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Methamphetamine use and associated factors among people who inject drugs in Iran 2020

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Abstract

Background Methamphetamine use is a pressing public health concern among people who inject drugs (PWID) worldwide. This study aimed to estimate the prevalence of methamphetamine use and its correlates in a nationwide survey among PWID in Iran in 2020.

Methods We recruited 2,684 PWID in 11 major cities from July 2019 to March 2020 using respondent-driven sampling (RDS). Participants were eligible if they were ≥ 18 years old, self-reported drug injection in the last 12 months, resided in the city of the study, and provided a valid RDS coupon. Behavioral data was collected using a standard questionnaire via face-to-face interviews. 2,259 PWID (84.2%) with valid responses to the primary outcome (i.e., methamphetamine use (either injecting or non-injection use) in the last three months) were included in the analysis. We used RDS-Gile's SS weighted analysis for descriptive statistics and a survey package (svy) using linearized variance estimations and stratification by cities for bivariable and multivariable logistic regression analyses.

Results The last 3-month prevalence of methamphetamine use among PWID was 47.0% (95% CI: 44.9, 49.1). The following factors were significantly associated with methamphetamine use in the last three months: history of homelessness in the last 12 months (aOR = 1.57; 1.77, 2.10), drug use onset before the age 18 (aOR = 1.40; 1.05, 1.87), injecting drug for more than ten years (aOR = 1.47; 1.11, 1.95), using non-injection (aOR = 7.18; 4.93, 10.47) and injecting illicit opioids (aOR = 2.98; 2.03, 4.36) in the last three months, as well as having multiple sex partners in the last 12 months (aOR = 1.60; 1.50, 2.73) and region (north: aOR = 5.42; 2.92 10.03; south: aOR = 2.95; 2.04, 4.27; east: aOR = 24.43; 15.62, 38.22).

Conclusions The frequency of methamphetamine use among PWID is considerable in Iran. Our findings underscore the importance of implementing tailored comprehensive harm reduction services for this sub-population

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of PWID. They also emphasize the urgent need for evidence-based interventions to address the harms associated with the increasing co-use of opioids and methamphetamine among PWID.

Keywords Substance Abuse, Methamphetamine, Prevalence, People Who Inject Drugs, Iran

Background

Injection drug use is a significant public health concern worldwide [1]. Global statistics show that about 16 million people worldwide inject drugs [2], with a large population of around 345,000 residing in Iran [3]. For many years, opioids have been the most prevalent traditional drugs in Iran, partly due to its long border with Afghanistan, the largest producer of illicit opioids in the world [4]. However, drug use patterns have changed dramatically in southwest Asia particularly in Afghanistan and consequently in Iran [5, 6]. According to United Nations Office on Drugs and Crime reports, seizures of methamphetamine in Afghanistan exceeded those of opium and heroin between 2019 and 2020 [6]. This surge in Afghan methamphetamine production has had a significant impact on Iran, as over 90% of the methamphetamine seized in Iran originated from Afghanistan, establishing the country as a major transit corridor for the burgeoning Afghan methamphetamine trafficking to foreign markets [6]. This flow of inexpensive Afghan methamphetamine into Iranian drug markets has led to up to 80% reduction in methamphetamine's retail street prices [7, 8]. However, the escalating methamphetamine crisis within Iran cannot be attributed solely to the price drop. Several other factors have contributed to the shift from traditional opium use to increasing methamphetamine use. Increased domestic methamphetamine production and trafficking after 2005 increased the availability of the drug, while people who used opioids turned to methamphetamine to counteract side effects like depression and poor sexual performance [9]. Moreover, a growing trend of poly-drug use emerged, where opioids and methamphetamine were used concurrently among who use illicit drugs and high-risk groups like truck drivers and bodybuilders [8].

Methamphetamine use could affect the health of people who inject drugs (PWID) through increasing injection high-risk behaviors (e.g., sharing needles/syringes) and high-risk sexual risk behaviors (e.g., having sex under the influence of drugs, having multiple partners, trading sex for drugs or money, engaging in unprotected sexual activity) [10–13]. In addition, methamphetamine has been shown to enhance Hepatitis C virus (HCV) replication in human hepatocytes, indicating its potential role in exacerbating HCV disease progression in affected individuals [14]. Furthermore, recent methamphetamine use can interfere with antiretroviral therapy (ART) effectiveness and lead to higher HIV viral loads among PWID [15, 16], likely due to its immunosuppressive effects [16]. Methamphetamine injection can also increase the risk of endocarditis, another potentially life-threatening infection affecting heart valves that occurs at higher rates among PWID [17]. In response to this public health concern and to reduce drug-related harms among PWID, several interventions have been implemented in Iran encompassing psychosocial treatment, residential rehabilitation, mutual aid, and harm reduction services [18].

