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SYSTEMATIC REVIEW

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Prevalence of hepatitis B, hepatitis C, and tuberculosis among people living with HIV in Iran: a systematic review and meta-analysis

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Abstract

Background Up to now several studies estimate the prevalence of HBV, HCV, and TB among people living with HIV (PLWH) in Iran; however, their results are inconsistent. This study aimed to estimate the overall prevalence of HBV, HCV, and TB among Iranian PLWH.

Methods In this systematic review and meta-analysis six databases including Medline, Web of Science, Scopus, MagIran, Scientific Information Database (SID), and Barakat Knowledge network system were searched up to October 2023 with no language restriction. All studies estimated the prevalence of HBV, HCV, and TB among PLWH in Iran were included. The random-effects model was used to report the study estimates. Results were reported at a 95% confidence interval (CI).

Results Out of 1050 retrieved references, 58 articles met the eligibility criteria. Overall among PLWH, HBV prevalence was 13.0% (95% CI: 11.0, 15.0), HCV prevalence was 54% (95% CI: 45.0, 64.0), and TB prevalence was 19% (95% CI: 13.0, 24.0). The results from multivariate meta-regression analysis showed no statistically significant association between HBV and TB prevalence with the year of study, quality of studies, age, gender, and persons who inject drugs (PWID). HCV prevalence was significantly associated with PWID.

Conclusion We found HBV, HCV, and TB infections are common among PLWH in Iran and required to be screened and treated with effective and timely services.

Key messages

The prevalence of HBV, HCV, and TB was high among Iranian PLWH

The prevalence was higher among at-risk groups such as PWIDs and homeless people

The prevalence of HCV was more than HBV and TB among PLWH

Keywords HIV, Hepatitis B, Hepatitis C, Tuberculosis, Systematic review, Iran

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Introduction

Human immunodeficiency virus (HIV), hepatitis B virus (HBV), and hepatitis C virus (HCV) are blood born viruses. HIV and HBV are primarily transmitted via injection drug use and unprotected sexual contact. HCV mainly transmitted via sharing the needles or other equipment for drug injection. Because of the same transmission routes of these viruses, the HIV infected people are at a higher risk of HBV and HCV than the general population [1]. By suppressing the immune system, HIV provides the basis for opportunistic infections such as tuberculosis (TB). The risk of TB among HIV-infected people is about 20 times more than the others and TB remains the main cause of death among people living with HIV (PLWH) [2]. HBV increases the risk of the progression of disease and mortality among HIV infected patients [3, 4].

The global burden of HIV-HCV co-infection is 2.75 million [1]. The prevalence of HIV-HCV co-infection is estimated from 2.4%, 4.0%, 6.4%, and 82.4% among the general population, heterosexually exposed people, men who have sex with men, and people who inject drugs respectively [5]. The prevalence of HCV infection among prisoners in Iran estimated from 19%, 25%, and 53% among general prisoners, prisoners who use drugs, and prisoners who inject drugs respectively [6]. The global prevalence of HBV among HIV infected people estimated approximately 5–10% [7]. It is estimated that 900,000 new cases of TB has occurred among people living with HIV (PLWH) in 2017, and about 300,000 people died of HIV associated TB [8]. The overall prevalence of TB/HIV co-infection is estimated at 14% in Iran [9].

In Iran, HIV infection is concentrated among people who inject drugs [10], in addition, injecting drugs is a major risk factor for HCV, so the coinfection of HIV with viral hepatitis B and C complicate the health status of these people and increase the risk of liver cancer [11]. According to the results of conducted systematic reviews, the prevalence of HCV among Iranian prisoners and TB/HIV coinfection in Iran were 28.0% [6] and 14.0% [9] respectively.

Several studies have estimated the prevalence of HBV, HCV, and TB among PLWH in Iran from 2003 to 2022; however, their results are inconsistent [12–19]. Although there are systematic reviews regarding the co-infection of TB/HIV [9] and prevalence of HCV among high-risk groups [6] in Iran, there are not sufficient evidence regarding the overall prevalence of TB, HCV, and HIV among PLWH in Iran. Our study simultaneously summarized the evidence regarding the prevalence of three important infectious diseases among PLWH. In addition,

studies regarding the coinfection of HIV, HBV, HCV, and TB are in priority for research in Iran especially among high risk groups [20]. In this systematic review and meta-analysis, we aimed to estimate the overall prevalence of HBV, HVC, and TB among Iranian PLWH.

Methods

Searching

A search strategy using the following keywords was designed: hepatitis C, hepatitis B, tuberculosis, HIV, acquired immunodeficiency syndrome, prevalence, and incidence. The international and national databases including Medline, Web of Science, Scopus, MagIran, Scientific Information Database (SID), and Barakat Knowledge network system were searched up to October 2023. In addition, the reference lists of selected studies were scanned in order to obtain more related studies.

Two investigators (ADI, BE) were independently responsible for screening the retrieved studies. The obtained references from the databases were included in the EndNote software. In the first step, duplicated studies were removed, and in the next step, the mentioned investigators based on the eligibility criterion screened the title and abstract of reminded studies. Any disagreement was resolved by the discussion and judgment of the third author (AM).

Inclusion criteria

All cross-sectional studies and studies that reviewed the patients' records retrospectively which had estimated the prevalence of HBV, HCV, and TB among Iranian HIV infected patients, regardless of sex and age, were included in this systematic review. There were no restrictions in date of publication and language of studies. The definition for HIV positive was two positive ELISA tests which confirmed by Western Blot. Positive HBV surface antigen (HBsAg) was defined as HBV, and positive anti-HCV antibody was considered as HCV infection. Diagnosis of TB was based on at least two positive acid-fast bacilli (AFB) in three sputum sample or one positive AFB plus radiographic evidence and clinical symptoms.

