                                | SADS-L              | ICD-10              | 29.8              | 18+       | Post-membership psychiatrists   | Within 72 hours        | Mixed            | 100%   | 79                              | 54                  |
| Einarsson 2009| Iceland        | Icelandic prison for sentenced inmates   | All new admissions in study period (females excluded)                               | All consenting prisoners interviewed at reception                                                | MINI 5              | DSM-IV              | 31                | 19–56     | Psychiatrist                   | Within 10 days         | Sentenced        | 100%   | 15                              | 16                  |
| Stompe 2010   | Austria        | Prison Vienna-Josefstadt                | Consecutive recruitment of admissions                                               | All eligible new admits.                                                                         | SCAN                | ICD-10              | Not reported       | 18+       | Doctor (psychiatry trainee)     | Not reported           | Mixed            | 100%   | Not reported                    | 0                   |
| Proctor 2012  | USA            | Minnesota state prisons                 | All reception 2000–03                                                                | All consenting prisoners interviewed at reception                                                | SUDDS-IV\(^3\)      | DSM-IV              | 32.8              | 18–58     | Addictions counsellors (computer recorded interview) | Not reported           | Sentenced        | 0      | Not reported                    | 0                   |
| Sarlon 2012   | France         | Local prisons of Fleury-Merogis, Loos, Lyon, Marseille | Reception: new receptions to local                                                 | All consenting prisoners interviewed at reception                                                | MINI plus 5.0       | DSM-IV              | 29.9              | 18–64     | Clinicians (psychiatrist and psychologist) | within 14 days          | Mixed            | 100%   | Not reported                    | 30                  |

(Continued)
Table 1. (Continued)

| Study       | Country | Population                                           | Sampling strategy | Sampling method                                      | Instrument criteria          | Mean age (years) | Age range | Psychiatric interviewer<sup>a</sup> | Diagnostic criteria | Main duration in prison | Type of prisoner | % male | No. committed violent offences | No. not consenting |
|-------------|---------|------------------------------------------------------|-------------------|-----------------------------------------------------|----------------------------|------------------|-----------|-------------------------------------|---------------------|---------------------------|------------------|--------|-----------------------------|-------------------|
| Tavares 2012 | Brazil  | Porto Alegre prison                                  | Consecutive admissions | Random sample among new admits (calculation of 30 a base-point for recruitment) | MINI-plus (Brazilian version) | 27.88            | Not reported | Not reported                       | DSM-IV              | Within 3 months           | Sentenced       | 100%   | 10                          | 0                 |
| Mir 2015     | Germany | Penal justice system in Berlin                        | Consecutive admissions screened for eligibility | All eligible new admits. Aimed for sample of 150. | MINI 6.0 (German version) | 34.3            | Not reported | Clinical psychologist              | DSM-IV              | Within 1 month (usually <1 week) | Mixed            | 0%     | 0                           | 48                |
| Mundt 2015   | Chile   | Santiago Uno central facility, Centro Penitenciario Feminino, San Joaquin, CPF San Miguel central admission facilities | Consecutive admissions | All consenting prisoners interviewed at reception | MINI Spanish version        | 31.6             | Not reported | Clinical psychologist/nurse (trained by senior consultant psychiatrist) | DSM-IV              | 7.7 days                   | Remand          | 54%    | 127                         | 30                |
| Hoffmann 2015| USA     | 8 adult state prison facilities of Minnesota          | Uses routine data collected on admissions, all admissions during 2002–03 | All consenting prisoners interviewed at reception | SUDDS-IV                  | 31              | 18–65     | Addiction counsellors              | SUDDS-I             | On admission               | Sentenced       | 90%    | Not reported                 | 0                 |

<sup>a</sup>Y = Yes; psychiatrist, N = no; non-psychiatrist (trained interviewer);<sup>b</sup>DIS = Diagnostic Interview Schedule;<sup>c</sup>DSM = Diagnostic and Statistical Manual of Mental Disorders; DSM-III-R = DSM-III revised;<sup>d</sup>CIDI = Composite International Diagnostic Interview;<sup>e</sup>SCAN = Schedules for Clinical Assessment in Neuropsychiatry;<sup>f</sup>SCID = Structured Clinical Interview for DSM Disorders;<sup>g</sup>ICD = International Classification of Diseases;<sup>h</sup>SADS-L = Schedule for Affective Disorders and Schizophrenia – life-time version;<sup>i</sup>SODQ = Severity of Opiate Dependence Questionnaire;<sup>j</sup>CAAPE = Comprehensive Addictions and Psychological Evaluation;<sup>k</sup>MN = Mini International Neuropsychiatric Interview;<sup>l</sup>SUDDS = Substance Use Disorders Diagnostic Schedule.
disorders in women, and for both drug and alcohol use disorders since 2000, which were consistent with findings on meta-regression. In addition, in alcohol use disorders, there were higher prevalence estimates in sentenced (than remand) prisoners. However, these subgroup analyses had overlapping CIs, apart from a higher estimate for women with drug use disorder compared to men (Figure 3).