While several small-scale studies have been conducted to evaluate the prevalence of methamphetamine use and associated factors among PWID in Iran [19–23], there remains a need for more large-scale and nationally representative research to further elucidate methamphetamine use patterns and risks in this population. Additional research in this area could help inform policymakers to develop appropriately targeted programs and services to meet the particular needs of this socio-economically marginalized sub-population. The current study aimed to contribute to addressing this knowledge gap by providing a snapshot of the prevalence of methamphetamine use and associated risk factors among a nationwide sample of PWID in Iran, in order to identify potential areas for service enhancement and delivery improvement.

Methods

Setting and sampling

Data were collected from the fourth national bio-behavioral surveillance survey (BBSS) among PWID in Iran from July 2019 to March 2020. Details of the study methodology have been published previously [24–26]. The survey was conducted in 11 cities representing different geographical areas. Recruitment occurred at single sites in all cities, except Tehran (the capital) which had three sites. The survey recruited 2,684 PWID using respondent-driven sampling (RDS). In the RDS recruitment method, three to five seeds in each city were selected in a non-random manner to initiate recruitment chains, while subsequent participants were recruited randomly through coupon referral to meet sample size targets. Additional seeds were recruited if the referral chains were stopped before reaching the sample size. Participants were eligible if they were over 18, self-reported drug injection in the last 12 months, resided in the surveyed city, and presented a valid referral RDS coupon, except seeds, per study methodology [27].

RDS recruitment process

Participant recruitment started with a purposeful seed selection. PWID, who had a vast network and were respected among this population, were selected as seeds in each city. Each seed participant received three referral coupons valid for three weeks. This timeframe, determined through steering committee consultations, balanced the need to allow sufficient time for coupon distribution and peer recruitment while minimizing study duration and costs. The selected seeds were trained to use them to recruit up to three peers through the coupons. The referred participants also received three RDS coupons each. This recruitment process was repeated until the target sample size was reached.

Data collection

Demographic and behavioral variables were collected by a gender-matched trained interviewer through face-to-face interviews in a private room using a standard questionnaire. The questionnaire contained questions on socio-demographic characteristics, drug use (non-injection and injection) history, sexual behaviors history, and access to harm reduction and drug use treatment services. After completing the interview, the participant underwent HIV (SD-Bioline, South Korea) and HCV rapid testing (SD-Bioline, South Korea). A confirmatory test (Unigold rapid test) was used for the participants with reactive HIV test. Pre-test and post-test counseling was conducted for all participants. They received a monetary incentive of around 2 USD in exchange for their participation and around 1 USD for each individual they successfully recruited.

Variables

The primary outcome of this study was self-reported methamphetamine use in the last three months, including both injection and non-injection forms. We asked the participants, "Have you ever used methamphetamine in the last three months?" and included those who answered this question in this study. Informed by the Rhodes risk environment framework [28, 29] and previous literature [30–33], we conceptualized several factors associated with methamphetamine use, such as demographics, substance use, sexual behavior, and the use of harm reduction services. Demographic factors include age at the time of the interview (<30, or ≥ 30), sex (male or female), education (less than high school diploma, or high school diploma and above), living with a spouse or partner (yes or no), employment status (having a full/part-time job (e.g., sex work, seasonal or day laborer, collecting plastic waste, street vending, theft, drug dealing or drug trafficking) or others (e.g., being supported by friends or spouse, friends and relatives support, charity, governmental subside, or retired), history of homelessness in the last 12 months (yes or no), and history of incarceration (yes or no). Substance use factors included age at first drug use of any type (<18 or ≥ 18 years old), duration of drug injection (<10 or ≥ 10 years), non-injection illicit opioid use in the last 12 months (yes or no), and injecting illicit opioid use in the last 12 months (yes or no). Sexual behavior factors were multiple sex partners, defined as having sex with more than one person in the last 12 months (yes or no), inconsistent condom use with a casual sex partner in the last three months (yes or no), and serological test results included HIV test results (positive or negative) and HCV test results (positive or negative). Additionally, we compared the characteristics of participants who were recruited to analysis and those who were excluded due to that they did not answer to the outcome's question.