Risk of bias assessment and data extraction

Eight items from the Joanna Briggs Institute (JBI) critical appraisal checklist for prevalence studies were selected for risk of bias assessment [21]. These items included: 1) the appropriateness of the sampling frame to address the target population, 2) the appropriateness of the sampling method, 3) the sample size was adequate. 4) The subjects and the setting of the study described in detail? 5) The use of a valid method for the identification of the

outcome? 6) Were the outcomes (HBV, HCV, and TB) measured in a standard, reliable way for all participants? 7) The appropriateness of statistical analysis? 8) Was the response rate adequate, and if not, was the low response rate managed appropriately? Each item scored as follows: meet the criteria equal two, unclear equal one, and not meet the criteria equal zero. The range of score for each study was 0–16. Studies that scored 15 or more were considered as the high quality, studies with scores 11–14 considered as intermediate quality and studies with lower than 11 scores were considered as low quality. Two authors (ADI, BE) were responsible for quality assessment independently. The Kappa statistic for the agreement between two authors was 71.0%.

The following variables were extracted from included studies: the name of first author, year of publication, year of study conduction, type of study design, the location of study, characteristics of study population, mean age of participants, gender, sample size, the number of PLWH, and the number of people with HBV, HCV, and TB.

Assessment of heterogeneity

The statistical heterogeneity was assessed using the chi-squared (Chi^2) test at the 5% statistical level. In addition, the heterogeneity across included studies was quantified by I^2 statistics, and the between-study variance was assessed using tau-squared (Tau^2) statistic [22].

Data analysis

The prevalence of HBV, HCV, and TB was calculated by dividing the number of people with HBV, HCV, and TB to the number of HIV patients. Meta-analysis was used to obtain the pooled estimate of the prevalence of HBV, HCV, and TB among HIV patients. The included studies were conducted in different provinces of Iran and by various researchers. In addition, the study populations of the included studies were different, so in addition to differences among the results of studies due to sampling variation, there is a random variation in the prevalence in various studies. Therefore, the random-effects model was used to the report of summary measures [23].

The meta-regression was used to identify the sources of heterogeneity in the results of the included studies. Subgroup analysis was conducted based on the gender, provinces of Iran, quality of studies, and date of study conduction (≤ 2005 , 2006–2010 and after 2011). Both Stata 11 (Stata Corp, College Station, TX, USA) and Review Manager [Review Manager (RevMan) Version 5.3 were used for data analysis. The pooled prevalence of HBV, HCV, and TB was reported at a 95% confidence interval (CI).

Results

Out of 1050 retrieved references from the six databases, 58 articles [12–17, 19, 24–74] met the eligibility criteria (Fig. 1). Among these articles 40, 42, and 14 have been reported the prevalence of HBV, HCV, and Tuberculosis among PLWH, respectively. These studies involved 17,905 PLWH. The characteristics of the included studies are reported in Table 1. The results of risk of bias assessment are shown in Fig. 2.

Prevalence of HBV among PLWH

The pooled prevalence of HBV among PLWH was 13.0% (95% CI: 11.0, 15.0) (Fig. 3). Results of studies that reported the prevalence of HBV among PLWH were high heterogeneous ($I^2=96.20\%$). HBV prevalence was higher among men (15.3%), intermediate quality studies (14.8%), and studies conducted 2005 or earlier (19.2%) (Table 2).

Most studies were conducted in Tehran (18 studies) with an overall HBV prevalence of 15.1% (95% CI: 11.3, 18.9).

Prevalence of HCV among PLWH

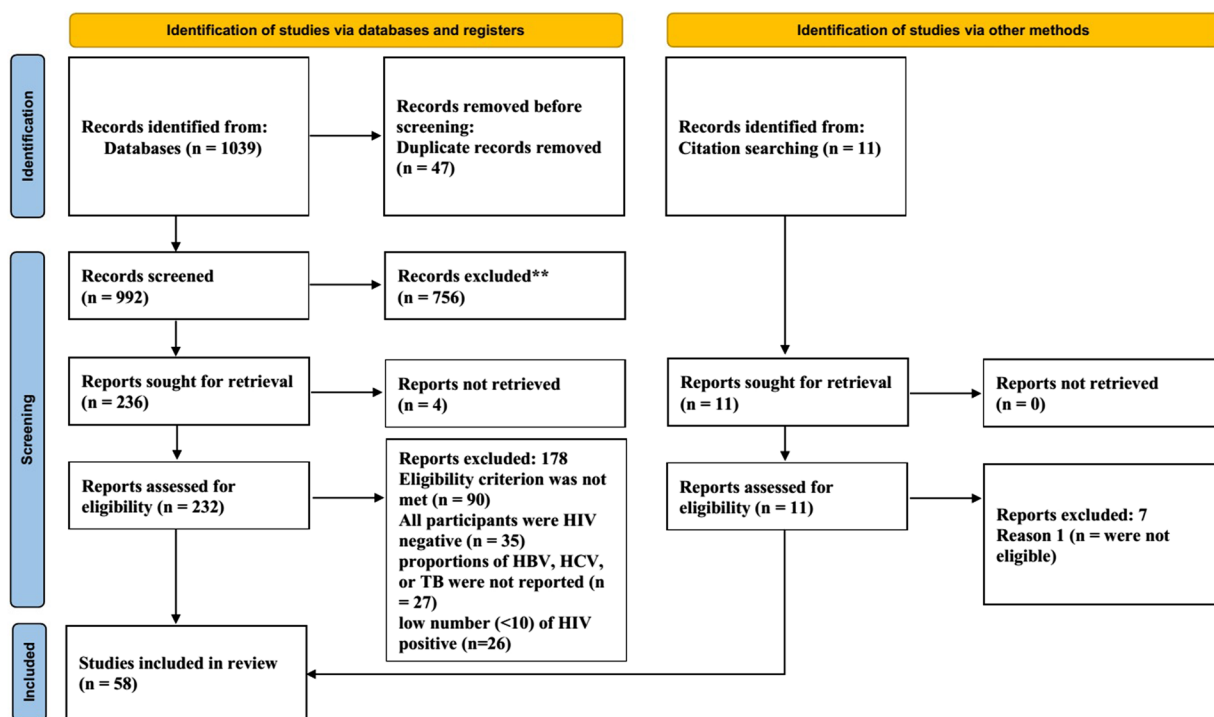
The pooled prevalence of HCV among PLWH was 54.0% (95% CI: 45.0, 64.0) (Fig. 4). According to the results of the heterogeneity test, the I^2 was 99.38%. HCV prevalence was higher among men, (67.3%), intermediate quality studies (65.7%) studies conducted from 2006 to 2010 (63.8%) (Table 2). Most of the included studies (19 studies) were related to Tehran province. The overall prevalence of HCV among PLWH in Tehran was 53.6 (95% CI: 432.2, 64.1). The prevalence of HCV in other regions of Iran is shown in Table 2.

