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Locked up and infected. Unveiling worldwide heterogeneity of HIV prevalence in prison populations: a systematic review and meta-analysis

Roya Gasem Soltani-Momtaz[1], Fatemeh Rostampour[1], Moradali Zareipour[2], Ali Rashidi[3], Mohammad Heidari[4]

[1]Department of Biostatistics and Epidemiology, Faculty of Medicine, Urmia University of Medical Sciences, Urmia, Iran
[2]Department of Public Health, Khoy University of Medical Sciences, Khoy, Iran
[3]Department of Health Information Technology, School of Medical Sciences, Urmia University of Medical Sciences, Urmia, Iran
[4]Social Determinants of Health Research Center, Clinical Research Institute, Urmia University of Medical Sciences, Urmia, Iran

Abstract

Introduction: Prisoners are at higher risk of human immunodeficiency virus (HIV) infection. This study aimed to investigate the prevalence of HIV among prisoners in different continents, and investigate its heterogeneity.

Material and methods: International databases, including PubMed/Medline, Scopus, Google Scholar, and ISI Web of Science were explored for original articles reporting the prevalence of HIV among prisoners from 2000 to 2022. Random effect model was applied to estimate pooled prevalence, and analysis was performed with Stata 13 using the metaprop package.

Results: Sixty-three studies evaluating HIV prevalence among total of 9,034 prisoners worldwide were included in the study. The prevalence rates of HIV varied considerably, ranging from 0 in Iran and England to > 0.23 in Zambia and 0.19 in Ghana. While the pooled prevalence of HIV among prisoners in all countries was 0.03 (95% CI: 0.03-0.04%), it was estimated that 0.01 (95% CI: 0.01-0.21%), 0.02 (95% CI: 0.01-0.03%), 0.03 (95% CI: 0.02-0.04%), and 0.02 (95% CI: 0.01-0.03%) prevalence rates were reported in Africa, Asia, North America, and Europe and South America, respectively. The prevalence among men was 0.04 but raised to 0.11 in Asia, and in women, it was 0.03 but also raised to 0.09 in Africa (one study).

Conclusions: Although the overall rate of HIV-infected male prisoners showed a higher prevalence than women, this difference was more evident in Asia. The prevalence and heterogeneity were very high among males in Asia. In contrast, among males in North America and Europe, the rates were low and more homogenous, which may be due to better healthcare infrastructure, effective government policies, and HIV education.

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Key words: HIV, prisoners, prevalence, worldwide, systematic review, meta-analysis.

Address for correspondence: Dr. Mohammad Heidari, Social Determinants of Health Research Center, Clinical Research Institute, Urmia University of Medical Sciences, Urmia, Iran, e-mail: heidari.m1358@gmail.com

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Introduction

Human immunodeficiency virus (HIV) control is a global challenge that poses a serious public health problem. Even after three decades, it remains one of the most serious global health challenges, affecting different age groups, races, and both sexes. Acquired immune deficiency syndrome (AIDS), addictions, and prison, constitute a combination of risk factors, which threaten the well-being of society. The prevalence of HIV in prisons varies worldwide [1-3]. Prisons play a key role in the spread of HIV/AIDS in society, especially among injection drug users. Many studies have also shown a significant relationship between previous imprisonment experience, drug use, and HIV/AIDS infection. Prisons are highly overcrowded, with inadequate nutrition, limited access to healthcare, continuous drug usage, unsafe injection methods, unprotected sexual contacts, and very high-risk environments for HIV transmission [4-8]. Moreover, prisons may serve as reservoirs for amplification and subsequent spreading of HIV in the community. The prevalence of HIV among prisoners in different countries ranges from 1.2% in Iran to 2% in America and Australia, 11% in Latin American countries, and 20% in African countries [9-12]. The world population of prisoners in 2014 was estimated at 10.2 million, and the incidence of HIV infection among prisoners was much higher than in the general population According to recent estimates, approximately 3.8% (389,000) of the 10.2 million individuals incarcerated worldwide are living with HIV [13].

The magnitude of HIV/AIDS in prisons is very significant due to its high prevalence in this environment as well as the possibility of its increased spread in the community after prisoners' release. They may transmit the disease to their spouses or sexual partners, and contribute to further spread of HIV through injection drug use and shared needles. Therefore, prevention, diagnosis, and treatment of HIV in prisons are very important, and can help reduce spreading of HIV/AIDS in the community [8]. Hence, up-to-date meta-analysis studies on HIV in prisons are essential to become aware of the trend of HIV spreading in prisons, which are high-risk areas for transmission. By using these information, the best methods and solutions for reducing the spread of HIV in prisons can be identified, and the improvement of health and treatment conditions for prisoners with HIV may be achieved.

Prevalence studies are the basis for large-scale health planning in all countries. However, heterogeneity between the estimates obtained from various studies due to differences in gender, social status, or level of development, make it difficult to have an accurate picture of the scale of the problem. In secondary studies, probable causes of such inconsistencies are investigated using sub-group analysis. This study aimed to unveil the worldwide heterogeneity of HIV prevalence in prison populations using a systematic review and meta-analysis.

Material and methods

Search strategy and study eligibility

All stages of the study work were completed according to standard procedures. Two authors, FM and RS, conducted a comprehensive literature search using various databases, such as PubMed, ISI, Scopus, EMBASE, Science Direct, and Scholar Google, without any time-based restrictions, until October 2022. The objective was to gather studies on the prevalence of HIV worldwide, particularly among prisoners. The search employed specific key words, including "HIV" or "Prevalence" or "Prisoners", combined with terms like "Worldwide" and "Systematic review." All identified studies were organized and managed using the Zotero citation manager software. Initially, duplicate studies were eliminated with a built-in feature of Zotero, followed by a manual screening of the remaining studies.

Systematic review and meta-analysis were conducted according to the preferred reporting items for systematic reviews and was registered in PROSPERO, with code No. CRD42022312338. Also, the project of the study was approved by the Urmia University of Medical Sciences, with code No. IR.UMSU.REC.1402.060.

Selection criteria

Three reviewers conducted independent assessments of all identified titles and abstracts. Subsequently, full texts of articles considered relevant by at least two reviewers were evaluated. Initial screening was performed by examining titles and abstracts, while further screening of full texts of potentially relevant papers was conducted specifically to identify data on the prevalence of HIV among prisoners. Studies reporting on numbers or percentages of HIV patients were considered suitable for data extraction.

Data extraction and quality assessment

Data presented in each article were gathered by two co-authors (RS and FR), who worked independently and used a standardized form. The extracted data consisted of various details, such as geographic location, years of survey, sample size, average age of participants, number and percentage of male and female participants as well as prevalence. Accuracy of the extracted data was verified by third author (MH). Additionally, the risk of bias in the included studies was evaluated independently by the same 3 authors, using the Newcastle-Ottawa scale.