Publication bias

There was no evidence of publication bias overall and in subgroups stratified by sex apart from drug use disorder in male prisoners, where there was non-significant evidence of publication bias in the funnel plot analysis (Egger’s test, \( t = 2.19, \ SE(t) = 4.27, P = 0.051 \) \([37,38,40–42,44,47,48,50–52,57,60]\)). Visual analysis of the funnel plot suggested asymmetry, but appeared to be mainly attributable to one study [60] with a high prevalence and large standard error, which when removed did not suggest clear publication bias (Supporting information, Appendix S4).

DISCUSSION

This updated systematic review of the prevalence of substance use disorder in prisoners is based on 24 studies and 18,388 individuals in 10 countries. In

Table 2 Prevalence estimates of substance use disorder in reception studies of prisoners.

| Study                  | Total no. | Males (%) | No. with alcohol use disorder | No. with drug use disorder | Prevalence of alcohol use disorder (%) | Prevalence of drug use disorder (%) |
|------------------------|-----------|-----------|------------------------------|----------------------------|---------------------------------------|-----------------------------------|
| Daniel 1988            | 100       | 0         | 10\(^a\)                     | -                          | 10.0                                  | -                                 |
| Collins 1988           | 1120      | 100       | 302\(^a\)                   | 112\(^a\)                  | 27.0                                  | 10.0                              |
| Teplin 1994            | 728       | 100       | 116\(^a\)                   | 129\(^a\)                  | 15.9                                  | 17.7                              |
| Jordan 1996            | 805       | 0         | 244\(^a\)                   | 138\(^a\)                  | 30.3                                  | 17.1                              |
| Smith 1996             | 235       | 100       | 63                          | 46                        | 26.8                                  | 19.6                              |
| Teplin 1996            | 1272      | 0         | 667\(^a\)                   | 304\(^a\)                  | 52.4                                  | 23.9                              |
| Bushnell 1997          | 100       | 100       | 19\(^a\)                    | 14\(^a\)                   | 19.0                                  | 14.0                              |
| Mason 1997             | 548       | 100       | 116\(^a\)                   | 214\(^a\)                  | 21.2                                  | 39.1                              |
| McClellan 1997         | 1030      | 67        | 309 male                    | 331 male                   | 30.0 male                             | 32.1 male                         |
|                        |           |           | 500 female                  |                            |                                       |                                   |
| Mohan 1997             | 45        | 0         | 0                            | 26                        | 0.0                                   | 57.8                              |
| Peters 1998            | 400       | 100       | 86\(^a\)                    | 100\(^a\)                  | 21.5                                  | 25.0                              |
| Lo 2000                | 152       | 76        | -                            | 73 male                    | -                                     | 48.0 male                         |
|                        |           |           | 48 female                   |                            |                                       | 60.4 female                       |
| Marquart 2001          | 500       | 0         | 88\(^a\)                    | 224\(^a\)                  | 17.6                                  | 44.8                              |
| Butler 2003            | 756       | 82        | 142 male                    | 378 male                   | 19.2 male                             | 52.0 male                         |
|                        |           |           | 165 female                  | 111 female                 | 16.5 female                           | 68.9 female                       |
| Wright 2006            | 94        | 0         | 23                          | 45                        | 24.7                                  | 48.4                              |
| Jones 2006             | 118       | 100       | 53                          | -                         | 44.9                                  | -                                 |
| Bulten 2009            | 191       | 100       | 53                          | 57                        | 27.7                                  | 29.8                              |
| Curtin 2009            | 615       | 100       | 148                         | 206                       | 24.1                                  | 33.5                              |
| Einarsson 2009         | 90        | 100       | 46                          | 55                        | 51.1                                  | 61.1                              |
| Stompe 2010            | 200       | 100       | 59\(^a\)                    | -                         | 29.5                                  | -                                 |
| Proctor 2012           | 801       | 0         | 242                         | 456                       | 30.2                                  | 56.9                              |
| Sarlon 2012            | 267       | 100       | 43                          | 47                        | 16.1                                  | 17.6                              |
| Mir 2015               | 150       | 0         | 31                          | 71                        | 20.7                                  | 47.3                              |
| Hoffmann 2015          | 6871      | 90        | 2177                        | -                         | 31.7                                  | -                                 |
| LMI countries          |           |           |                              |                           |                                       |                                   |
| Tavares 2012           | 60        | 100       | 26                          | 18                        | 43.3                                  | 30.0                              |
| Mundt 2015             | 229 male  | 54        | 68 male                     | 128 male                  | 29.7 male                             | 55.9 male                         |
|                        | 198 female |            | 23 female                  | 47 female                  | 11.6 female                           | 23.7 female                       |
| Juvenile prisoners     |           |           |                              |                           |                                       |                                   |
| Köhler 2009            | 149       | 100       | 31                          | -                         | 20.8                                  | -                                 |
| Vreugdenhil 2003       | 204       | 100       | 45                          | -                         | 22.1                                  | -                                 |
| McClelland 2004        | 1143      | 64        | 289 male\(^a\)              | 276 male\(^a\)             | 25.3 male                             | 24.1 male                         |
|                        | 631 female|            | 156 female\(^a\)            | 260 female\(^a\)           | 24.7 female                           | 41.2 female                       |
| Plattner 2012          | 275       | 100       | 45                          | 135                       | 16.4                                  | 49.1                              |
| Dixon 2005             | 100       | 0         | 55\(^a\)                    | 85\(^a\)                  | 55.0                                  | 85.0                              |