Prevalence of TB among PLWH

The overall prevalence of TB among PLWH was 17.0% (95% CI: 13.0, 22.0) (Fig. 5). The I^2 for the results of studies that have been reported the prevalence of TB among PLWH was 97.69%. TB prevalence was higher among men (21.6%), high quality studies (26.1%), and studies conducted from 2006 to 2010 (22.4%) (Table 2). The highest prevalence of TB among PLWH was related to southwest of Iran with 35.2% (95% CI: 6.4, 64.1) (Table 2).

Meta-regression analysis

The results from multivariate meta-regression analysis showed no statistically significant association between HBV prevalence and year of study, quality of studies, age, gender, and PWID (Table 3). HCV prevalence was significantly associated with PWID (crude Beta=0.48, p -value 0.004). TB prevalence was associated with gender (crude Beta=48) and PWID (crude Beta 0.72 but these associations were not statistically significant).



From: Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. *BMJ* 2021;372:n71. doi: 10.1136/bmj.n71. For more information, visit: <http://www.prisma-statement.org/>

Fig. 1 A flow chart showing the stages of retrieving articles and assessing the eligibility criteria for meta-analysis of prevalence of HBV, HCV, and TB among HIV-POSITIVE patients

Discussion

Our findings suggest that among people living with HIV, one in eight infected with HBV, one in two infected with HCV and one in six infected with Tuberculosis. Men who live with HIV have a higher prevalence of HBV, HCV, and Tuberculosis infection; while injection was the only significant predictor for high HCV prevalence. We observed no significant change in prevalence of HBV, HCV and Tuberculosis overtime among people living with HIV.

Overall, the results of this study indicated a considerable prevalence of Iranian PLWH affected by HBV, HCV, and TB. In addition, the prevalence of these infectious diseases among higher at risk PLWH groups such as PWIDs, homeless people, and hospitalized patients was more than other groups such as HIV patients referring to the counseling center. Due to the same transmission routes of HIV, HBV, and HCV, it is expected that the prevalence of HBV and HCV be higher among HIV infected people. In Iran, injecting drug use (IDU) is one of the main risk factors of HIV [76]. On the other hand, sharing syringe is the main risk factor for HCV [75], so the high prevalence of HCV among PLWH can be justified.

In a review article in 2014, the prevalence of HBV co-infection among Iranian HIV positive people was ranged from 1.8–26.8% [77], similar to what we found. In India, this figure was 7.28% to 10.7%, and in Europe, was from 3.6% to 59.0% [77], similar to our results. According to the findings of a meta-analysis, the combined prevalence of HBsAg among people living with HIV in Latin America was 7.0% with a confidence interval of 95% (7.0–7.0%) [78]. According to the results of a systematic review in Iran, the prevalence of coinfection with HIV and HBV among injecting drug users and prisoners was 1.88% and 0.13%, respectively. In addition, 10.95% of injecting drug users (95% CI: 2.82–19.08%) were positive for both HIV and HCV [79].

We found an overall HCV prevalence of 54%, the prevalence was different based on the study population, and the highest HCV prevalence was related to PWIDs which was from 74.0% to 85.0%. This finding was similar to the global median HCV prevalence (82%; IQR: 55–84) among PWIDs [5].

Tuberculosis among PLWH is a major health issue. Immunodeficiency in PLWH leads to opportunistic infectious diseases such as TB. The pooled prevalence of TB among Iranian PLWH in the included studies was ranged

Table 1 Characteristics of included studies and prevalence of hepatitis B and C and tuberculosis infections among people living with HIV