Inclusion and exclusion criteria

All research articles conducted to estimate the prevalence of HIV among prisoners until the proposal was approved were reviewed. Additionally, articles that did not report the prevalence or percentage were not considered for inclusion.

Results

First, the titles and abstracts of the articles were examined. Irrelevant items were removed based on inclusion and exclusion criteria. A total of 310 relevant articles remained for further review. In the second step, all articles were analyzed independently to determine their eligibility. Finally, a total of 63 articles were selected for analysis (Figure 1).

After evaluating the quality of full texts of potentially related studies and extracting original data from 63 selected articles, the total number of HIV-infected people was 9,034 patients from the total sample size of 319,284 individuals. Data analysis showed that the prevalence of HIV among prisoners was significant, with a 95% confidence interval (CI): 0.03-0.04% and a heterogeneity of 98.85% ($p < 0.001$). Moreover, in examining the relationship between gender and different continents, the most prevalence rate was observed in the African continent (0.1%, 95% CI: 0.01-0.21%), and the lowest rate of HIV prevalence was seen in Asia and South America (0.02%, 95% CI: 0.01-0.03%) (Figure 2) [14-18, 20, 21, 23, 24, 27, 29-35, 37, 38, 40, 42, 44, 45, 48, 52, 53, 55]. The characteristics of the studies on the prevalence of HIV among prisoners are summarized in Table 1 [14-54]. According to this table, the highest percentage of HIV-infected prisoners was reported in Thailand (25.7%) and Zambia (22.5%), while the lowest percentage was observed in Zagreb, Croatia (0.15%) and in Khorasan, Iran (0.1%).

The prevalence of HIV among female prisoners was 0.03 (95% CI: 0.02-0.05%), and the heterogeneity index was calculated as $I^2 = 93.77\%$ ($p < 0.001$). The highest prevalence of HIV among female prisoners was found in Ethiopia, with a value of 0.09 and a confidence interval of 0.02 to 0.38% (Figure 3) [14, 16-18, 23, 24, 29, 33, 35, 37, 38, 43, 51-53, 55]. Despite the overall prevalence rate of the disease as 0.04% (95% CI: 0.02-0.06%) in Europe and North America, the prevalence in the Canadian population was found to be 0.09% (95% CI: 0.06-0.13%) and in Connecticut population, it was 0.08% (95% CI: 0.07-0.08%).

Among men, the highest prevalence was found in the Asian continent (0.11%; 95% CI: 0.09-0.13%). This prevalence was reported to vary across different countries, ranging from 0.00% (95% CI: 0.00-0.01%) in Lebanon to 0.26% (95% CI: 0.22-0.32%) in Thailand (Figure 4) [6, 14, 17-19, 22-26, 28, 29, 33, 35-39, 41, 46, 47, 49, 52-56].

Discussion

The results of the current meta-analysis showed a huge variance in the prevalence of HIV among different continents. The highest number of HIV-positive cases in both sexes was observed in Africa, and the lowest rates were

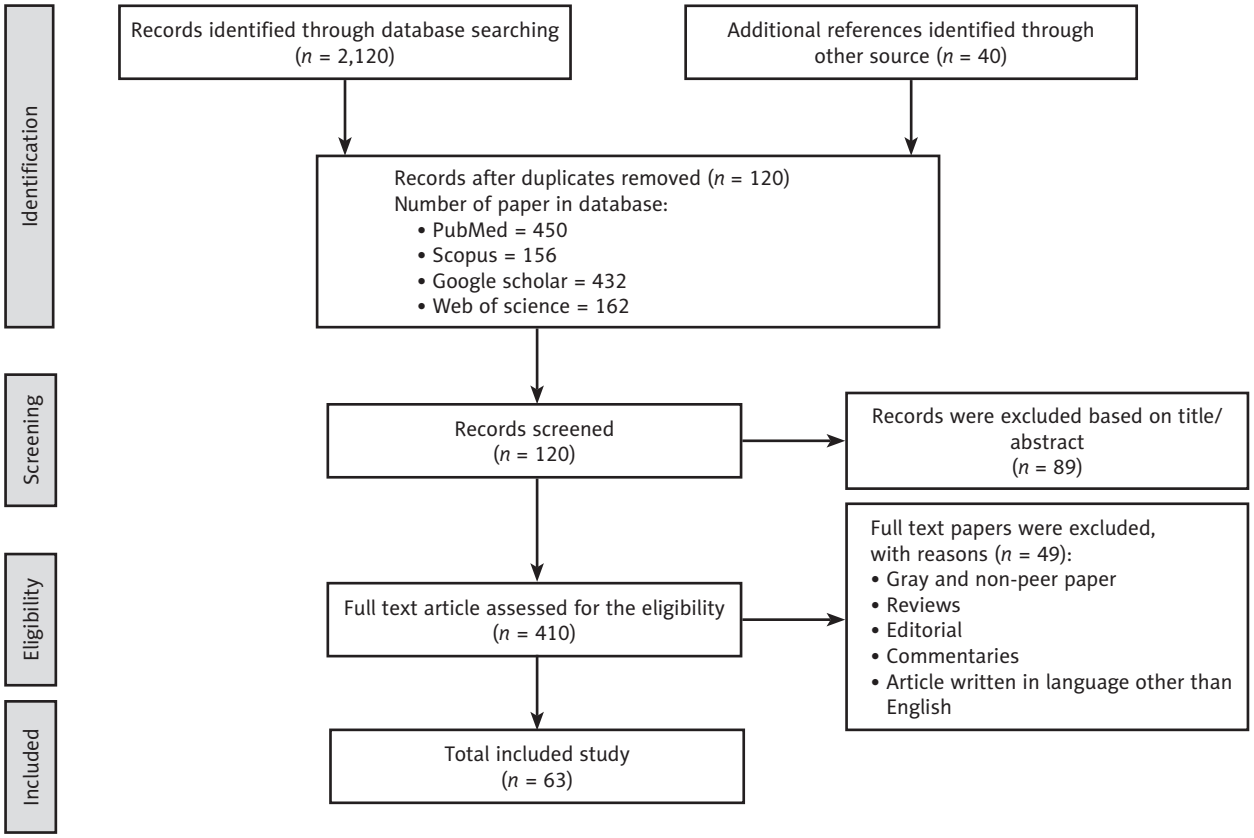

Figure 1. The study selection process, a meta-analysis of HIV prevalence among prisoners