\(^a\)Figures for combined abuse and dependence; the rest are dependence only.
addition, we identified five studies in juvenile prisoners and two investigations in LMI countries. The sample size in this update is more than double of that a previous systematic review [11], which identified relevant prevalence studies until 2004, and this updated synthesis allowed for an investigation of sources of heterogeneity between included studies.

We report two main findings. The first is that alcohol use disorder was highly prevalent in prisoners, with a pooled estimate of 24% (95% CI = 21–27). In men, the lowest estimate suggests that one in six (16%) met the threshold for alcohol use disorder on arrival into prison, and in women it was one in 10. By way of comparison, in the United States in 2013 community rates of past year alcohol use disorder were estimated at 8.7% for men and 4.6% in women [62]. According to the Global Burden of Disease 2015 Study, the global prevalence of alcohol use disorder was 1.5% for males and 0.3% for females (0.9% for both sexes) worldwide [63]. The second major finding was that drug use disorder was as high as the alcohol estimates, and possibly higher in female prisoners, with a pooled estimate of 51% (95% CI = 43–58). Importantly, the lowest prevalence study in women found that 30% had a drug use disorder. This can be contrasted with US community samples, where 3.4% of men and 1.9% women had such a disorder [62], and 0.8% in men and 0.4% in women (0.6% for both sexes) worldwide [63].

We investigated sources of heterogeneity more carefully than previous work, which led to a number of potentially important findings. First, using meta-regression, we found evidence of increasing drug use disorder in prison studies during the past three decades. This is in contrast with community trends in some high-income countries such as the United States, where drug use disorder had not increased (and alcohol reduced slightly) between 2000 and 2013 [64]. Secondly, two other study characteristics were associated with significant variations in prevalence. Having a higher participation rate was associated with lower rates in drug use disorder, and there were higher rates of drug use disorders in women prisoners. Being assessed by a psychiatrist was also linked with lower alcohol use disorder prevalence in subgroup analyses, although the confidence intervals overlapped. This should inform the interpretation of single studies, particularly if used for service planning and development. One possible explanation for heterogeneity that we did not investigate are the community baseline rates of substance use disorders, and future work could examine this using
comparable measures of drug and alcohol use, such as the ongoing Global Burden of Disease [63]. In addition, the reported high prevalence range of 30–56% for substance use disorder in LMI countries needs further research, as it was based on only two investigations.