Author (year)	Location	Study design	Study population (Sampling Method)	Number of HIV-Positive participants	% Male	Mean Age	% PWID	HBV Positive (%)	HCV-positive (%)	TB-positive (%)
Moradmand (2011) [58]	Tehran	Cross-sectional	HIV-POSITIVE patients in counseling center (Patients records)	365	80.00	37	50.96	90 (24.66)	129 (35.34)	
Aminzadeh (2007) [28]	Tehran	Cross-sectional	iHospitalized PWIDs (Convenience sample)	21	100.00	37	100.00	3 (14.29)	13 (61.9)	
Tayeri (2008) [71]	Isfahan	Cross-sectional	PWIDs patients referring to counseling center	106	100.00	51	100.00	2 (1.89)	80 (75.47)	
Hajjabdolbaghi (2014) [44]	Tehran	Cross-sectional	Hospitalized HIV-POSITIVE patients (Records of patients)	498	84.30		76.51			137 (27.51)
Daryazadeh (2016) [34]	Isfahan	Cross-sectional	HIV-POSITIVE patients in counseling center (Records of patients)	241	0.00	39	0.00	3 (1.24)	79 (32.78)	16 (6.64)
Hosseini-rad (2017) [46]	Tehran	Cross-sectional	HIV-POSITIVE patients referring to counseling center	481	85.00	42	77.75	32 (6.65)	331 (68.81)	
Vaziri (2008) [73]	Kermanshah	Cross-sectional	HIV-POSITIVE patients referring to counseling center	887	98.00	31	13.98	19 (2.14)	35 (3.95)	
Aghakhani (2016) [24]	Tehran	Cross-sectional	HIV-POSITIVE patients referring to counseling center	92	54.30	38	41.30		30 (32.61)	
Aghasadeghi (2013) [25]	Tehran	Cross-sectional	HIV-POSITIVE patients counseling center	600	69.60	36.9	53.60	9 (1.5)		
Alavi SM (2012) [12]	Ahvaz	Cross-sectional	Hospitalized HIV-POSITIVE patients (Records of patients)	123	100.00	32.4	80.49			81 (65.85)
Alavi (2007) [26]	Ahvaz	Cross-sectional	Hospitalized PWID patients hospital	104	100.00	28	67.53	46 (44.23)	77 (74.04)	
Ataei (2010) [30]	Isfahan	Cross-sectional	HIV-POSITIVE patients referring to counseling center	130	98.00	50.23	81.54	15 (11.54)	100 (76.92)	
Davarpanah (2013) [13]	Shiraz	Cross-sectional	HIV-POSITIVE patients referring to counseling center	226	95.00	35.6	74.78		196 (86.73)	
Davarpanah (2007) [35]	Shiraz	Cross-sectional	HIV-POSITIVE patients referring to counseling center	228	90.00	35.5	0.00	17 (7.46)		

Table 1 (continued)

Author (year)	Location	Study design	Study population (Sampling Method)	Number of HIV-Positive participants	% Male	Mean Age	% PWID	HBV Positive (%)	HCV-positive (%)	TB-positive (%)
Davarpanah (2015) [36]	Shiraz	Cross-sectional	HIV-POSITIVE patients referring to counseling center (Random sampling)	840	0.00	37	0.00			29 (3.45)
Davarpanah (2015) [37]	Shiraz	Cross-sectional	HIV-POSITIVE patients referring to counseling center	186	88.00	37	73.12	66 (35.48)		
Davarpanah (2009) [38]	Shiraz	Cross-sectional	HIV-POSITIVE patients referring to counseling center	459	85.00		0.00			14 (3.05)
Davoodian (2009) [14]	Bandar Abbas	Cross-sectional	Prisoners PWIDs (Random sampling)	38	100.00	35.4	100.00	3 (7.89)	35 (92.11)	
Doosti-Irani (2017) [75]	Khoramabad	Cross-sectional	Male homeless people (Convenience sample)	20	100.00	35.86	38.76		18 (90)	
Farhoudi (2016) [15]	Tehran	Cross-sectional	Prisoners HIV positive patients (Active case finding)	85	100.00	34.55	0.00	3 (3.53)	50 (58.82)	5 (5.88)
Foroughi (2017) [43]	Tehran	Cross-sectional	Street and labour children (Biobehavioural surveillance survey)	45	95.00	15.9	0.00	2 (4.44)	5 (11.11)	
Hashemi-Shahri (2016) [16]	Zahedan	Retrospective	Hospitalized patients With HIV/AIDS	41	73.00	43.9	0.00	11 (26.83)	13 (31.71)	
Javad Zahedi (2014) [49]	Kerman	Cross-sectional	HIV-POSITIVE patients referring to counseling center	165	82.00	40.4	76.36	6 (3.64)	122 (73.94)	
Keramat (2011) [17]	Hamadan	Cross-sectional	HIV-POSITIVE patients referring to counseling center	15	72.00	29.7	52.51	1 (6.67)	13 (86.67)	
Khazaei (2016) [51]	Abadan	Cross-sectional	HIV-POSITIVE patients in counseling center (Records of patients)	366	86.00	33.5	73.50	20 (5.46)	126 (34.43)	80 (21.86)
Khorvash (2014) [52]	Isfahan	Cross-sectional	HIV-POSITIVE patients referring to counseling center	64	0.00	33.64	10.94	12 (18.75)	8 (12.5)	
Khosravi (2010) [53]	Shiraz	Cross-sectional	HIV-POSITIVE patients referring to counseling center	101	88.00	54.9	35.64		87 (86.14)	
Khosravi (2012) [54]	Ahvaz	Cross-sectional	Hospitalized HIV-POSITIVE patients	50	90.00	30	0.00	16 (32)	8 (16)	9 (18)

Table 1 (continued)