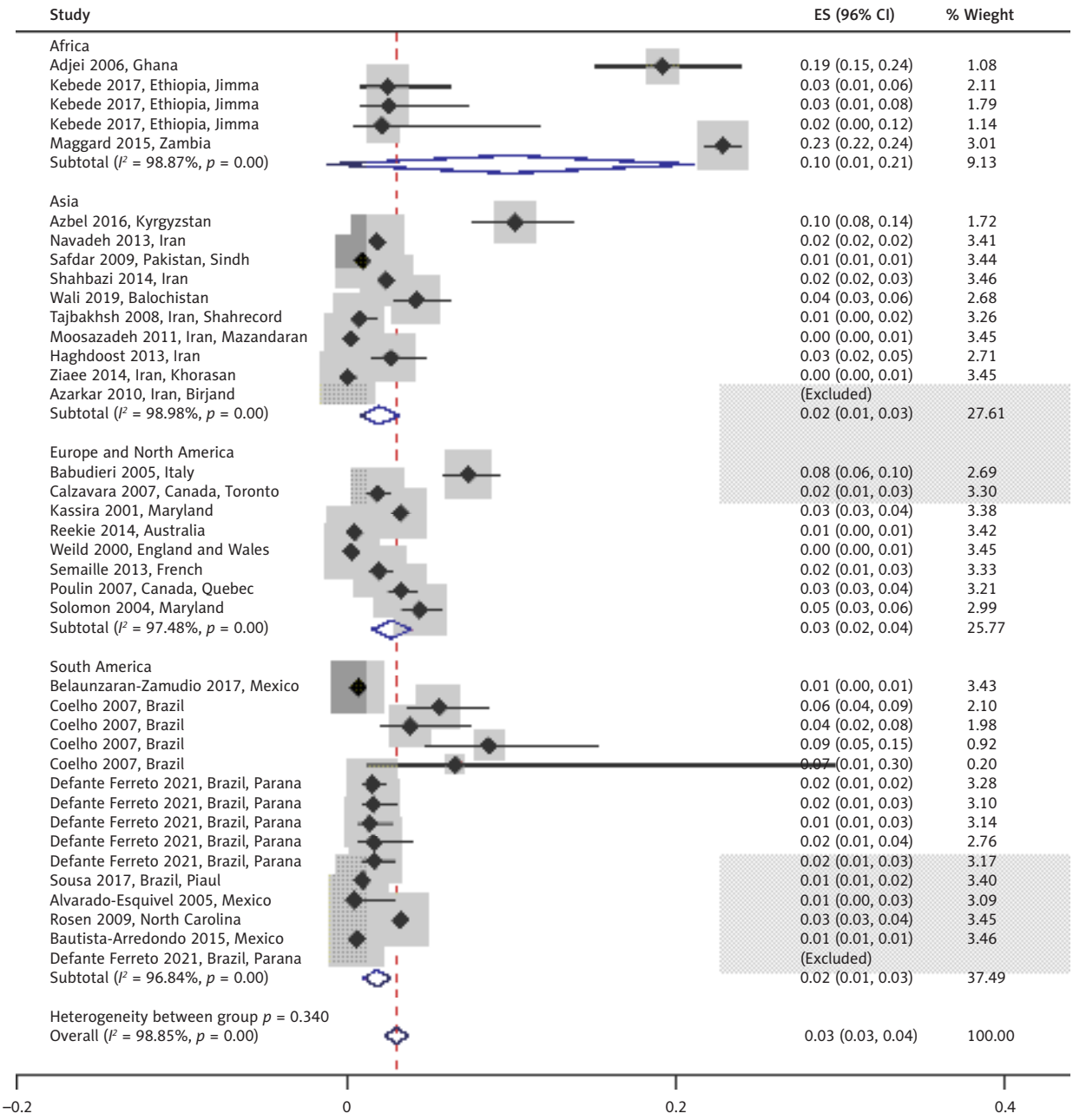

Figure 2. Prevalence of HIV among prisoners in different continents

found in Asia and South America. However, Asia showed the highest number of HIV-infected cases among men, while for women, it was the African continent. In this study, the prevalence of HIV among male prisoners was higher than among female prisoners (4% vs. 3%), and this amount is more prominent among male Asian prisoners. Moreover, in the survey of the HIV rate among different countries, the highest percentage of HIV-infected prisoners was found in Thailand (25.7%) and Zambia (22.5%), and the lowest percentage was observed in Zagreb, Croatia (0.15%) and in Khorasan, Iran (0.1%).

As mentioned above, the prevalence of HIV infection among incarcerated individuals of both sexes in African prisons was found to be significantly greater than that of other continents. Our results of gender-stratified analysis revealed that male prisoners in Asian continent and female prisoners in African continent demonstrated the highest prevalence of HIV cases. In the studies conducted by Semaille *et al.* [37], Jin *et al.* [57], and Golrokhi *et al.* [58], the highest number of HIV-positive cases among prisoners was seen in Africa. Also, in Gaughwin *et al.*'s study [59], South Africa was reported as the most HIV-affected country, with HIV

Table 1. Characteristics of the studies conducted on the prevalence of HIV among prisoners in Iran and the world

First author [Ref.]	Study date	Country	Continent	Sex	Age means/ Category	Sample size (*n*)	HIV-positive (*n*)	Percentage
Azbel [14]	2016	Kyrgyzstan	Asia	Two genders	Mean (37.4)	368	38	10.3
				Male	Mean (36.8)	320	37	11.5
				Female	Mean (40.6)	48	1	2.5
Adjei [15]	2006	Ghana	Africa	Two genders	–	281	54	19.2
Babudieri [16]	2005	Italy	Europe and North America	Two genders	Mean (36)	973	73	7.5
				Male	Mean (36)	847	66	7.8
				Female	Mean (37)	126	7	5.6
Belaunzaran-Zamudio [17]	2017	Mexico	South America	Two genders	> 18	3,197	24	0.75
				Male	> 18	2,995	20	0.6
				Female	> 18	202	4	1.5
Calzavara [18]	2007	Canada, Toronto	Europe and North America	Two genders	≥ 30	1,578	31	2.0
				Male	≥ 30	1,270	327	2.1
				Female	≥ 30	308	6	1.8
Catalan-Soares [19]	2000	Brazil	South America	Male	Mean (30.2)	63	2	3.17
Coelho [20]	2007	Brazil	South America	Two genders	Mean (30.1)	333	19	5.7
Defante Ferreto [21]	2021	Brazil, Parana State	South America	Two genders	–	1,132	18	1.6
El Maerrawi [22]	2015	Brazil	South America	Male	18-35, mean (29.8)	514	9	1.8
Kassira [23]	2001	Maryland	Europe and North America	Two genders	–	5,283	176	3.3
				Male	–	4,613	145	3.0
				Female	–	670	31	5.0
Kebede [24]	2017	Ethiopia, Jimma	Africa	Two genders	20-50, mean (28.1)	156	4	2.6
				Male	20-50	145	3	2.0
				Female	20-50	11	1	9.0
Khan [25]	2019	Pakistan, Balochistan	Asia	Male	15-45, mean (25)	104	16	15.4
Macalino [26]	2004	Rhode Island	Europe and North America	Male	≥ 30	3,932	70	1.8
Maggard [27]	2014	Zambia	Africa	Two genders	–	4,694	1,077	22.9
Mahfoud [28]	2010	Lebanon	Asia	Male	> 16	580	1	0.17
Navadeh [29]	2013	Iran	Asia	Two genders	–	4,536	88	2.1
				Male	–	4,337	84	2.1
				Female	–	199	4	1.9
Reekie [30]	2014	Australia	Europe & North America	Two genders	≥ 25	1,394	7	0.4
Safdar [31]	2009	Pakistan, Sindh	Asia	Two genders	–	4,897	49	1.0
Shahbazi [32]	2014	Iran	Asia	Two genders	–	212,475	5,191	2.5

