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Odds of HIV among incarcerated drug users: a systematic review and meta-analysis of Asian countries

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Background: HIV makes up a large portion of infectious diseases globally. People injecting drugs in prisons are at high risk for contracting HIV infection. Prisons house ~10.2 million people globally, making them a high-risk setting for HIV transmission. This systematic review summarizes the available data on the odds of developing HIV infection among imprisoned people who inject drugs (PWIDs) in Asian regions.

Methods: The authors electronically assessed published studies from January, 2000 to December, 2022, including studies that investigated the odds of HIV in imprisoned PWIDs. We extensively searched PubMed, ERIC, and Cochrane Central and Google Scholar with no constraints in language or time. All the observational studies evaluating the chances of HIV in Asian prisoners with an exposure group of PWIDs and a control group of non-injecting-drug users were included in our analysis.

Results: The databases search yielded 254 potential studies, 10 observational studies of which having a total of 17 333 participants were included. A low or moderate risk of bias was reported in all the studies except one case-control. The pooled analysis showed a significant association between PWIDs and the chances of contracting HIV infection (Odds ratio = 6.40; 95% CI = 3.89–10.52; $P < 0.00001$; $I^2 = 53\%$).

Conclusion: This study found a vital correlation between injecting-drug usage during imprisonment and HIV transmission speed. The results of this meta-analysis support the need to prevent HIV and conducting treatment programs in high-risk settings like prisons.

Keywords: AIDS, infectious diseases, prisoners, public health, virology

Introduction

HIV has affected 38.4 million people globally, out of which 3.8 million HIV-infected individuals reside in the Southeast Asian region[1]. HIV risk has been documented to be significantly higher in inmates than in communities outside prison settings[2], showing a correlation between imprisonment and a high incidence of HIV infection[3]. This could be due to prisons possessing characteristics that amplify the odds of HIV exposure, including high rates of injecting-drug use, unsafe sex, and non-sterile equipment for shaving and tattooing[2]. Approximately 10.2 million people are residing in prisons worldwide , making them a space for implication of prevention and treatment measures as large population of vulnerable group can be targeted at once[3].

Prisoners convicted for drug-related offenses and injecting-drug users contribute mainly to the increased HIV rates in prison[4]. People who inject drugs (PWIDs) belong to one of the key populations in prison settings[5]. Imprisonment of PWIDs who often continue injecting drugs during incarceration and other risk behaviours, as mentioned above, provides a favourable environment for the transmission of HIV in prisons[2]. HIV transmission within prisons affects both the incarcerated population and the general population living outside prisons because the average length of jail stay is not more than 3 months[2].

Worldwide, PWIDs are one of the most vulnerable groups to get infected with HIV[6]. According to a study conducted in Kyrgyzstan, 22.6% of the prisoners were involved in drug-related crimes, and 35.4% were PWIDs[7]. The chances of HIV infection increase by forty times (adjusted odds ratio: 38.75; $P < 0.001$) if the addict has been taking drugs via injection throughout his life making it an essential independent association of HIV infection. HIV was also significantly correlated with the number of years of injecting and days of experiencing drug problems. Furthermore, each year spent behind bars increased the odds of contracting HIV by 8%[7]. A similar study in Azerbaijan substantiated that

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drug injection significantly correlated with HIV, with 31.9% of participants reporting injecting drugs use[8]. Other risk factors for HIV were the presence of an STI and unprotected anal or vaginal sex. People working in Ukraine or Russia and having some mental illness were two additional variables related to HIV[8]. Surveys conducted in several Iranian cities revealed that the mass population of prisoners was PWIDs[9–11]. Being single, residence in urban areas, tattooing and shared syringe use, and having a promiscuous lifestyle were other risk factors for HIV infection[9]. Other studies in Indonesia and Taiwan also showed that injecting drugs is the most important risk factor for HIV transmission[12,13]. Thus, existing evidence indicates injecting drugs may contribute to HIV infection among PWIDs.

There are limited systematic reviews on odds of HIV among PWIDs in Asian countries. An Iranian systematic review[14] involving 22 studies suggested a pooled HIV prevalence of 18.4%, while another review and meta-analysis found an HIV odds of 3.4%[15]. Furthermore, a systematic review on lower and middle-income countries (LMICs) examined the HIV odds among men in militaries[16]. Other reviews highlighted the criminalization of injecting drugs use, HIV prevention, and treatment indicators[17] and the odds of HIV[18,19]. However, scarcity of literature on HIV odds in PWIDs in Asian countries, increases the necessity to assess HIV infection among PWIDs in these regions and identify the role that prisons play in the transmission dynamics[2].