Author (year)	Location	Study design	Study population (Sampling Method)	Number of HIV-Positive participants	% Male	Mean Age	% PWID	HBV Positive (%)	HCV-positive (%)	TB-positive (%)
Koochak (2017) [55]	Tehran	Cross-sectional	HIV-POSITIVE patients referring to counseling center	200	72.00		0.00		121 (60.5)	
Mohammad Nejad (2013) [56]	Tehran	Cross-sectional	Hospitalized HIV-POSITIVE patients	213	92.00	35	46.48	24 (11.27)		
Mohammadi (2009) [57]	Tehran	Cross-sectional	HIV-POSITIVE patients referring to counseling center	391			51.66	57 (14.58)	282 (72.12)	
Motamedifar (a) (2015) [59]	Shiraz	Retrospective	HIV-POSITIVE patients referring to counseling center	765	70.00	39	64.71			59 (7.71)
Motamedifar (b) (2015) [60]	Shiraz	Retrospective	HIV-POSITIVE patients referring to counseling center	1480	98.00	37.4	0.00	178 (12.03)		
Rabirad (2012) [62]	Tehran	Cross-sectional	Hospitalized HIV-POSITIVE patients (Records of patients)	71	92.00	35	0.00			20 (28.17)
Rahimi-Movaghar (2010) [63]	Tehran	Cross-sectional	PWIDs who were selected from drug treatment centers and community (Volunteer)	96	96.00	33.87	100.00	69 (71.88)	77 (80.21)	
Ramezani (2014) [64]	Arak	Cross-sectional	PWID attending methadone maintenance clinics	19	100.00	33.3	100.00	5 (26.32)	15 (78.95)	
Ramezani (2009) [65]	Tehran	Cross-sectional	HIV-POSITIVE patients referring to counseling center	92	72.00	36.7	47.83	4 (4.35)	63 (68.48)	
Rezaianzadeh (2012) [67]	Shiraz	Retrospective	HIV-POSITIVE patients referring to counseling center	1339	85.00	36	73.71		1044 (77.97)	
SeyedAlinaghi (2011) [68]	Tehran	Cross-sectional	Hospitalized HIV-POSITIVE patients	201	86.00	36	48.76	89 (44.28)	135 (67.16)	
Tabarsi (2015) [69]	Tehran	Cross-sectional	HIV-POSITIVE patients referring to counseling center	154	82.00	36	0.00			58 (37.66)
Amiri (2014) [29]	Tehran	Cross-sectional	Homeless individuals (Convenience sampling)	20	87.00	41	27.49	3 (15)	17 (85)	1 (5)
Azadmanesh (2008) [31]	Tehran	Cross-sectional	HIV-POSITIVE patients referring to counseling center	106	75.00	36.4	15.09	22 (20.75)		

Table 1 (continued)

Author (year)	Location	Study design	Study population (Sampling Method)	Number of HIV-Positive participants	% Male	Mean Age	% PWID	HBV Positive (%)	HCV-positive (%)	TB-positive (%)
Bokharaei-Salim (2016) [33]	Tehran	Cross-sectional	Hospitalized HIV-POSITIVE patients	109	62.00	35.2	41.28		50 (45.87)	
Kasraiyani (2003) [18]	Shiraz	Cross-sectional	Blood donors (Volunteers)	34	94.00	33.4	0.00	2 (5.88)	4 (11.76)	
Amini (2020) [27]	Sanandaj	Cross-sectional	HIV positive individuals referring to Consultation Center	185	76.00	39.26	0.00		99 (53.51)	
Azmoodeh-Ardalan (2021) [32]	Sanandaj	Cross-sectional	HIV positive individuals referring to Consultation Center	184	76.00	39.26	0.00	24 (13.04)		
Dehghani-Dehej (2020) [39]	Tehran	Cross-sectional	HIV-positive individuals who were referred to hospitals	72	0.00	33.6	0.00	7 (9.72)	6 (8.33)	
Dehghani-Dehej (2020) [39]	Tehran	Cross-sectional	HIV-positive individuals who were referred to hospitals	126	63.60	35.3	0.00	18 (14.29)	79 (62.7)	
Dehghani-Dehej (2018) [40]	Tehran	Cross-sectional	HIV-positive individuals who were referred to HIV laboratory of national centre	140	64.00	35.7	0.00		62 (44.29)	
Donyavi (2019) [41]	Tehran	Cross-sectional	IUD participants with established HIV infection who were referred to hospitals	161	95.00	38.9	100.00	20 (12.42)	134 (83.23)	
Hatami (2018) [45]	National	Cross-sectional	HIV-positive individuals	908	67.00	36.9	34.00	22 (2.42)	350 (38.55)	
Jamshidi (2020) [47]	Tehran	Cross-sectional	HIV-positive individuals who were referred to hospitals	190	63.00	36.5	43.00	23 (12.11)	85 (44.74)	
Janbakhsh (2017) [48]	Kermanshah	Cross-sectional	HIV-positive individuals (random sampling)	200	0.00		0.00	77 (38.5)		
Lavaee (2022) [19]	Shiraz	Cross-sectional	HIV-positive individuals who were referred to Shiraz HIV research center for routine dental treatment	73	53.00	39.12	0.00	4 (5.48)	27 (36.99)	
Naghbifar (2021) [61]	Tehran	Cross-sectional	HIV positive individuals referring to Consultation Center	3047	77.00	44.24	44.00	98 (3.22)	961 (31.54)	415 (13.62)

Table 1 (continued)

Author (year)	Location	Study design	Study population (Sampling Method)	Number of HIV-Positive participants	% Male	Mean Age	% PWID	HBV Positive (%)	HCV-positive (%)	TB-positive (%)
Rastegarian (2020) [66]	Shiraz	Cross-sectional	HIV positive individuals referring to Consultation Center	251	63.00	40.8	0.00	1.5 (5.98)		
Talebi-Taher (2017) [70]	Tehran	Retrospective	HIV-positive individuals (Records of patients)	194	51.00	37.82	0.00			23 (11.86)
Teimoori (2019) [72]	Ahvaz	Cross-sectional	HIV positive individuals referring to Consultation Center	229	98.00	32	0.00		135 (58.95)	
Zayedi (2020) [74]	Ahvaz	Cross-sectional	HIV-positive individuals who were referred to hospitals	78	86.00	29	83.00		25 (32.05)	