We also compared access to harm reduction services between individuals with and without a history of methamphetamine use in the last three months. These variables included the receipt of harm reduction services, including receipt of free needles/syringes in the last 12 months (yes or no), lifetime history of HIV testing (yes or no), and lifetime history of HCV testing (yes or no). In this analysis, methamphetamine use was considered an independent variable and variables on access to harm reduction services were dependent variables.

Statistical analysis

Using RDS Analyst software, we used RDS Gile's weighted analysis to report descriptive statistics (proportion and 95% confidence intervals [CI]). To analyze the associated factors with methamphetamine use, bivariable and multivariable logistic regression analyses were conducted to calculate crude and adjusted odds ratios (cOR and aOR) through survey analysis using the *svy* package with linearized variance estimations and stratification by cities of the study in Stata software [34]. This package is designed for complex survey data and allows to provide a proper estimation of population parameters while incorporating the details of survey design. Variables with a p-value <0.2 in bivariable logistic regression were entered into the multivariable logistic regression. The model was then reduced through backward elimination. All remaining variables were significant at a p-value <0.05. We also compared the use of harm reduction services and high-risk behaviors between individuals who had used methamphetamine in the last three months and those who had not by reporting the aOR (adjusted for socio demographic and injection related variables).

Results

From 2,684 PWID, 15.8% either preferred not to answer to the question of the outcome of interest or did not recall that they used methamphetamine in the last three months or not. Consequently, their answers had been considered as missing, and they were excluded from the analysis. We have described the participants who were excluded from the analysis in supplementary A. 2,259 (84.2%) answered to the question on methamphetamine use in the last three months and were included in the analysis. The participants had a mean age of 40.1 years (standard deviation (SD): 9.3). The overwhelming majority of participants were male (96.5%, $n=2,179$), had not graduated from high school (70.1%, $n=1,578$), and were employed either full-time or part-time (85.8%, $n=1,937$) as their primary source of income. The prevalence of methamphetamine use within the last 3 months was 47.0% (95% CI: 44.9, 49.1). Most participants had a history of non-injection use ($n=816$; RDS-weighted %: 85.4), 11.0% ($n=180$) had a history of methamphetamine injection, and 3.6% ($n=66$) reported both injection and non-injection methamphetamine use. Moreover, the participants who did not recruit to the analysis were significantly older, less educated, and had an overall less high-risk sexual and drug behavior profile (Supplementary A).

Factors associated with methamphetamine use in the PWID

Based on the bivariable analysis, methamphetamine use was significantly higher among those who were 30 or older (cOR: 1.62; 95% CI: 1.24, 2.10), had less than a high school education (cOR: 1.81; 95% CI: 1.50, 2.18), were not living with a partner (cOR: 1.73; 95% CI: 1.42, 2.12), who experienced homelessness in the last 12 months (cOR: 2.52; 95% CI: 2.12, 2.99), started using drugs before the age of 18 (cOR: 1.43; 95% CI: 1.20, 1.71), injected drugs for ten years or more (cOR: 1.52; 95% CI:1.28, 1.80), had a history of non-injection opioid use in the last three months (cOR: 7.90; 95% CI: 6.36, 9.81), had a history of injecting opioids in the last three months (cOR: 5.84; 95% CI: 4.65, 7.31), and region (central: cOR: 4.47; 95% CI:3.37, 5.94; north: cOR: 4.15; 95% CI:2.94, 5.87; south: cOR: 6.96; 95% CI:5.58, 8.68; east: cOR: 26.84; 95% CI:18.51, 38.93). In terms of sexual behavior variables, methamphetamine use was significantly higher among those who had multiple sex partners in the last 12 months (cOR: 2.19; 95% CI: 1.73, 2.78), and inconsistent condom use with a casual partner in the last three months (cOR: 1.56; 95% CI: 1.30, 1.87). Moreover, among the serological variables, a positive HCV test result was significantly associated with methamphetamine use (cOR: 1.73; 95% CI: 1.43, 2.10) (Table 1).