Our systematic review and meta-analysis aim to address the gaps in previous research by identifying, collating, appraising, and synthesizing available literature published to date examining HIV odds in PWIDs in Asian prisons. To our knowledge, this is the first published review and meta-analysis to appraise and synthesize the available literature and give an idea of HIV epidemiology in PWIDs in prisons of Asian countries. Therefore, findings can have the potential to encourage opportunities for action and inform resource allocation as well as HIV policy and programming priorities.

Materials and methodology

This study was reported following the guidelines set by Preferred Reporting Items for Systemic Review and Meta-Analysis (PRISMA, Supplemental Digital Content 1, http://links.lww.com/MS9/A268)[20]. Checklist for PRISMA is provided in Table S1, Supplemental Digital Content 3, http://links.lww.com/MS9/A270. This study has been reported in line with AMSTAR 2 guidelines, Supplemental Digital Content 2, http://links.lww.com/MS9/A269[21]. Patient consent or institutional review board (IRB) permission was not required, as this was publicly accessible data. This systematic review and meta-analysis review protocol was registered on the International Prospective Register of Systematic Reviews (PROSPERO).

Data sources and search strategy

Electronic databases such as PubMed, Google Scholar, ERIC, and Cochrane Central were searched from January, 2000 to December, 16th 2022, without putting any language and time restrictions during the literature search. We used the medical subject headings (MESH) "HIV", "Human Immunodeficiency Virus", "AIDS virus", "prisoners", "convicts", "inmates", "prison", "incarcerat*", "imprison", "injection drug usage", "injection drug use", "injection drug user", "injection drug abuse", "people with injecting drugs use", "injection drug abuser", "IV drug usage", "IV drug use", "IV drug user", "IV drug abuse", "intravenous drug abuse", "intravenous drug use", "injecting drug use", "people who inject drugs", "developing countries", "lower middle-income countries", "southeast Asian countries". An extensive search string used for all databases is mentioned in Table S2, Supplemental Digital Content 3, http://links.lww.com/MS9/A270. Grey literature was searched. Different data sources were searched manually, namely bibliographies of the retrieved trials, editorials, conference proceedings for indexed abstracts, meta-analyses, and systematic reviews to find eligible studies.

Study selection

Following were the pre-specified eligibility criteria set for the selected studies: (a) the study design, including observational studies, that is cohort, cross-sectional, and case-control studies were included based on eligibility criteria; (b) Asian prisoners should be the target population; (c) the outcome was HIV, with non-injecting-drug users (non-IDUs) in the control group and PWIDs being in the experimental group; (d) the relationship between injecting-drug use and the odds of HIV was evaluated; (e) the studies should only be of Asian countries (f) for the comparison of PWIDs and non-IDUs, an estimate odds ratio (OR) with 95% CI was given. We excluded all the studies which did not meet the above-mentioned eligibility criteria. All studies, including meta-analyses, case reports, case series, studies having irrelevant outcomes, and irrelevant populations were excluded.

All the finalized articles retrieved from the systematic search were then transferred to EndNote Reference library software (X7 v17.0.0.7072) where duplicated studies were filtered and removed. Two independent reviewers (H.H. and S.T.R.) assessed the rest of the articles based on the eligibility criteria. Any discrepancies were resolved by involving a third investigator (K.N.) who cross-checked the discrepancies and fixed them through mutual discussion.

Data extraction and quality assessment

Two independent authors (H.H. and S.T.R.) extracted the data onto a pre-designed excel sheet, and the discrepancies were solved by a third author (K.N.). Baseline characteristics and patients' characteristic data were extracted onto the pre-designed criteria. Following were the inclusive criteria: HIV screening, history of PWID, and prisoners of Asia. Studies that were not eligible were excluded, that is, non-Asian prisoners and prisoners with no history of PWID. We used the New-castle Ottawa scale to assess the quality of the included cross-sectional and case-control studies, which were assessed based on selection, comparability, and outcome criteria. Two investigators assessed the quality of the ten included studies, independently. Disagreements regarding the risk of bias amongst reviewers were resolved through discussion by the third author. A study can be graded 9 as the highest for case-control studies and 10 for a cross-sectional study. with 9 depicting the best study for case-control and 10 for cross-sectional studies.