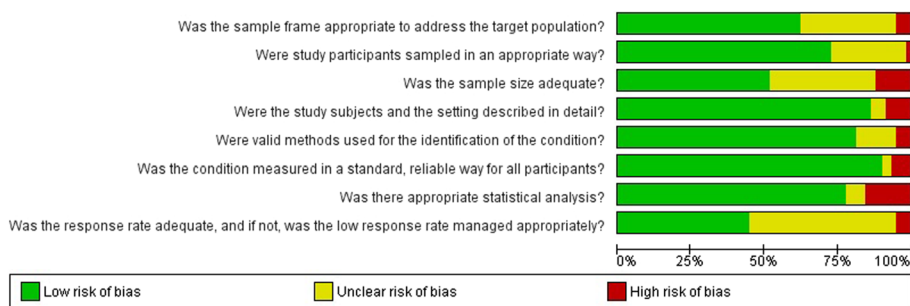


Fig. 2 Results of risk of bias assessment

from 12.7% to 22.3%. Results of a systematic review and meta-analysis showed that the global prevalence of TB among HIV-positive prisoners was 31% (95% CI: 22–39), the prevalence in Africa, America, Asia, and Europe was 13%, 37%, 40%, and 28% respectively [80]. The pooled prevalence in Iran was 19.0% and the highest prevalence

was related to southwest of Iran (35.2%) that nearly same to the two America countries included United States and Brazil [80]. A reason for the high prevalence of TB in our meta-analysis may be due to more detection and case finding of TB among PLWH. According to the Iranian guideline for management and treatment of the

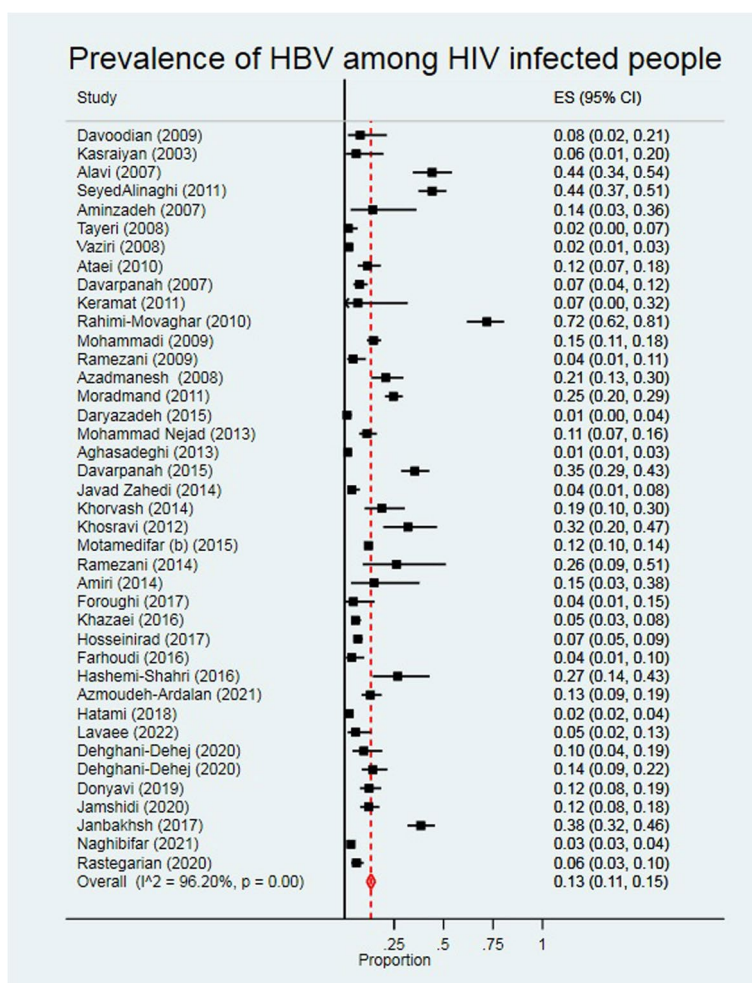


Fig. 3 The individual and pooled prevalence of HBV among people diagnosed with HIV

Table 2 Prevalence of hepatitis B, C and tuberculosis infections among people living with HIV by gender, quality of papers, and years of study

Variables	HBV				HCV				TB			
	N	P%	95% CI	I ² %	N	P%	95% CI	I ² %	N	P%	95% CI	I ² %
Gender												
Men	8	15.3	7.0, 23.7	96.76	9	67.3	49.2, 85.3	96.50	2	21.6	17.3, 25.9	0.00
Women	1	9.7	4.0, 19.0	0.00	1	8.3	3.1, 17.3	0.00	-	-	-	-
Both	31	13.3	10.9, 15.6	92.37	32	52.2	41.1, 63.2	99.49	12	14.7	10.3, 19.1	97.13
Quality of papers												
High	14	13.9	10.2, 17.5	96.73	16	51.6	32.7, 70.5	99.65	4	26.1	5.9, 46.2	97.80
Intermediate	17	14.8	10.6, 18.9	94.47	16	65.7	58.1, 73.3	99.43	5	13.0	7.7, 18.4	96.31
Low	9	10.3	6.4, 14.3	94.53	10	40.7	23.1, 58.3	98.90	5	14.1	7.3, 20.9	94.80
Year of study												
2002–2005	3	19.2	0.04, 42.4	0.00	3	59.4	15.7, 99.99	0.00	-	-	-	-
2006–2010	14	16.3	11.0, 21.6	97.60	14	63.8	41.3, 86.3	99.63	5	22.4	9.1, 35.7	98.28
2011–2015	13	12.1	8.0, 16.1	94.97	14	51.0	37.1, 64.9	98.33	8	15.7	8.7, 22.7	97.20
2016–2020	10	10.7	7.5, 13.9	94.53	11	45.0	34.5, 55.6	97.90	1	13.6	12.4, 14.9	0.00
Geographical region												
Tehran	18	15.1	11.3, 18.9	97.04	19	53.6	43.2, 64.1	98.38	7	18.3	11.4, 25.2	94.14
Center	5	7.7	2.6, 12.8	86.74	5	55.0	28.2, 81.8	98.13	1	6.6	3.8, 10.6	0.00
West	4	15.1	0.04, 30.7	97.62	4	58.1	14.3, 99.99	99.28	-	-	-	-
Southwest	3	26.9	0.09, 54.7	0.00	3	41.5	12.2, 70.9	0.00	3	35.2	6.4, 64.1	0.00
South	6	11.7	6.0, 17.3	92.96	7	56.5	4.10, 7.19	99.07	3	4.7	2.1, 7.3	0.00
Southeast	3	10.9	0.02, 21.7	0.00	3	66.6	39.6, 93.6	0.00	-	-	-	-
National	1	2.4	1.5, 3.6	0.00	1	38.5	35.4, 41.8	0.00	-	-	-	-
Study population												
HIV-positive patients referring to counseling center	25	10.2	8.1, 12.2	95.61	26	50.8	38.7, 62.8	99.56	8	12.3	7.7, 16.9	97.45
HIV-positive PWIDs	7	25.5	7.6, 43.3	97.80	7	79.8	74.3, 85.4	59.18	-	-	-	-
Hospitalized HIV-positive patients	4	28.5	9.3, 47.6	95.57	4	40.5	16.4, 64.5	96.09	4	35.0	15.5, 54.4	95.99
HIV-positive Homeless people	1	15.0	3.2, 37.9	0.00	2	87.9	77.9, 98.0	0.00	1	5.0	0.01, 24.9	-
HIV-positive Prisoners	1	3.5	0.07, 10.0	0.00	1	58.8	47.6, 69.4	0.00	1	5.0	1.9, 13.2	0.00
HIV-positive Street and labour children	1	4.4	0.05, 15.1	0.00	1	11.1	3.7, 24.1	0.00	-	-	-	-
Volunteers for blood doner	1	5.9	0.07, 19.7	0.00	1	11.8	3.3, 27.5	0.00	-	-	-	-
Overall	40	13.3	11.2, 15.5	96.20	42	54.3	44.6, 64.0	99.38	14	17.5	12.7, 22.3	97.69