A number of implications arise from this updated meta-analysis. First, it highlights the opportunity that jails and prisons present to treat substance use disorders [65]. The high prevalences underscore the importance of evidence-based interventions being available to all individuals entering custody. Four areas should be considered to improve management of substance use disorders in prisoners. First, prison arrival centres need to have systems in place to identify individuals with high treatment needs, and treatments should be matched to individual needs [65]. Secondly, acute detoxification management should be available to all entrants to custody, which may include short-term prescription of benzodiazepines for alcohol withdrawal [66] and symptomatic treatment of withdrawal from other substances that may include opioid agonists (such as methadone or buprenorphine). Detoxification programmes may benefit from the use of clinical tools to document withdrawal symptoms [67]. Thirdly, combination pharmacological and psychosocial treatments should be available, considering the high prevalences and the subsequent effects on adverse outcomes, including mortality after release and violent re-offending [68,69]. Finally, considering the high relapse rates, programmes need to link prisoners with community services. Structured, simple and scalable tools to identify those at highest risk [70] and case management [71] may assist in this process. A second implication from the review is that prevalence research needs to consider some areas of improvement. These include separating prevalences by drug and alcohol use disorder, and also providing information stratified by sex and prisoner status (i.e. sentenced or not). Baseline information on socio-demographic and criminal history characteristics (such as those listed in Table 1, including the sample’s age structure and index offence) should be provided in new studies, and supplemented with more clinically informative information, such as comorbidities with mental illness [72] and chronic pain, prevalence by individual drugs and most recent treatment. At the same time, as there are now at least 24 studies on prevalence on more than 18,000 prisoners, whether new research should prioritize how treatment can be delivered most effectively to prisoners and former prisoners needs to be considered by funding agencies, researchers and government agencies in criminal justice and public health.

### Table 3. Pooled prevalence estimates for drug and alcohol use disorders in newly incarcerated men and women by pre-specified subgroups.

|                  | Alcohol use disorder % (95% CI) | Drug use disorder % (95% CI) |
|------------------|---------------------------------|------------------------------|
|                  | Male                            | Female                       | Male                          | Female                        |
| **Country**      |                                 |                              |                              |                               |
| High income      |                                 |                              | 30 (22–38)                    | 51 (43–58)                    |
| countries        | –                               | –                            | (n = 5750; k = 13)            | (n = 4379; k = 10)            |
| USA              | 23 (19–27)                      | 20 (15–25)                   | 37 (26–48)                    | 48 (39–57)                    |
|                  | (n = 9619; k = 5)               | (n = 3978; k = 6)            | (n = 2948; k = 5)             | (n = 3926; k = 6)             |
| Non-USA          | 25 (21–28)                      | 20 (15–24)                   | 40 (31–50)                    | 56 (44–68)                    |
|                  | (n = 3573; k = 14)              | (n = 453; k = 4)             | (n = 3255; k = 12)            | (n = 453; k = 4)              |
| **Publication year** |                                |                              | 46 (33–58)                    | 54 (47–62)                    |
| Before 2000      | –                               | –                            | (n = 2622; k = 4)             | (n = 1757; k = 6)             |
| 2000 and after   | –                               | –                            | –                            | –                             |
| **Prisoner type** |                                 |                              |                               |                               |
| Remand           | 21 (18–25)                      | –                            | –                            | –                             |
|                  | (n = 1502; k = 4)               |                              |                               |                               |
| Sentenced        | 33 (29–37)                      | –                            | –                            | –                             |
|                  | (n = 8808; k = 7)               |                              |                               |                               |
| **Interviewer**  |                                 |                              |                               |                               |
| Psychiatrist     | 23 (19–26)                      | –                            | –                            | –                             |
|                  | (n = 2265; k = 6)               |                              |                               |                               |
| Other            | 30 (26–35)                      | –                            | –                            | –                             |
|                  | (n = 9746; k = 8)               |                              |                               |                               |

CI = confidence interval.
Some limitations to this review need to be considered. First, there was variation in the diagnostic tools and interviewers used to assess substance use disorders, and we found that psychiatrist interviewers were associated with lower prevalences for alcohol use disorder. To reflect this clinical and statistical heterogeneity, we also reported prevalence ranges. Secondly, as we focused upon substance use disorders on prison entry, these estimates may not reflect treatment needs later in prison or on prison release, where novel psychoactive substances are increasingly problematic and may require different treatment approaches [73]. In addition, the misuse of prescribed medication such as painkillers, anti-epileptics and anxiolytics inside custody needs to be considered, and may further increase treatment needs. Finally, some of the subgroup analyses were based on fewer than 10 studies, and should be interpreted with caution.

In summary, the high prevalence of alcohol and drug use disorders in prisoners remains a key challenge for prison health. Tackling this will probably require interventions at all stages of the criminal justice process—from identifying and treating withdrawal in police custody [74] and on arrival to prison, to opiate maintenance and other treatments during any period in prison [68], to community links being made and integrated treatment provided on release [75]. Comprehensive strategies to prevent relapse of substance dependence are likely to reduce premature mortality, recidivism and subsequent return to prison.

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Declaration of interests

None.

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Supporting Information

Additional Supporting Information may be found online in the supporting information tab for this article.

**Appendix S1** Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) checklist.

**Appendix S2** Quality checklist.

**Appendix S3** Study characteristics of studies of substance use disorders in juvenile prisoners.

**Appendix S4** Funnel plot of studies reporting drug use disorder prevalence in male prisoners.