Statistical analysis

We used RevMan (Version 5.4; Copenhagen: The Nordic Cochrane Centre, The Cochrane Collaboration, 2014) to perform all statistical analyses. The outcome of interest was extracted as OR (some studies mentioned crude ORs while some mentioned adjusted ORs in their data whereas those which did not include ORs were calculated through medcalc)[21] by a ratio of (odd of occurrence of event in the exposed group) / (odd of occurrence of event in the non-exposed group) with CI 95% were pooled using the inverse-variance weighted random-effects model. Pooled data analyses were assessed through forest plots. Higgins I^2 statistics were used to assess the heterogeneity amongst the studies, with a value of 25–50% I^2 being mild, 50–75% being moderate and greater than 75% being considered severe heterogeneity[22]. Sensitivity analysis was performed by determining the effect of independent studies by excluding them from analysis to reduce the heterogeneity amongst them. A *P* value of less than 0.05 was considered as significant. A funnel plot was not created for the evaluation of the relevance of small studies and publication bias as our meta-analysis did not contain enough studies. Hence, Begg's and Egger's regression test was performed to assess the publication bias.

Results

An initial literature search of four electronic databases resulted in 254 articles, out of which 238 were left after were removed the duplicates. 152 articles were then excluded based on the abstract and title screening. After a full-text review of 80 articles, 70 were further excluded that did not meet the inclusion criteria. Hence, 10 observational studies were selected in this meta-analysis. The summarized literature search is presented in the PRISMA flowchart in Fig. 1.

Study characteristics and patients' baseline characteristics

Study characteristics and patients' characteristics have been summarized in Table 1 and Table 2, respectively. Out of the 10 observational studies, there were nine cross-sectional studies[7–12,24–26] and 1 case-control study[27]. The first study was published in July 2005, whereas the latest study came out in June 2017. The sample size ranged from 121 to 6900. These studies showed a total number of 17 333 participants, of which 2679 prisoners were PWIDs and 6851 were non-IDUs, among them, 2 studies did not specify non-IDUs and PWIDs but as they followed the predefined criteria, those studies were included in our meta-analysis[7,11]

The recruitment criteria used for the included studies were based on HIV prevalence among the incarcerated population, the assessment of health condition, addiction status and prevalence of infectious diseases among them. HIV assessment was done through different tests. The most common involved assays were enzyme-linked immunosorbent assay[7,9–11,24,26,27], western blot test[8,9,24,27], enzyme immunoassay[12,23] and electrochemiluminescent immunoassay[12,23] whereas some studies used AxSYM assay[24], Monolisa[7] microparticle capture enzyme immunoassay[24], chemiluminescent microparticle immunoassay Architect Combo[8] and recombinant immunoblot assay tests[10]. The method of drug usage assessment of HIV prisoners was mostly through questionnaires and interviews assessing HIV-related variables[7–12,23,24,26,27], and face-to-face meetings[27]. The age of patients ranged from 17 to 60 years. The prevalence of HIV varied among male and female. In males, it ranged from 78 to 100%, with a mean of 94.17% and in females, it ranged from 3.5 to 21% with a mean of 9.69%, respectively. The duration of prisoners in prison was also evaluated, ranging from 1 to 103.2 months. Majority of the studies included in this meta-analysis were statistically significant, and they were carried out in different regions: 50% of the studies were from the Middle East, 20% from Central Asia, 20% from Southeast Asia, and 10% of studies were from East Asia. Figure 2 shows the geographical distribution of the studies in our meta-analysis, with most studies (5) conducted in Iran, followed by Indonesia (2), and 1 study each in Taiwan, Kyrgyzstan, and Azerbaijan.

Quality assessment and publication bias

Low or moderate risk of bias was found in all included cross-sectional studies, as depicted in Table S3, http://links.lww.com/MS9/A270. A very high risk of bias was found in case-control study, as depicted in Table S4, http://links.lww.com/MS9/A270. The only major bias reported in Behnaz *et al.*[9] and Chu *et al.*[24] was their failure to justify the small sample size of the patient population. Pourahmad *et al.*[27] is the only included case-control study and is deemed to have a very high risk of bias due to sketchy details regarding the control group. Hence, the quality assessment table depicts a range of 2–9 out of a maximum score of 10. Publication bias was not evaluated by funnel plot as our meta-analysis did not contain enough studies.