In the multivariable logistic regression model, methamphetamine use had a significant and positive association with having history of homelessness in the last 12 months (aOR 1.57; 95% CI: 1.77, 2.10). Additionally, methamphetamine use was positively and significantly associated with initiating substance use before the age of 18 (aOR 1.40; 95% CI: 1.05, 1.87), engaging in drug injection for ≥ 10 years (aOR 1.47; 95% CI: 1.11, 1.95), non-injection opioid use within the last three months (aOR 7.18; 95% CI: 4.93, 10.47), and injecting opioids in the last three months (aOR 2.98; 95% CI: 2.03, 4.36]). Furthermore, methamphetamine use was significantly associated with some sexual behaviors, such as having multiple sexual partners within the last 12 months (aOR 1.60; 95% CI: 1.50, 2.73), and region (north: aOR = 5.42; 2.92 10.03; south: aOR = 2.95; 2.04, 4.27; east: aOR = 24.43; 15.62, 38.22) (Table 2).

Methamphetamine use and high-risk behaviors by PWID

Our results show that PWID who used methamphetamine in the last three months had higher odds of engaging in unsafe sex with a casual partner (aOR = 2.25; 95% CI: 1.79, 2.81) compared to those who did not use methamphetamine. Receptive equipment sharing in the last three months was not significantly associated with methamphetamine use (aOR = 1.09; 95% CI: 0.73, 1.64). However, receptive needle/syringe sharing in the last three months was more common among methamphetamine users than non-users (aOR = 2.01, 95% CI: 1.13, 3.60) (Table 3).

Methamphetamine use and the utilization of harm reduction service

The results demonstrated a non-significant increase in the odds of obtaining free needles/syringes (aOR = 1.14; 95% CI: 0.82, 1.58). Also, individuals with a recent history of methamphetamine use had increased odds of undergoing HIV testing (aOR = 1.66; 95% CI: 1.32, 2.09), and HCV testing (aOR = 1.10; 95% CI: 0.80, 1.50) compared to those who did not use methamphetamine (Table 3).

Discussion

This multi-central study among 2,684 PWID in Iran found that recent methamphetamine use was associated with lower education levels, recent homelessness, early initiation of drug use, and long-term injection. The study also revealed that methamphetamine use in the last three months was significantly associated with opioid use during the same period, having multiple sexual partners (last 12 months), lower likelihood of accessing harm reduction services (lifetime), and higher engagement in risky

Table 1 Characteristics of recent methamphetamine use among people who inject drugs in Iran (20192020)

Variables	N (%[a]); Total: 2259	Methamphetamine use (L3M[c]) N (%[a]); 1062 (44.9)	Crude odds ratio[b] (95% CI; *P*-value)
Individual factors			
Age (years)			
< 30 years old	270 (11.0%)	99 (42.8%)	Ref
≥ 30 years old	1973 (89.0%)	954 (48.6%)	1.62 (1.24, 2.10; < 0.001)
Sex			
Male	2179 (95.6%)	1018 (48.3%)	Ref
Female	80 (4.4%)	44 (68.2%)	1.39 (0.89, 2.18; 0.147)
Education level			
Less than high school diploma	1578 (68.9%)	811(52.5%)	1.81 (1.50, 2.18; < 0.001)
High school diploma or higher	673 (31.1%)	248 (40.6%)	Ref
Living with spouse or partner			
Yes	524 (22.6%)	193 (33.9%)	Ref
No	1724 (77.4%)	67 (53.6%)	1.73(1.42, 2.12; < 0.001)
Source of income			
Full/ part-time job	1937 (84.3%)	930 (48.7%)	1.33 (1.05, 1.69; 0.020)
others	322 (15.7%)	132 (49.8%)	Ref
Region			
Central	299 (18.6%)	146 (42.9%)	4.47 (3.37, 5.94; < 0.001)
North	183 (3.5%)	86 (43.3%)	4.15 (2.94, 5.87; < 0.001)
South	753 (50.0%)	450 (62.4%)	6.96 (5.58, 8.68; < 0.001)
East	296 (7.0%)	252 (77.5%)	26.84 (18.51, 38.93; < 0.001)
West	728 (20.9%)	128 (14.1%)	Ref
History of homelessness (L12M[d])			
Yes	957 (43.1%)	576 (67.0%)	2.52 (2.12,2.99; < 0.001)
No	1289 (56.9%)	483 (38.9%)	Ref
History of incarceration			
Yes	1484 (62.7%)	817 (57.7%)	2.59 (2.15, 3.11; < 0.001)
No	754 (37.3%)	242 (31.1%)	Ref
Substance use-related factors			
Age at first drug use (any type)			
< 18 years old	765 (35.2%)	417 (59.1%)	1.43 (1.20, 1.71; < 0.001)
≥ 18 years old	1351 (64.8%)	615 (58.3%)	Ref
Duration of injection			
< 10 years	1098 (55.7%)	474 (52.4%)	Ref
≥ 10 years	1051 (44.3%)	563 (51.2%)	1.52 (1.28,1.80; < 0.001)
Non-injection illicit opioid use (L3M[1])			
Yes	664 (37.8%)	530 (78.4%)	7.90 (6.36,9.81; < 0.001)
No	1595 (62.2%)	532 (28.2%)	Ref
Injecting illicit opioid use (L3M[1])			
Yes	542 (27.9%)	421 (77.1%)	5.84 (4.65,7.31; < 0.001)
No	1717 (72.1%)	641 (34.4%)	Ref
Injecting illicit benzodiazepine use (L3M[1])			
Yes	14 (0.7%)	13 (88.8%)	14.82 (1.93, 11.48; 0.009)
No	2245 (99.3%)	1049 (49.0%)	Ref
Injecting cocaine use (L3M[1])			
Yes	24 (0.7%)	1 (13.3%)	0.05 (0.01, 0.35; 0.003)
No	2235 (99.3%)	1061 (49.1%)	Ref