Table 1. Cont.

First author [Ref.]	Study date	Country	Continent	Sex	Age means/ Category	Sample size (*n*)	HIV-positive (*n*)	Percentage
Sousa [33]	2017	Brazil, Piauí State	South America	Two genders	–	2,131	21	1.0
				Male	–	1,977	19	1.0
				Female	–	154	2	1.3
Thaisri [6]	2003	Thailand	Asia	Male	20-50	689	175	25.4
Wali [34]	2019	Pakistan, Balochistan	Asia	Two genders	Mean (30)	562	24	4.0
Weild [35]	2000	England and Wales	Europe and North America	Two genders	–	3,930	14	0.4
				Male	–	2,807	9	0.3
				Female	–	410	5	1.0
Kazi [36]	2010	Pakistan	Asia	Male	18-81, mean (27)	357	7	2.0
Semaille [37]	2013	France	Europe and North America	Two genders	25-42	1,876	38	2.0
				Male	25-42	1,607	32	2.0
				Female	25-42	267	6	2.6
Poulin [38]	2007	Canada, Quebec	Europe and North America	Two Gender	–	1,607	54	3.4
				Male	Mean (33.3)	1,357	32	2.4
				Female	Mean (35.5)	250	22	8.8
Khani [39]	2003	Iran, Zanjan	Asia	Male	18-71, mean (33.7)	346	4	1.2
Tajbakhsh [40]	2008	Iran, Shahrekord	Asia	Two genders	Mean (25.4)	600	5	0.83
Davoodian [41]	2009	Iran, Bandar Abbas and Roodan	Asia	Male	Mean (35.4)	249	38	15.1
Moosazadeh [42]	2011	Iran, Mazandaran	Asia	Two genders	Mean (26.8)	2,405	7	0.3
Nokhodian [43]	2012	Iran, Isfahan	Asia	Female	Mean (34.5)	163	12	7.3
Haghdoost [44]	2013	Iran	Asia	Two genders	–	392	11	2.8
Ziaee [45]	2014	Iran, Khorasan	Asia	Two genders	Mean (34.7)	881	1	0.1
Feng [46]	2012	Taiwan	Asia	Male	17-70, mean (37.7)	908	197	21.6
Afsar Kazerooni [47]	2010	Iran	Asia	Male	19-70, mean (33.2)	363	25	6.6
Alvarado-Esquivel [48]	2005	Mexico	South America	Two genders	17-74, mean (32.2)	181	1	0.6
Gough [49]	2009	Belize	Europe & North America	Male	16-64, mean (28)	623	25	4.0
Solomon [50]	2004	USA, Maryland	Europe & North America	Two genders	17-63, mean (33.4)	1,081	49	4.6
Altice [51]	2005	USA, Connecticut	Europe & North America	Female	20-58	3,315	250	7.5

Table 1. Cont.

First author [Ref.]	Study date	Country	Continent	Sex	Age means/ Category	Sample size (*n*)	HIV-positive (*n*)	Percentage
Rosen [52]	2009	USA, North Carolina	Europe and North America	Two genders	> 18, mean (43)	21,419	718	3.4
				Male	> 18	15,461	562	3.6
				Female	> 18	5,958	156	2.6
Bautista-Arredondo [53]	2015	Mexico	South America	Two genders	18-81	117,084	118	0.69
				Male	18-81, mean (33.1)	15,354	105	0.68
				Female	18-81, mean (34.9)	1,730	13	0.75
Burek [54]	2010	Croatia, Zagreb	Europe and North America	Male	18-77	3,348	5	0.15