Outcome analysis

All 10 observational studies reported the odds of HIV in PWIDs. Among these studies, there were a total of 17 333 participants, of which 2679 were PWIDs, and 6851 were non-IDUs. The pooled analysis in Fig. 3 shows a significant correlation between PWIDs, and odds of developing HIV (OR = 14.51; 95% CI = 6.66–31.64; $P < 0.00001$, $I^2 = 85\%$). Sensitivity analysis was performed by removing three studies[12,25,26], that resulted in a significant change (OR = 6.40; 95% CI = 3.89–10.52; $P < 0.00001$) revealing a moderate heterogeneity ($I^2 = 53\%$, $P = 0.05$) (Fig. 4).

Discussion

Our meta-analysis consists of 10 studies with 17 999 participants. Our study suggests that PWIDs are more susceptible to contracting HIV in Asian prisons when compared with non-IDUs (OR = 6.40; 95% CI = 3.89–10.52; $P < 0.00001$). Most of the included observational studies have been conducted in Iran, whereby a large amount of literature exists on prisons in Tehran. To our knowledge, drawing an association between HIV seroprevalence and incarcerated PWIDs in Asian prisons is being done for the first time.

Our findings are consistent with a meta-analysis that found an increased odds of contracting HIV among imprisoned populations (95% CI: 3.8–9.4; $P < 0.001$)[28]. Another study evaluated prisons across the globe and provided a comprehensive analysis of PWIDs (prisoners who inject drugs) and their association with HIV[28]. Gough and colleagues assessed the odds of HIV, hepatitis C, and hepatitis B in US prisons.

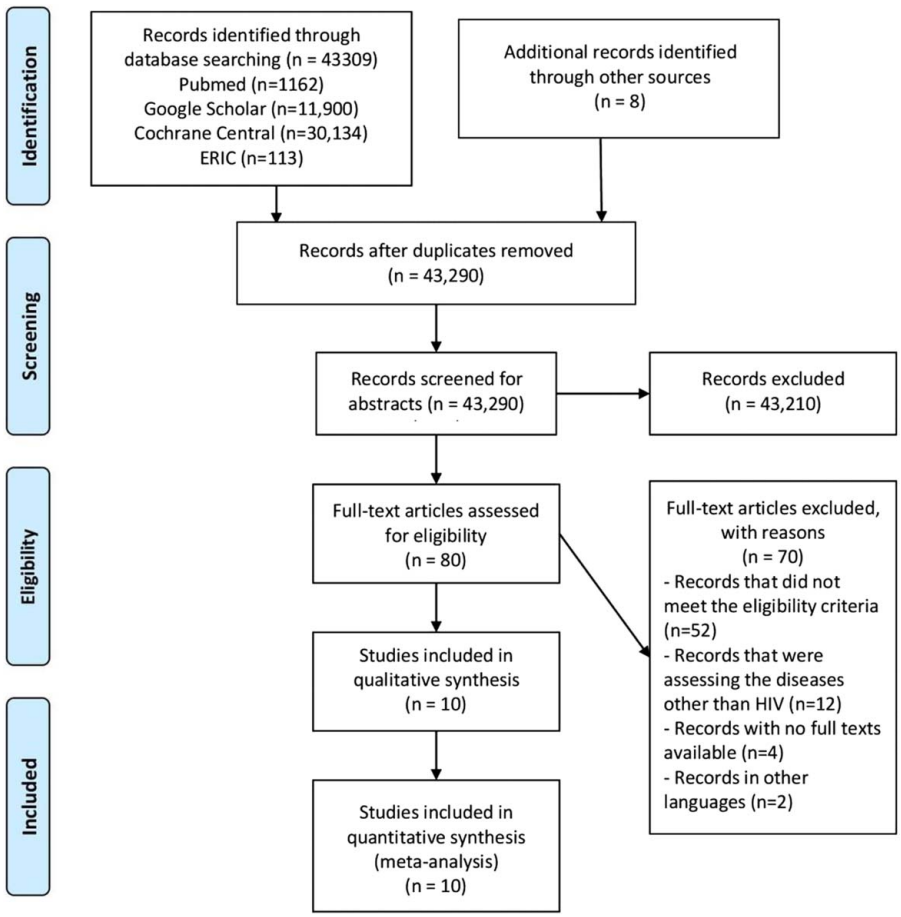

Figure 1. Preferred Reporting Items for Systemic Review and Meta-Analysis (PRISMA) flowchart summarizing results of literature search.