Table 1 (continued)

Variables	N (%[a]); Total: 2259	Methamphetamine use (L3M[c]) N (%[a]); 1062 (44.9)	Crude odds ratio[b] (95% CI; *P*-value)
Sexual-related factors			
Multiple sex partners (L12M[2])			
Yes	389 (21.6%)	259 (62.6%)	2.19 (1.73,2.78; < 0.001)
No	1176 (78.4%)	558 (51.0%)	Ref
Inconsistent condom use with a casual partner (L3M[c])			
Yes	629 (28.6%)	346 (56.7%)	1.56 (1.30, 1.87; < 0.001)
No	1630 (71.4%)	716 (46.1%)	Ref
Receptive needle/syringe sharing (L3M[c])			
Yes	83 (4.2%)	54 (45.9%)	2.01 (1.28, 3.15; 0.002)
No	1568 (95.8%)	741 (57.2%)	Ref
HIV test result			
Positive	70 (2.4%)	32 (3.0%)	0.95 (0.59, 1.53; 0.825)
Negative	2189 (97.6%)	1030 (97.0%)	Ref
HCV test result			
Positive	577 (24.6%)	330 (54.3%)	1.73 (1.43, 2.10; < 0.001)
Negative	1682 (75.4%)	732 (48.0%)	Ref

[a] RDS weighted

[b] Calculated based on survey analysis

[c] Last three months

[d] Last 12 months

behaviors like unsafe sexual practices and needle/syringe sharing (last three months).

Our study found a significant association between methamphetamine and opioid use within the last three months, consistent with previous research [35–38]. International studies have identified factors that may drive this co-use, such as balancing drug effects or coping with negative consequences (e.g., using opioids to reduce methamphetamine-related anxiety or using methamphetamine to counter opioid sedative effects) [38, 39]. While these patterns have been documented internationally, it is essential to gain a deeper understanding of the underlying motives for engaging in such polysubstance use practices among PWID in Iran to guide overdose prevention strategies. Regardless of the reasons behind co-using methamphetamine and opioids among PWID in Iran, the significant heterogeneity in PWID's substance use practices should be considered in substance use research and clinical practices in Iran, which frequently concentrate on single-substance usage patterns that do not align with the reality of substance use practices among PWID. Such polysubstance use behaviors can significantly increase the risk of various harms, including fatal and non-fatal overdose among PWID [40, 41]. Given the strong association between methamphetamine and opioid use, we recommend integrating treatment approaches for both substances. This could include expanding existing opioid treatment programs to address stimulant use, incorporating behavioral interventions specific to methamphetamine use within opioid treatment settings, and developing comprehensive care models that address the complex needs of individuals who use both substances [42, 43]. Such integrated approaches may improve treatment engagement and outcomes while better reflecting the reality of substance use patterns among PWID in Iran.