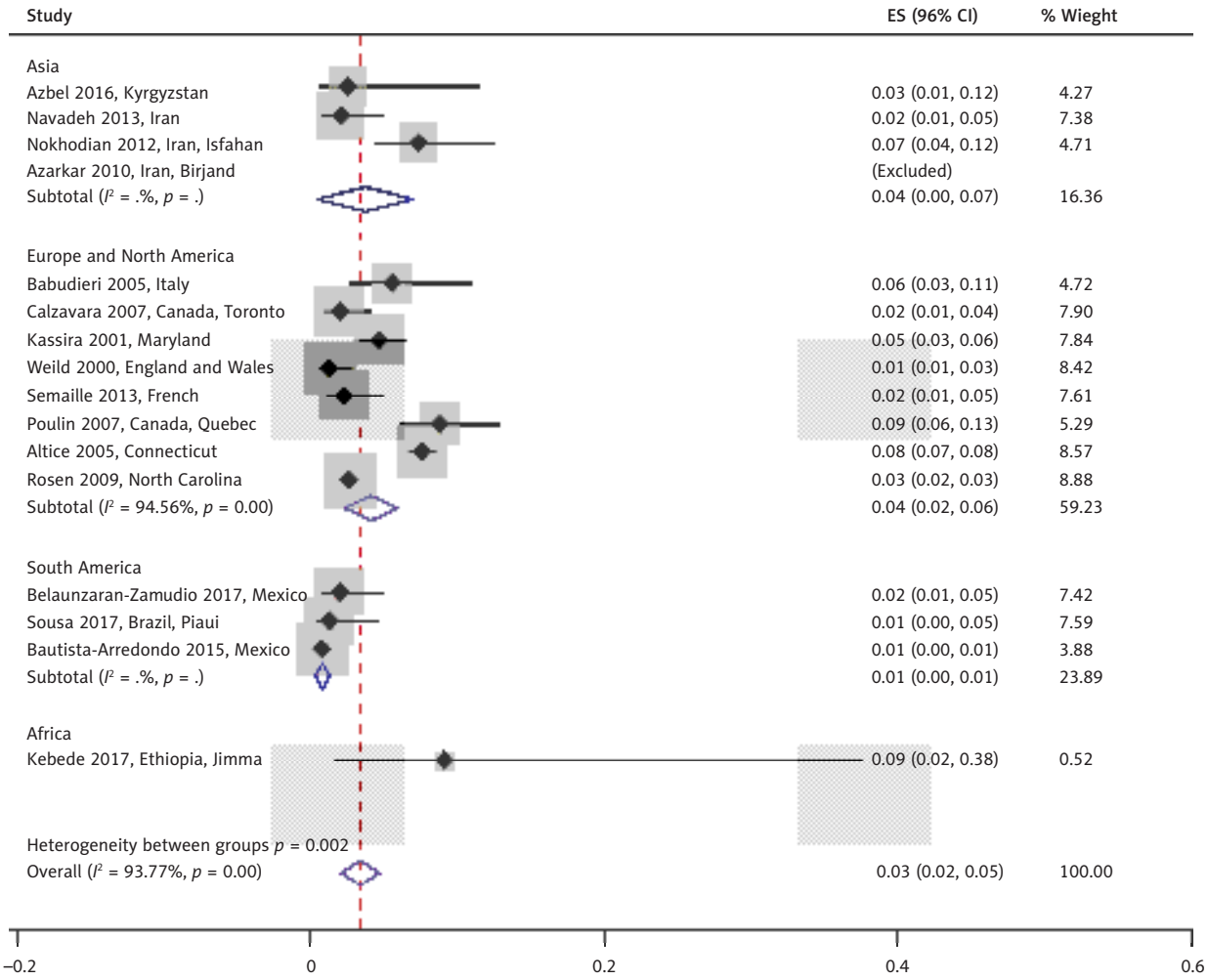

Figure 3. Prevalence of HIV among female prisoners in different continents

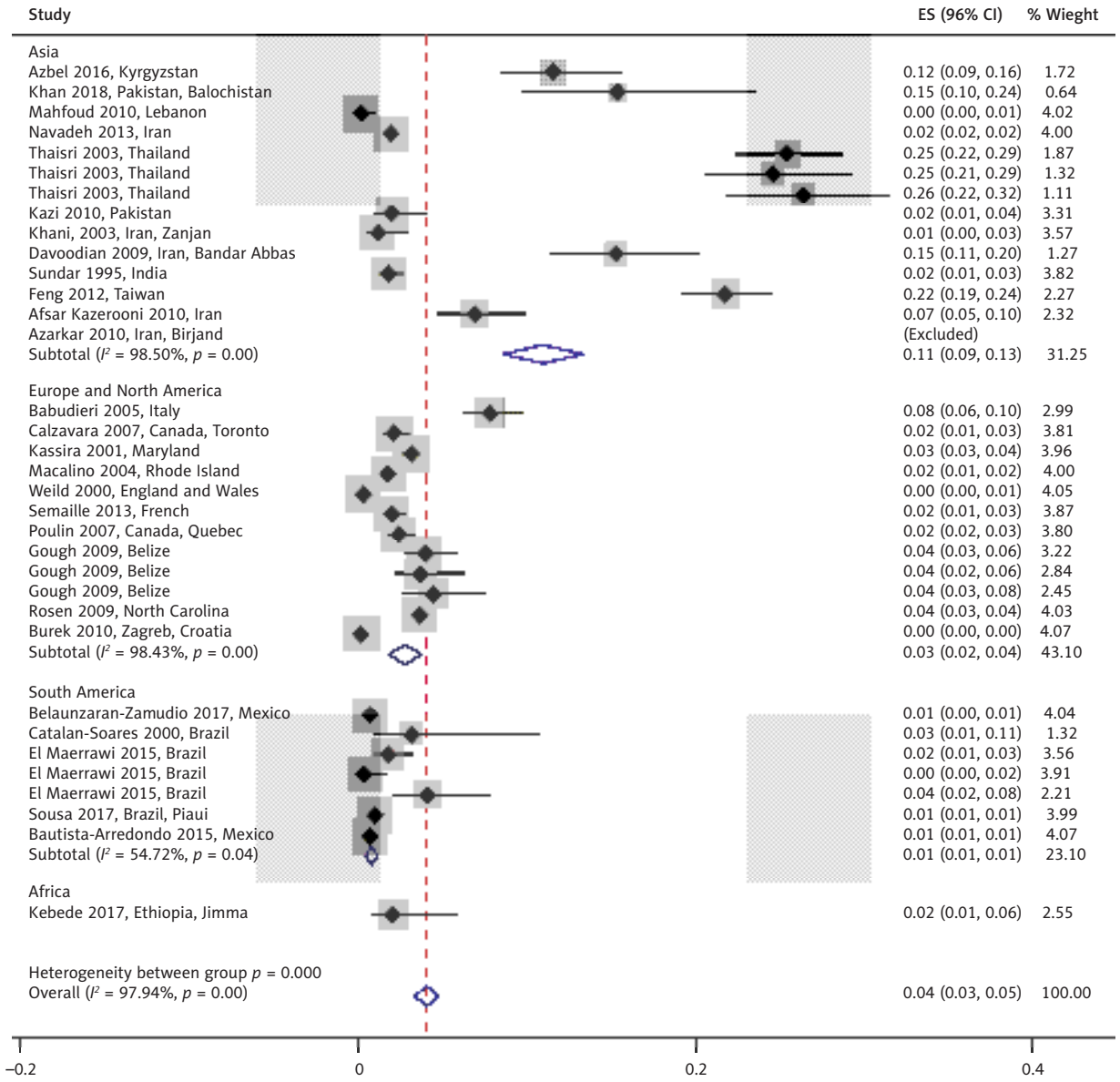

Figure 4. Prevalence of HIV among male prisoners in different continents

prevalence among prisoners varying from 2.3% to 34.9% in different regions. This can be because of various factors, such as limited access to healthcare, high poverty rates, cultural beliefs, and inadequate education on HIV prevention [59]. Conversely, countries in Asia and South America exhibit lower prevalence rates, which could be attributed to better healthcare infrastructure, effective government policies, and more comprehensive education programs designed to promote awareness on HIV/AIDS prevention and treatment. In addition, the higher prevalence rates among female prisoners in Africa indicate unique risk factors, such as poverty, gender inequality, and limited access to healthcare and education [60].