The authors concluded that a low incidence rate of HIV prevails in US prisons when compared with hepatitis C virus and HBV in intravenous drug users (1.14/100py, 95% CI: 0.83,1.45)[29]. Shayan *et al.* (2021) meta-analysis revealed similar findings to our present research, further corroborating our findings with the HIV odds being highest in Iran. However, the findings of the aforementioned meta-analysis are not entirely comparable to ours since the authors only assessed intravenous drug users from community settings in Iran, Pakistan, and Afghanistan[30]. Overall, the evidence shows that injecting-drug abuse is an increasingly important risk factor for contracting HIV in prison settings or the general population.

The included studies[7,8,10,11,24] in the present research revealed a higher odds of HIV in prisons when compared with the normal population and is also reflective of other studies conducted in not just middle- and lower-income regions[31] but developed nations as well, including the United States[4]. Rahimi *et al.*'s (2020) meta-analyses revealed a significant odds of one-third to one-fourth PWIDs amongst tested HIV patients in Iran[32]. The authors attributed the high odds in prisons to the lack of accessibility of sterile syringes and needles in prisons which ultimately leads to sharing of needles and syringes, thus contributing to a significant risk factor for contracting HIV[32]. In the Asian region, the odds and data regarding HIV epidemics differ from country to country. In the present study, Indonesian prisons account for a steep rise in the HIV epidemic, and injecting-drug usage is a major driving force in HIV cases[33,34]. Similar trends have been observed in Taiwanese prison populations[24]. Razaghi and colleagues and Jafari and colleagues attributed the increased number of PWIDs in prisons and the general community to the increased price of drugs, curiosity, seeking greater pleasure, self-treating drug dependence by buprenorphine injection, and incarceration[35,36]. Chakrapani *et al.* demonstrate the dire need to incorporate better injecting-drug abuse programs by highlighting important exacerbating factors such as experiencing withdrawal symptoms at the start of the imprisonment period and the prison staff's discerning attitudes regarding dealing with this issue[37].

Another important association exists between recidivists and injecting-drug abuse, as evidenced by Azbel and colleagues' cross-sectional study[7], whereby increased incarceration period is an independent risk factor for a positive HIV diagnosis. Repeated incarcerations expose such drug abusers to high-risk environments, which further propagate HIV transmission[38]. Similarly, Alizadeh and colleagues reported a significant correlation between HIV-injecting-drug abuse with repeated incarcerations[10]. A study conducted in Vietnam conducted by Ahmed *et al.*[39] signified a

Table 1

Characteristics of the included studies.