Methamphetamine use among PWID was significantly associated with having multiple sexual partners, which greatly increases their risk of contracting and spreading HIV and other sexually transmitted infections (STI) [44, 45]. Having multiple sexual partners aligns with prior research and can be explained by methamphetamine's stimulant effects, including increased sexual desire, libido, euphoria, confidence, delayed orgasm, and disinhibition, and may lead users to seek more sexual encounters and casual partners, particularly in social contexts where this is normalized [45, 46].

Several studies support our findings linking early injection initiation to higher methamphetamine use among PWID, likely due to behavioral (e.g., riskier substance-using practices among youth) and biological (e.g., neurological changes during adolescence) factors [47, 48]. However, the role of the length of injection is inconsistent, as some individuals transition to methamphetamine

Table 2 Multivariable analysis of factors associated with methamphetamine use among people who inject drugs in Iran (2019–2020)

Variables	Adjusted odds ratio (95% CI)	*P*-value
History of homelessness (L12M[a])		
Yes	1.57 (1.77, 2.10)	0.001
No	Ref	
Age at first drug use (any type)		
< 18 years old	1.40 (1.05, 1.87)	0.020
≥ 18 years old	Ref	
Duration of injection[ab]		
≥ 10 years	1.47 (1.11, 1.95)	< 0.001
< 10 years	Ref	
Non-injection illicit opioids use (L3M[c])		
Yes	7.18 (4.93, 10.47)	< 0.001
No	Ref	
Injecting illicit opioids use (L3M[c])		
Yes	2.98 (2.03, 4.36)	< 0.001
No	Ref	
Multiple sex partners (L12M[a])		
Yes	1.60 (1.50, 2.73)	< 0.001
No	Ref	
Region		
Central	1.15 (0.70, 1.89)	0.585
North	5.42 (2.92, 10.03)	< 0.001
South	2.95 (2.04, 4.27)	< 0.001
East	24.43 (15.62, 38.22)	< 0.001
West	Ref	

[a] Last 12 months

[b] While this variable showed collinearity with age, we retained duration of injection because it represents a more direct measure of cumulative exposure to injection-related risks and environmental vulnerabilities that can influence methamphetamine use patterns. Unlike chronological age, injection career length better captures the accumulated effects of high-risk injection environments, unsafe practices, and structural vulnerabilities that are known to shape

[c] Last three months

Table 3 The association between methamphetamine and high-risk behaviors and harm reduction services utilization

	Methamphetamine use (L3M[a]) **Adjusted odds ratio (95% CI; *P*-value)**
Variables	Yes
Unsafe sex with a casual partner (L3M[a])	2.25 (1.79, 2.81; < 0.001)[c]
Receptive equipment sharing (L3M[a])	1.09 (0.73, 1.64; 0.967)[d]
Receptive needle/syringe sharing (L3M[a])	2.01 (1.13, 3.60; 0.018)[e]
Received free needle/syringes (L12M[b])	1.14 (0.82, 1.58; 0.438)[c]
Lifetime history of HIV testing	1.66 (1.32, 2.09; 0.001)[c]
Lifetime history of HCV testing	1.10 (0.80, 1.50; 0.555)[c]

[a] Last three months

[b] Last 12 months

[c] Adjusted for socio-demographic variables (age, sex, education level, living with spouse or partner, source of income), receptive needle/syringe sharing, and receptive equipment sharing in the last three months

[d] Adjusted only for socio-demographic variables (age, sex, education level, living with spouse or partner, source of income) and receptive needle/syringe sharing

[e] Adjusted only for socio-demographic variables (age, sex, education level, living with spouse or partner, source of income) and receptive equipment sharing

after shorter periods [49]. Our findings also demonstrate a significant association between methamphetamine use in the last 3 months and higher odds of receptive needle/syringe sharing among the study population. This high-risk behavior increases the likelihood of transmission of HIV and other blood-borne infections, such as hepatitis B and C, within the community of PWID [50]. Several factors may contribute to this association. Methamphetamine use has been linked to increased impulsivity, impaired judgment, and risk-taking behaviors [51, 52], which may lead to a higher likelihood of engaging in unsafe injection practices, including sharing needles and syringes. To address this issue, targeted interventions focusing on harm reduction strategies, such as needle and syringe exchange programs, coupled with accessible drug treatment services, are essential to reduce unsafe injection practices and curb the spread of infections among PWID who use methamphetamine.