co-infection of HIV and TB, all PLWH in the time of diagnosis and subsequent visits are evaluated for active TB.

Based on the results of a study in Iran adherence to Highly active antiretroviral therapy (HAART) is between 60.0 to 70.0%, although the adherence in Iranian PLWH is acceptable [81] but, about 30.0% of these patients have not adherence to HAART, so this issue may increase the risk of coinfection with TB. On the other hand, based on the report of the World Bank the coverage of antiretroviral therapy in Iranian PLWH was increased from 2000 to 2022, this value in 2022 was 37.0% [82].

Based on the results of meta-regression analysis HCV prevalence was significantly associated with PWID and age in the crude analysis. TB prevalence was associated with gender and PWID, however, these associations were not statistically significant. In addition, we could not run the multivariable meta-regression and adjust other variables for TB prevalence, because a total number of studies that reported the TB prevalence was 12, and there was missing data regarding the proportion of PWID and male gender. Therefore, we only reported the crude estimates.

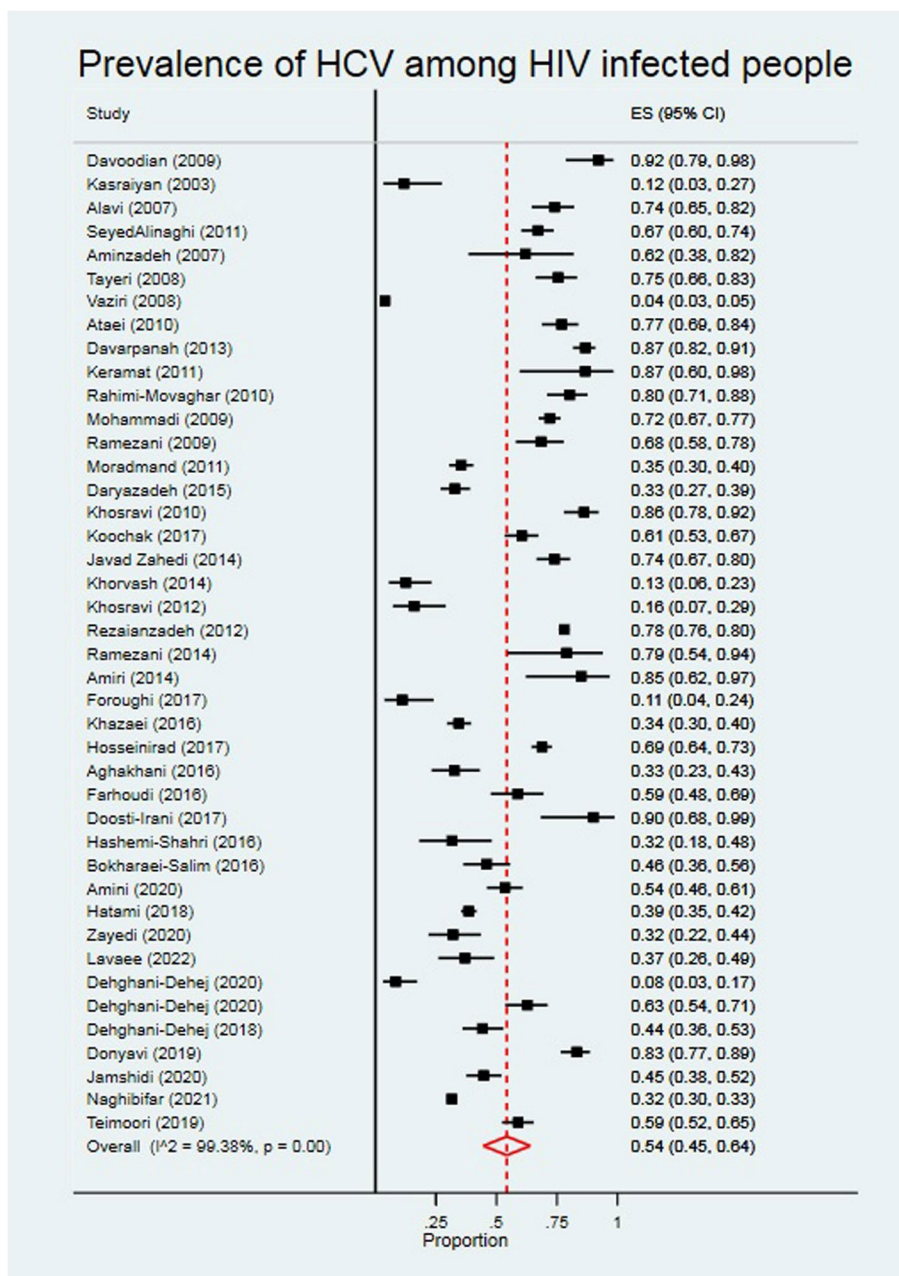


Fig. 4 The individual and pooled prevalence of HCV among people diagnosed with HIV