Author (year)	Design	Region	Total participants	Experimental: PWIDs (HIV +)	Comparator: non-IDUs (HIV +)	HIV assessment	Drug usage assessment	Aims of study
Azbel *et al.* (2016)[7]	Cross-sectional study	Kyrgyzstan (Central Asia)	368	—	—	MONOLISA, ELISA	Usage of one or more of the following substances: barbiturates, illicit opioids, sedatives, cocaine, hallucinogens, or amphetamines (multiple substance use)	Prevalence and means were computed, and generalized linear modeling was conducted
Azbel *et al.* (2015)[8]	Cross-sectional study	Azerbaijan (Central Asia)	510	161/162 (99.3%)	169/348 (48.5%)	(CMIA) Architect Combo, Bio-Rad New Lav Blot 1 Western Blot	Barbiturates, illegal opioids, sedatives, cocaine, hallucinogens, or amphetamines were among the substances used before an arrest was assessed for drug usage	Assessing health status, addiction, and infectious diseases (HIV, hepatitis C, hepatitis B, and syphilis)
Nelwan *et al.* (2016)[12]	Cross-sectional study	Indonesia (Southeast Asia)	1550	43/115 (37.4%)	2/547 (0.4%)	Rapid tests, EIA, and ECLIA methods	All detainees were questioned if they had ever injected drugs and were evaluated for needle track alterations or other symptoms of injecting-drug use during the medical check-up	Implemented and targeted testing are compared to assess the better HIV screening techniques
Pourahmad *et al.* (2007)[23]	Case-control study	Iran (Middle East)	1431	56/401 (14%)	36/1030 (0.03%)	ELISA and Western blot tests	Assessed by questionnaires and face-to-face meetings	Evaluate the risk factors for HBV, HCV, and HIV infections
Navadeh *et al.* (2013)[24]	Cross-sectional study	Iran (Middle East)	4536	54/726 (8.1%)	34/3803 (0.9%)	ELISA test	A structured questionnaire assessing HIV-related variables	To estimate the prevalence of HIV and related risk behaviours among prisoners
Behnaz *et al.* (2007)[9]	Cross-sectional study	Iran (Middle East)	121	4/22 (18.2%)	3/99 (0.03%)	ELISA and Western blot tests	Questionnaire and interviews assessing type and route of addiction, and some high-risk activities such as tattooing and sharing syringes	To determine the prevalence of HIV, HBV, and HCV in the addicted prisoners in Gorgan city
Chu (2009)[25]	Cross-sectional study	Taiwan (East Asia)	753	49/192 (25.5%)	3/561 (0.005%)	MEIA, Western Blot, AxSYM assay, and ELISA	Users of illicit drugs who are convicted of their first or second offense are sentenced to 1–2 months in a prison-affiliated detoxification clinic	To investigate the seroprevalence of HBV, HCV, HDV, and HIV infection in 753 male substance users who were detained in a detoxification centre in Taoyuan, Taiwan
Alizadeh *et al.* (2005)[10]	Cross-sectional study	Iran (Middle East)	427	1/149 (0.67%)	3/278 (1.07%)	ELISA and RIBA tests	Intravenous drug usage history, blood and/or blood products received, tattoos, body piercing,	To find the rate of HCV amongst prison inmates and compare it with the general population
SeyedAlinaghi *et al.* (2017)[11]	Cross-sectional survey	Iran (Middle East)	6900	71/851 (0.08%)	N/R properly	Trinity and ELISA tests	A questionnaire assessing injecting-drug use behaviours	To evaluate HIV-positive prisoners in the prison's quarantine and two housing units in Tehran
Nelwan *et al.* (2010)[26]	Cross-sectional study	Indonesia (Southeast Asia)	737	58/61 (95.1%)	169/185 (91.3%)	Determine, EIA, ECLIA	Structured questionnaire evaluating HIV infection-related risk behaviour	To determine the prevalence and behavioural correlates of HIV, HBV, and HCV infections among Indonesian prisoners and to examine the impact of voluntary counselling and testing for all incoming prisoners on access to ART.

ART, anti-retroviral therapy; CMIA, chemiluminescent microparticle immunoassay; ECLIA, electrochemiluminescence immunoassay; EIA, enzyme immunoassay; ELISA, enzyme-linked immunosorbent assay; HBV, hepatitis B virus; HCV, Hepatitis C virus; HDV, hepatitis D virus; MEIA, microparticle enzyme immunoassay; Non-IDUs, non-injecting-drug users; PWIDs, people who inject drugs; RIBA, recombinant immunoblot assay.

Table 2

Baseline characteristics of the patients

Author (year)	Age[a]	Sex	Duration in prison[b]	Patient selection
Azbel *et al.* (2016)[7]	37.4 ± 11.2 years	Male: 287, 78%; Female: 81, 22%	8.60 ± 7.0 years	Patients older than 18 years of age presently serving in a non-specialised facility and were scheduled to be released within 6 mo.
Azbel *et al.* (2015)[8]	38.2 (21–63) years	Male: 452, 88.6%; Female: 58, 11.4%	3.3 ± 2.6 years	Patients older than 18 years, present in non-specialized prisons are scheduled to be released within the next 6 mo.
Nelwan *et al.* (2016)[12]	29.3 ± 5.7 years	Only male prisoners	9.8 ± 5.2 months	Male prisoners incarcerated in Banceuy prison.
Pourahmad *et al.* (2007)[23]	25–60 years	Only male prisoners	1–10 years	Prisoners imprisoned for drug-related offenses.
Navadeh *et al.* (2013)[24]	< 30 years (2022); ≥ 30 years (2510)	Male: 4337; Female: 199	< 3 (689); 3–11 (1506);12–36 (1308); > 36 (1033) months	Inmates who had been in prison for at least one week and had not participated in previous studies in the two months before the interview, and gave verbal informed agreement to take part in the study were considered.
Behnaz *et al.* (2007)[9]	25–30 years	Male: 109; Female 12	NR	Drug-addicted prisoners in the central prison of Gorgan.
Chu (2009)[25]	30.4 ± 7.5 years (range, 16–57 years)	Only male prisoners	1–2 months	Elicited drug abusers convicted of a first or second -degree offense for 1–2 months.
Alizadeh *et al.* (2005)[10]	37.9 ± 9.7 (range 15–77 years)	Male: 397 (93%); Female: 30 (7%)	2–26 months	Prisoners in the central prison of Hamedan were selected after reviewing individual files.
SeyedAlinaghi *et al.* (2017)[11]	30.7 ± 7.9 years	Only male prisoners	> 10 years	Male prisoners incarcerated in Greater Tehran Prison.
Nelwan *et al.* (2010)[26]	31.3 (range 17–63) years	Male: 96.5%; Female: 3.5%	8.3 (range 0.3–37.6) months; incoming prisoners, 18.4 (7.0–32.0) months; resident prisoners	Male prisoners were referred to the clinic who were immediately symptomatic and those who were asymptomatic after 3 months.