Our findings that methamphetamine use was associated with lower education levels and recent homelessness align with previous research [35, 53]. Lower education often serves as a proxy for broader socioeconomic disadvantages, including poverty and limited access to resources. The relationship between methamphetamine use and lower education may reflect economic constraints, as methamphetamine's relatively lower cost makes it more accessible. However, this association is not universal; a study in Ethiopia [54] found no educational differences between people who use methamphetamine versus other drugs. Recent homelessness can also significantly increase an individual's susceptibility to methamphetamine use. Homeless PWID may use methamphetamine to remain vigilant, protect themselves from victimization, and safeguard their personal belongings [7]. These associations suggest that upstream societal factors—including poverty, housing instability, and limited access to support services—may be more fundamental drivers of methamphetamine use than education alone [55]. Therefore, addressing upstream social determinants of health through stable housing, skill training, and improved social services could aid the prevention of methamphetamine use among socio-economically marginalized PWID.

Our study revealed considerable geographic disparities in methamphetamine use among PWID across Iran. In particular, the prevalence in the eastern region was 77.5%, compared with 14.1% in the western region. These differences may be explained by the substantial rise in methamphetamine production in neighboring Afghanistan, where seizures increased from 182 kg in 2018 to 1200 kg in 2020 [56]. Given Afghanistan's role as a key methamphetamine supplier to Iran, Turkey, and the Balkan market, provinces in eastern Iran are especially impacted by the drug's ready availability and lower price, attributable to their proximity to the Afghan border. These findings underscore the importance of region-specific public health responses, with strategies for prevention, harm reduction, and treatment carefully tailored to distinct local contexts. Recognizing these regional dynamics is crucial to inform effective policy, align resource allocation, and strengthen initiatives that mitigate methamphetamine-related harms across Iran [57].

We acknowledge the limitations of our findings. First, the cross-sectional design prevents establishing cause-and-effect relationships due to reverse causation. Second, while our RDS methodology enabled access to diverse PWID networks across multiple cities in Iran, reaching individuals often missed by conventional sampling, we acknowledge that no single sample can represent all PWID subgroups. Nevertheless, the chain-referral process, combined with RDS statistical adjustments, enhanced sample representativeness and strengthened the generalizability of our findings compared to traditional convenience sampling. Lastly, relying on self-reported data, including drug use behaviors and health service utilization, makes our study susceptible to biases such as underreporting and social desirability bias, despite efforts to mitigate them through face-to-face interviews conducted by experienced interviewers of matched genders.

Conclusion

In conclusion, this study highlights the associations between methamphetamine use, sociodemographic factors, high-risk behaviors, and health service utilization among PWID in Iran. The findings underscore the need for interventions that address individual, social, and structural determinants of methamphetamine use among PWID, emphasizing the importance of evidence-based targeted prevention, harm reduction, and treatment strategies that do not simplify their substance use practices by concentrating on their primary drug of choice.

Abbreviations

PWID	People who inject drugs
HCV	Hepatitis C virus
ART	Antiretroviral therapy
BBSS	Bio-behavioral surveillance survey
RDS	Respondent-driven sampling
CI	Confidence intervals
cOR	Crude odds ratio
aOR	Adjusted odds ratio
SD	Standard deviation
STI	Sexually transmitted infection

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s13011-025-00645-x.

Supplementary Material 1.

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Authors' contributions
HSH, SM, NG, AM, MK, and AAH conceptualized the study and developed the study conception and design. Material preparation and data collection were performed by HSH, AAH, NG, FT, SM, MP, SF, and MKH. HSH and MK supervised the study implementation and data collection. SM performed the data analysis and YM drafted the manuscript. All authors reviewed and revised the initial draft and approved the final version of the manuscript. Each author certifies that their contribution to this work meets the standards of the International Committee of Medical Journal Editors.

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Data availability
No datasets were generated or analysed during the current study.

Declarations

Ethics approval and consent to participate
The study protocol and procedures were approved by the Research Ethics Committee of Kerman University of Medical Sciences (Ethics Code: IR.KMU.REC.1397.573). The participants gave verbal informed consent and declined to answer any questions. Their refusal to participate in the study did not affect their receipt of services at the site.

Consent for publication
Not applicable.

Competing interests
The authors declare no competing interests.

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