The present study's findings demonstrate a higher HIV prevalence rate among male prisoners compared with their female counterparts, and this number is more prominent among male Asian prisoners. The current result is consistent with previous research by Ziaee *et al.* [45], Wali *et al.* [34], Viitanen *et al.* [61], and Navadeh *et al.* [29]. However, Sousa *et al.* [33], Semaille *et al.* [37], and Kebede *et al.* [24] reported higher prevalence rates of HIV among female prisoners in their respective studies. The discrepancies in HIV prevalence between male and female prisoners across different regions highlight the need for targeted interventions, tailored to the specific challenges faced by each region [62, 63].

In the present study's survey of the HIV rate among different countries, the highest percentage of HIV patients among prisoners was observed in Thailand (25.7%) and Zambia (22.5%), while the lowest percentage was seen in Zagreb, Croatia (0.15%) and in Khorasan, Iran (0.1%). According to Golrokhi *et al*.'s research [58], countries with the highest prevalence of AIDS among prisoners are Zambia in Africa (27%), and located in the Middle East, Iran (24%). In Sayyah *et al*.'s study [64], in Asian countries, notable increases in HIV prevalence rates among prisoners were reported in Iran's Southern region (15%). In North American countries, similarly high HIV prevalence rates were shown among prisoners in certain regions of the United States (18.75%). In Europe, three countries exhibit significant levels of HIV prevalence among prisoners, including Spain (21%), Estonia (16%), and Ukraine (14.5%).

Finally, the conditions in prisons around the world can exacerbate the spread of HIV, as overcrowding, poor sanitation, and limited access to healthcare, can aggravate HIV prevention and treatment [61]. Moreover, the dynamic nature of prison populations, involving constant movement of prisoners, prison staff, and visitors (in and out of the prison setting), poses a significant risk for the spread of blood-borne viruses among prisoners and broader community [45, 64].

Conclusions

The meta-analysis performed in the current study confirms that there are significant variations in HIV prevalence across different continents, with African countries exhibiting the highest overall prevalence rate. In contrast, Asia and South America demonstrate lower rates of prevalence due to better healthcare infrastructure, effective government policies, and education programs. Moreover, the study highlights the need for targeted interventions tailored to the specific challenges faced by male and female prisoners in different regions. Overall, the findings underscore the importance of addressing social determinants of health as well as implementing effective prevention and treatment strategies to reduce the impact of HIV on a global scale.

Strengths and limitations

The strengths of the study include high accuracy in searching and selecting studies related to the research topic, while accuracy and reliability of the results of data analysis reduced the likelihood of errors. However, considering the qualitative evaluation of the studies and eliminating low-quality research, the limitation of the study may be the possibility of a low number of eligible studies included.

Conflict of interest

The authors have no potential conflicts of interest concerning the research, authorship, and/ or publication of this article.

Disclosures

1. Institutional review board statement: The study was approved by the Ethics Committee of the Urmia University of Medical Sciences, approval number IR.UMSU.REC. 1402.060.
2. Assistance with the article: None.
3. Financial support and sponsorship: None.
4. Conflicts of interest: None.

Reference

1. Strazza L, Azevedo R, Carvalho H, Massad E. The vulnerability of Brazilian female prisoners to HIV infection. Braz J Med Biol Res 2004; 37: 771-776.
2. Dolati F, Behboudi E, Naderi M, Shahramian I, Moradi A. Evaluation of lamivudine resistance mutations in HBV/HIV co-infected patients. Iran J Med Microbiol 2022; 16: 66-75.
3. Wu ZH, Baillargeon J, Grady JJ, Black SA, Dunn K. HIV seroprevalence among newly incarcerated inmates in the Texas correctional system. Ann Epidemiol 2001; 11: 342-346.
4. Long J, Bird SM, Allwright S, Barry J, Reynolds SR, Thornton L, et al. Prevalence of antibodies to hepatitis B, hepatitis C, and HIV and risk factors in entrants to Irish prisons: a national cross-sectional survey commentary: efficient research gives direction on prisoners' and the wider public health except in England and Wales. BMJ 2001; 323: 1209. DOI: 10.1136/bmj.323.7323.1209.
5. Allwright S, Bradley F, Long J, Barry J, Thornton L, Parry JV. Prevalence of antibodies to hepatitis B, hepatitis C, and HIV and risk factors in Irish prisoners: results of a national cross-sectional survey. BMJ 2000; 321: 78-82.
6. Thaisri H, Lerwitworapong J, Vongsheree S, Sawanpanyalert P, Chadbanchachai C, Rojanawiwat A, et al. HIV infection and risk factors among Bangkok prisoners, Thailand: a prospective cohort study. BMC Infect Dis 2003; 3: 25. DOI: 10.1186/1471-2334-3-25.
7. Buavirat A, Page-Shafer K, Van Griensven G, Mandel J, Evans J, Chuaratanaphong J, et al. Risk of prevalent HIV infection associated with incarceration among injecting drug users in Bangkok, Thailand: a case-control study. BMJ 2003; 326: 308. DOI: 10.1136/bmj.326.7384.308.
8. Krebs CP, Simmons M. Intraprison HIV transmission: an assessment of whether it occurs, how it occurs, and who is at risk. AIDS Educ Prev 2002; 14 (5 Suppl): 53-64.
9. Ganczak M, Szych Z. HBV, HCV, and HIV infection prevalence among prison staff in the light of occupational risk factors. Med Pr 2017; 68: 507-517 [Article in Polish].
10. Wohl DA, Rosen D, Kaplan AH. HIV and incarceration: dual epidemics. AIDS Read 2006; 16: 247-250, 257-260.
11. Hellard M, Aitken C. HIV in prison: what are the risks and what can be done? Sexual Health 2004; 1: 107-113.
12. Khajehkazemi R, Osooli M, Sajadi L, Karamouzian M, Sedaghat A, Fahimfar N, et al. HIV prevalence and risk behaviors among people who inject drugs in Iran: the 2010 National Surveillance Survey. Sex Transm Infect 2013; 89 (Suppl 3): iii29-iii32. DOI: 10.1136/sextrans-2013-051204.
13. Dolan K, Wirtz AL, Moazen B, Ndeffo-Mbah M, Galvani A, Kinner SA, et al. Global burden of HIV, viral hepatitis, and tuberculosis in prisoners and detainees. Lancet 2016; 388: 1089-1102.
14. Azbel L, Polonsky M, Wegman M, Shumskaya N, Kurmanalieva A, Asanov A, et al. Intersecting epidemics of HIV, HCV, and syphilis among soon-to-be-released prisoners in Kyrgyzstan: implications for prevention and treatment. Int J Drug Policy 2016; 37: 9-20.
15. Adjei AA, Armah HB, Gbagbo F, Ampofo WK, Quaye IK, Hesse IF, et al. Prevalence of human immunodeficiency virus, hepatitis B virus, hepatitis C virus, and syphilis among prison inmates and officers