IQR, interquartile range.
[a,b]Mean ± SD and Median (IQR) values are provided for age and duration of prison.

vital practice of group injecting behaviours due to a lack of knowledge of HIV transmission practices and prisons' high-risk environment.

In light of the signifying evidence, it is vital to introduce and incorporate better prevention and treatment programs to minimize HIV transmission in Asian prisons. Effective antiretroviral therapy (ART) should be incorporated into prison treatment programs specifically targeting PWIDs since they amount to a large majority of HIV prisoners[40]. Despite National AIDS Centres reporting a high number of prisoners covered by ART, an increasing number of prisoners remain undiagnosed[41]. Azerbaijan and Kyrgyzstan are two Asian countries, where proper practices are put into place to limit HIV transmission with a high percentage of prisoners being covered by ART treatment[7,8]. At present, prevention practices such as needle syringe programs, methadone maintenance treatment[42], and bleach for clean syringes[43] do exist in LMICs but there needs to be better implementation in community settings to set a better example for prisons[31]. The importance of routine screening has been highlighted in Nelwan *et al.*[12]'s study to better evaluate prevention methods for HIV. The implementation of such practices can prove to be successful in developing countries if followed with caution[12]. Nunn *et al.*[44] have further solidified these findings by evaluating a 75% decrease in AIDS-related fatality if timely routine screening is adopted in prisons.

Strengths and limitations

This robust meta-analysis has strengths. This is the first systematic review and meta-analysis providing a comprehensive literature search and a detailed representation of results and analyses across Asian countries, to the best of our knowledge. Sensitivity analysis was conducted to considerably reduce heterogeneity in the results. These three studies had potential discrepancies in the baseline characteristics such as time spent in prison and recurrence of drug offenses amongst the included participants may have contributed to the heterogeneity. The included studies are of five countries' prisons as opposed to focusing on a single region in Asia. This further solidifies the findings of the present analyses and, thus, can pave the way for future prevention implications for LMICs in Asia. As with all other meta-analyses, this study also has certain limitations. The primary limitation is the lack of generalizability of the findings to prisoners who are women or over the age of 60 as the mean age of participants ranged between 17 and 60 with a predominant population of males. The second limitation concerns the included studies' inadequate sample size, which may have given way to selection bias. Hence, most of the information available cannot be applied to the overall country's population as the data were collected from a few prisons within the country. It is suggested that the trials determining the association of HIV risk with incarcerated PWIDs are conducted over a larger sample size selected from multiple prisons to promote generalizability. Thirdly, the studies did not investigate if participants were HIV-infected pre-incarceration, which would have contributed to false-positive findings. Another major limitation is that many of the included studies used interactive sessions or paper versions of questionnaires to assess drug usage, which may have contributed to imprecise findings. Hence the administration of

Figure 2. Geographical distribution of the included studies.

electronic forms can be beneficial in improving the accuracy of results. Overall, the risk of bias in all the studies was medium to low except for one cross-sectional study, which could not provide details about the control group. The potential bias should be considered when considering the results of this review.