The strength point of current study is that we conducted a comprehensive systematic review and estimated the prevalence of HCV, HBV, and TB prevalence as three important infectious diseases among PLWH. However, our systemic review had two major limitations. First, the high heterogeneity between the findings of included studies limited us to identify the source of

heterogeneity. Last, studies with low and intermediate quality may also affected our findings.

Despite the mentioned limitations, our results may be useful in planning for better management of PLWH and treatment of HCV, HBV, and TB coinfection with HIV. In addition, these findings may be useful evidence for health policymakers' decision-making.

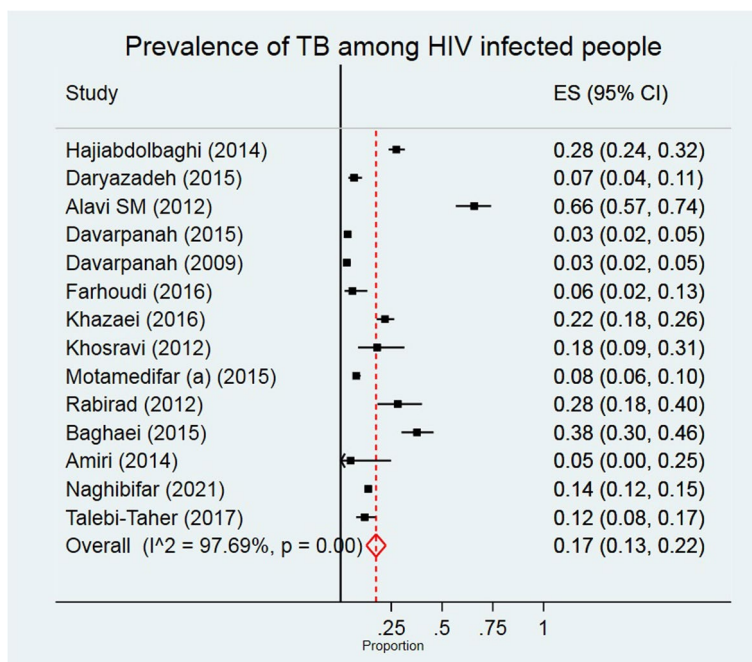


Fig. 5 The individual and pooled prevalence of TB among people diagnosed with HIV

Table 3 Crude and adjusted meta-regression to identify the source of heterogeneity

HBV						
Variables	Crude			Adjusted		
	Coeff	p-value	95% CI	Coeff	p-value	95% CI
Year of study (for every year increase)	-0.005	0.274	-0.15, 0.004	-0.008	0.468	-0.03, 0.02
Quality (for every score increase)	0.004	0.556	-0.01, 0.2	0.02	0.453	-0.04, 0.08
Mean age (for every year increase)	-0.004	0.317	-0.01, 0.004	-0.01	0.158	-0.03, 0.004
Proportion of male (for every 1% increase)	0.24	0.216	-0.14, 0.62	0.17	0.707	-0.75, 1.09
Proportion of PWID (for every 1% increase)	0.11	0.359	-0.13, 0.35	0.15	0.402	-0.21, 0.50
HCV						
Variables	Coeff	p-value	95% CI	Coefficient	p-value	95% CI
Year of study (for every year increase)	-0.01	0.168	-0.03, 0.005	-0.003	0.814	-0.03, 0.02
Quality (for every score increase)	0.004	0.716	-0.02, 0.03	-0.02	0.458	0.08, 0.04
Mean age (for every year increase)	0.01	0.021	0.002, 0.03	0.006	0.401	-0.008, 0.02
Proportion of male (for every 1% increase)	0.51	0.068	-0.04, 1.06	0.49	0.310	-0.49, 1.47
Proportion of PWID (for every 1% increase)	0.48	0.004	0.17, 0.79	0.28	0.172	-0.13, 0.68
TB						
Variables	Coeff	p-value	95% CI	-	-	-
Year of study (for every year increase)	-0.01	0.517	-0.05, 0.03	-	-	-
Quality (for every score increase)	0.007	0.623	-0.02, 0.08	-	-	-
Mean age (for every year increase)	-0.02	0.118	-0.05, 0.006	-	-	-
Proportion of male (for every 1% increase)	0.48	0.248	-0.39, 1.34	-	-	-
Proportion of PWID (for every 1% increase)	0.72	0.141	-0.37, 1.80	-	-	-

Conclusions

The results of this systematic review showed that the prevalence of HBV, HCV, and TB was high among Iranian PLWH especially higher at-risk groups such as

PWIDs and homeless people. Therefore, it seems the strength of the surveillance system is necessary for increase the screening and therapeutic activities for viral hepatitis and TB among PLWH in Iran.

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Authors' contributions

A.D.I. and B.E. conducted the database search, screening, and quality assessment. A.D.I, A.M, and E.M contributions to the analysis of data, and drafting. A.D.I, A.M, E.M, and B.E revising the article.

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Declarations**Ethics approval and consent to participate**

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Competing interests

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