at Nsawam and Accra, Ghana. J Med Microbiol 2006; 55: 593-597.
16. Babudieri S, Longo B, Sarmati L, Starnini G, Dori L, Suligoi B, et al. Correlates of HIV, HBV, and HCV infections in a prison inmate population: results from a multicentre study in Italy. J Med Virol 2005; 76: 311-317.
17. Belaunzaran-Zamudio PF, Mosqueda-Gomez JL, Macias-Hernandez A, Rodríguez-Ramírez S, Sierra-Madero J, Beyrer C. Burden of HIV, syphilis, and hepatitis B and C among inmates in a prison state system in Mexico. AIDS Res Hum Retroviruses 2017; 33: 524-533.
18. Calzavara L, Ramuscak N, Burchell AN, Swantee C, Myers T, Ford P, et al. Prevalence of HIV and hepatitis C virus infections among inmates of Ontario remand facilities. CMAJ 2007; 177: 257-261.
19. Catalan-Soares BC, Almeida RTP, Carneiro-Proietti ABF. Prevalence of HIV-1/2, HTLV-I/II, hepatitis B virus (HBV), hepatitis C virus (HCV), Treponema pallidum, and Trypanosoma cruzi among prison inmates at Manhuaçu, Minas Gerais State, Brazil. Rev Soc Bras Med Trop 2000; 33: 27-30.
20. Coelho HC, Perdoná GC, Neves FR, Passos ADC. HIV prevalence and risk factors in a Brazilian penitentiary. Cad Saude Publica 2007; 23: 2197-2204.
21. Defante Ferreto LE, Guedes S, Braz Pauli F, Soligo Rovani S, Aní Caovilla Follador F, Paula Vieira A, et al. Seroprevalence and associated factors of HIV and Hepatitis C in Brazilian high-security prisons: a state-wide epidemiological study. PLoS One 2021; 16: e0255173. DOI: 10.1371/journal.pone.0255173.
22. El Maerrawi I, Carvalho HB. Prevalence and risk factors associated with HIV infection, hepatitis, and syphilis in a state prison of São Paulo. Int J STD AIDS 2015; 26: 120-127.
23. Kassira EN, Bauserman RL, Tomoyasu N, Caldeira E, Swetz A, Solomon L. HIV and AIDS surveillance among inmates in Maryland prisons. J Urban Health 2001; 78: 256-263.
24. Kebede W, Abdissa A, Seid Y, Mekonnen Z. Seroprevalence and risk factors of hepatitis B, hepatitis C, and HIV infections among prisoners in Jimma Town, Southwest Ethiopia. Asian Pac J Trop Dis 2017; 7: 270-275.
25. Khan MD, Wali A, Fatima R, Yaqoob A, Aziz S. Prevalence and associated risk factors of HIV in prisons in Balochistan, Pakistan: a cross-sectional study. F1000Res 2018; 7: 1821. DOI: 10.12688/f1000research.16994.2.
26. Macalino GE, Vlahov D, Sanford-Colby S, Patel S, Sabin K, Salas C, et al. Prevalence and incidence of HIV, hepatitis B virus, and hepatitis C virus infections among males in Rhode Island prisons. Am J Public Health 2004; 94: 1218-1223.
27. Maggard KR, Hatwiinda S, Harris JB, Phiri W, Krüüner A, Kaunda K, et al. Screening for tuberculosis and testing for human immunodeficiency virus in Zambian prisons. Bull World Health Organ 2015; 93: 93-101.
28. Mahfoud Z, Kassak K, Kreidieh K, Sharma S, Ramia S. Prevalence of antibodies to human immunodeficiency virus (HIV), hepatitis B and hepatitis C and risk factors in prisoners in Lebanon. J Infect Dev Ctries 2010; 4: 144-149.
29. Navadeh S, Mirzazadeh A, Gouya MM, Farnia M, Alasvand R, Haghdoost AA. HIV prevalence and related risk behaviors among prisoners in Iran: results of the national biobehavioural survey, 2009. Sex Transm Infect 2013; 89 (Suppl 3): iii33-iii6. DOI: 10.1136/sextrans-2013-051295.
30. Reekie JM, Levy MH, Richards AH, Wake CJ, Siddall DA, Beasley HM, et al. Trends in HIV, hepatitis B and hepatitis C prevalence among Australian prisoners-2004, 2007, 2010. Med J Aust 2014; 200: 277-280.
31. Safdar S, Mehmood A, Abbas SQ. Prevalence of HIV/AIDS among jail inmates in Sindh. J Pak Med Assoc 2009; 59: 111-112.
32. Shahbazi M, Farnia M, Rahmani K, Moradi G. Trend of HIV/AIDS prevalence and related interventions administered in prisons of Iran-13 years' experience. Iran J Public Health 2014; 43: 471-479.
33. Sousa KAAd, Araújo TMEd, Teles SA, Rangel EML, Nery IS. Factors associated with HIV prevalence in a prison population. Rev Esc Enferm USP 2017; 51: e03274. DOI: 10.1590/S1980-220X-2016040903274.
34. Wali A, Khan D, Safdar N, Shawani Z, Fatima R, Yaqoob A, et al. Prevalence of tuberculosis, HIV/AIDS, and hepatitis; in a prison of Balochistan: a cross-sectional survey. BMC Public Health 2019; 19: 1631. DOI: 10.1186/s12889-019-8011-7.
35. Weild A, Gill O, Bennett D, Livingstone S, Parry J, Curran L. Prevalence of HIV, hepatitis B, and hepatitis C antibodies in prisoners in England and Wales: a national survey. Commun Dis Public Health 2000; 3: 121-126.
36. Kazi AM, Shah SA, Jenkins CA, Shepherd BE, Vermund SH. Risk factors and prevalence of tuberculosis, human immunodeficiency virus, syphilis, hepatitis B virus, and hepatitis C virus among prisoners in Pakistan. Int J Infect Dis 2010; 14: e60-e66. DOI: 10.1016/j.ijid.2009.11.012.
37. Semaille C, Le Strat Y, Chiron E, Chemlal K, Valantin M, Serre P, et al. Prevalence of human immunodeficiency virus and hepatitis C virus among French prison inmates in 2010: a challenge for public health policy. Euro Surveill 2013; 18: 20524. DOI: 10.2807/1560-7917.es2013.18.28.20524.
38. Poulin C, Alary M, Lambert G, Godin G, Landry S, Gagnon H, et al. Prevalence of HIV and hepatitis C virus infections among inmates of Quebec provincial prisons. CMAJ 2007; 177: 252-256.
39. Khani M, Vakili MM. Prevalence and risk factors of HIV, hepatitis B virus and hepatitis C virus infections in drug addicts among Zanjan prisoners. Arch Iran Med 2003; 6: 1-4.
40. Tajbakhsh E, Yaghoubi R. Serologic evaluation of HIV contamination in Shahrekord prisoners through ELISA and Western blot. Sci J Iran Blood Transfus Organ 2008; 4: 365-368.
41. Davoodian P, Dadvand H, Madhuri K, Amoozandeh A, Salavati A. Prevalence of selected sexually and blood-borne infections in injecting drug abuser inmates of Bandar Abbas and wooden correction facilities, Iran, 2002. Braz J Infect Dis 2009; 13: 356-358.
42. Moosazadeh M, Amiresmaili M, Parsaei M, Ahmadi M, Jalahi H. Prevalence of tuberculosis among the prisoners of Mazandaran. J Rafsanjan Univ Med Sci 2011; 10: 309-316.
43. Nokhodian Z, Yazdani MR, Yaran M, Shoaei P, Mirian M, Ataei B, et al. Prevalence and risk factors of HIV, syphilis, hepatitis B and C among female prisoners in Isfahan, Iran. Hepat Mon 2012; 12: 442-447.
44. Haghdoost AA, Mirzazadeh A, Shokoohi M, Sedaghat A, Gouya MM. HIV trend among Iranian prisoners in 1990s and 2000s; analysis of aggregated data from HIV sentinel sero-surveys. Harm Reduct J 2013; 10: 32. DOI: 10.1186/1477-7517-10-32.
45. Ziaee M, Sharifzadeh G, Namaee MH, Fereidouni M. Prevalence of HIV and hepatitis B, C, D infections and their associated risk factors among prisoners in Southern Khorasan Province, Iran. Iran J Public Health 2014; 43: 229-234.
46. Feng MC, Feng JY, Chen YH, Chang PY, Lu PL. Prevalence and knowledge of sexually transmitted infections, drug abuse, and AIDS among male inmates in a Taiwan prison. Kaohsiung J Med Sci 2012; 28: 660-666.
47. Afsar Kazerooni P, Amini Lari M, Joolaei H, Parsa N. Knowledge and attitude of male intravenous drug users on HIV/AIDS associated high risk behaviors in Shiraz Pir-Banon Jail, Fars Province, Southern Iran. Iranian Red Crescent Medical Journal 2010; 12: 334-336.
48. Alvarado-Esquivel C, Sablon E, Martinez-Garcia S, Estrada-Martinez S. Hepatitis virus and HIV infections in inmates of a state correctional facility in Mexico. Epidemiol Infect 2005; 133: 679-685.
49. Gough E, Edwards P. HIV seroprevalence and associated risk factors among male inmates at the Belize Central Prison. Rev Panam Salud Publica 2009; 25: 292-299.