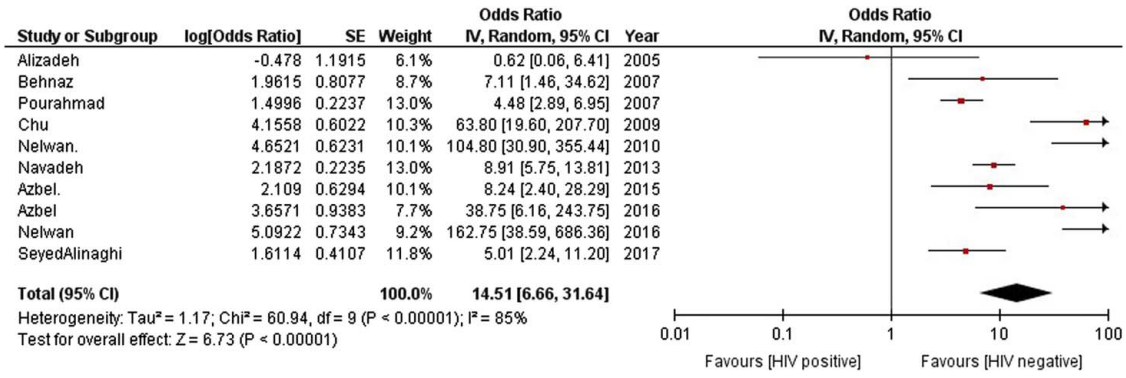

Figure 3. Odds of developing HIV in people who inject drugs before sensitivity analysis.

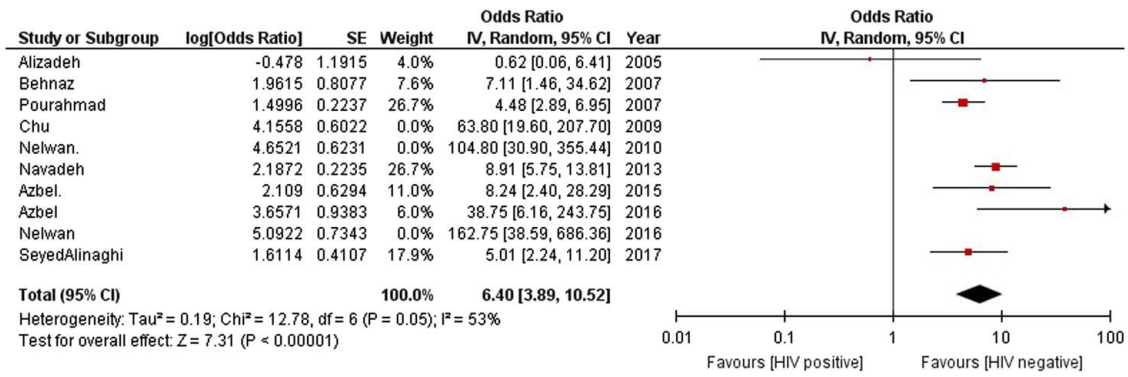

Figure 4. Odds of developing HIV in people who inject drugs after sensitivity analysis.

Conclusion

Our findings support the notion that odds of HIV need to be curbed in Asian populations and that a significant association exists between injecting-drug usage during imprisonment and the speed at which HIV transmits. A large amount of literature exists on Iranian prisons, and there is a need to conduct further studies in more Asia regions to understand the risk factors associated with PWIDs and HIV infection. This study also highlights a dire need to prevent HIV and conducting treatment programs in high-risk settings like prisons.

Ethical approval

Ethics approval was not required for this systematic review/Meta-analysis.

Consent

Informed consent was not required for this systematic review/Meta-analysis.

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Author contribution

This work was carried out in collaboration among all authors. H. U.H., K.N., S.T.R., A.A. and M.J.T. contributed to the conception of the review and interpreted the literatures based on the level of evidence and revised the manuscript. H.U.H., Z.K., M.R.H., U.K., C.A.F., M.N.H., K.N., O.N.S. and S.T.R. participate in reviewing preparation of the manuscript. M.N.H., A.A., M.J.T., and S.T.R. participate in preparation and critical review of the manuscripts. In addition, all authors read and approved the manuscript.

Conflicts of interest disclosure

The authors declare no conflict of interest.

Research registration unique identifying number (UIN)

1. Name of the registry: PROSPERO.
2. Unique Identifying number or registration ID: CRD4202-2334471.
3. Hyperlink to your specific registration (must be publicly accessible and will be checked): https://www.crd.york.ac.uk/PROSPERO/display_record.php?RecordID=334471.

Guarantor

Oadi N. Shrateh.

Data availability statement

Data set is available upon reasonable request.

Provenance and peer review

Not commissioned, externally peer-reviewed.

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