50. Solomon L, Flynn C, Muck K, Vertefeuille J. Prevalence of HIV, syphilis, hepatitis B, and hepatitis C among entrants to Maryland correctional facilities. J Urban Health 2004; 81: 25-37.
51. Altice FL, Marinovich A, Khoshnood K, Blankenship KM, Springer SA, Selwyn PA. Correlates of HIV infection among incarcerated women: implications for improving detection of HIV infection. J Urban Health 2005; 82: 312-326.
52. Rosen DL, Schoenbach VJ, Wohl DA, White BL, Stewart PW, Golin CE. Characteristics and behaviors associated with HIV infection among inmates in the North Carolina prison system. Am J Public Health 2009; 99: 1123-1130.
53. Bautista-Arredondo S, González A, Servan-Mori E, Beynon F, Juarez-Figueroa L, Conde-Glez CJ, et al. A cross-sectional study of prisoners in Mexico City comparing the prevalence of transmissible infections and chronic diseases with that in the general population. PLoS One 2015; 10: e0131718. DOI: 10.1371/journal.pone.0131718.
54. Burek V, Horvat J, Butorac K, Mikulić R. Viral hepatitis B, C, and HIV infection in Croatian prisons. Epidemiol Infect 2010; 138: 1610-1620.
55. Azarkar Z, Sharifzadeh G. Evaluation of the prevalence of hepatitis B, hepatitis C, and HIV in inmates with drug-related convictions in Birjand, Iran in 2008. Hepat Mon 2010; 10: 26-30.
56. Sundar M, Ravikumar KK, Sudarshan MK. A cross-sectional seroprevalence survey for HIV-1 and high risk sexual behaviour of seropositives in a prison in India. Indian Journal of Public Health. 1995 Jul 1;39(3):116-8.
57. Jin H, Restar A, Beyrer C. Overview of the epidemiological conditions of HIV among key populations in Africa. J Int AIDS Soc 2021; 24 (Suppl 3): e25716. DOI: 10.1002/jia2.25716.
58. Golrokhi R, Farhoudi B, Taj L, Pahlaviani FG, Mazaheri-Tehrani E, Cossarizza A, et al. HIV prevalence and correlations in prisons in different regions of the world: a review article. Open AIDS J 2018; 12: 81-92.
59. Gaughwin M, Douglas R, Wodak A (eds.). Behind bars – risk behaviours for HIV transmission in prisons, a review. HIV/AIDS and Prisons (conference proceedings). Canberra: Australian Institute of Criminology; 1991.
60. Loh DA, Plugge E, Van Hout MC. Continuity of opioid substitution treatment between prison and community in Southeast Asia: a scoping review. Int J Drug Policy 2023; 112: 103957. DOI: 10.1016/j.drugpo.2023.103957
61. Viitanen P, Vartiainen H, Aarnio J, von Gruenewaldt V, Hakamäki S, Lintonen T, et al. Hepatitis A, B, C and HIV infections among Finnish female prisoners – young females a risk group. J Infect 2011; 62: 59-66.
62. Centers for Disease Control and Prevention. HIV in Prisons, 2018. Available at: https://www.cdc.gov/hiv/pdf/library/factsheets/hiv-in-prisons-factsheet.pdf (Accessed: 09.06.2023).
63. Rich JD, Beckwith CG, Macmadu A, Marshall BDL, Brinkley-Rubinstein L, Amon JJ, et al. Clinical care of incarcerated people with HIV, viral hepatitis, or tuberculosis. Lancet 2016; 388: 1103-1114.
64. Sayyah M, Rahim F, Kayedani GA, Shirbandi K, Amal SM. Global view of HIV prevalence in prisons: a systematic review and meta-analysis. Iran J Public Health 2019; 48: 217-226.