



## Patterns of high-risk behaviors associated with HIV among male prisoners: A latent class analysis

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Received: 14 Sep 2019

Published: 29 Aug 2020

### Abstract

**Background:** Acquired Immunodeficiency Syndrome (AIDS) is one of the most important health challenges worldwide. Moreover, the prevalence of the Human Immunodeficiency Virus (HIV) infection differs among Iranian prisoners and the general population. The present study aimed to identify the patterns of HIV-related high-risk behaviors in male prisoners.

**Methods:** In this cross-sectional study, 2832 inmates were examined for HIV-related high-risk behaviors. The required data were collected using a questionnaire on high-risk behaviors, including a history of heterosexual and homosexual intercourse, and a history of drug use disorders. A Latent Class Analysis (LCA) was performed to analyze the obtained data in WinLTA software.

**Results:** Five latent classes were defined for the male prisoners, as follows: low-risk (20%), moderate-risk (23%), Injection Drug Use (IDU) (8%), heterosexual intercourse/methamphetamine use (38%), and high-risk (11%). The LCA results revealed that high-risk sexual behaviors, IDU, and sharing injection equipment in prisons significantly influence the classification. The obtained data suggested that a history of imprisonment was not frequent in class 2 (OR=1.0033, %95CI:0.9936–1.01) and class 4 members (OR=1.0053, %95CI:0.9929–1.0179). However, it was more prevalent in class 3 (OR=1.0164, %95CI:1.0068–1.0262), and 5 (OR=1.0211, %95CI:1.0129–1.0293). Heterosexual contact had the highest prevalence (75%) in this regard. The results showed that the lowest prevalence of high-risk behaviors was associated with morphine use (0.3%). Among illicit drugs, methamphetamine was the most prevalent drug (42%) in the studied subjects.

**Conclusion:** The present study indicated a high prevalence of high-risk sexual behaviors and methamphetamine use in the investigated participants. We observed the co-occurrence of HIV-related high-risk behaviors in male prisoners. Thus, providing safe sex education for prisoners is highly recommended. It is also necessary to pursue care programs about IDU as a key risk factor for HIV transmission in prisons.

**Keywords:** Latent class analysis, Male prisoners, Male non-prisoner, Human Immunodeficiency Virus (HIV)

**Conflicts of Interest:** None declared

**Funding:** None

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**Cite this article as:** Ale-Ebrahim J, Janani L, SeyedAlinaghi SA, Farhoudi B, Abbasi-Ghahramanloo A, Sajadipour M, Motevalian SA. Patterns of high-risk behaviors associated with HIV among male prisoners: A latent class analysis. *Med J Islam Repub Iran.* 2020 (29 Aug);34:109. <https://doi.org/10.34171/mjiri.34.109>

### Introduction

Prisoners are at risk of Human Immunodeficiency Virus (HIV) infection in Iran (1). Prisoners are at greater risk of

developing HIV, compared to other groups, globally. A combination of HIV, Drug Use Disorders (DUDs), and

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#### ↑What is “already known” in this topic:

In our study, the prevalence of substance abuse and some high-risk sexual behaviors were studied separately.

#### →What this article adds:

This study showed the co-occurrence of high-risk behaviors associated with HIV in prisoners.

imprisonment threatens the health of communities (2).

HIV prevalence among prisoners is higher than the general population (3). In Iran, HIV prevalence among prisoners is 8 times higher than the general population (4). Its prevalence is approximately 1% in Iranian prisons (5). The prevalence of such infections could be related to various risk factors, such as a history of imprisonment, DUDs, drug injection, tattooing, having unprotected sex, using shared injection equipment, and deficient risk perception (6-8). Prisoners living with HIV could spread the infection in the general population (9).

Tehran, the capital city of Iran, with a population of 12800000 individuals (according to the last official census in 2016) is among the most populous cities in Iran. This population is prone to various difficulties if the necessary socioeconomic and cultural conditions are disregarded. Changes in the patterns of high-risk behaviors associated with HIV in the general population, as well as the risk of imprisonment, are among these difficulties.

Latent Class Analysis (LCA) is beneficial for classifying individuals. In this method, similar individuals are categorized within each class. This analysis defines different latent classes based on special indicators. LCA has been used in various studies on DUDs and sexual behaviors (10-12). The present study aimed to evaluate HIV-related risky behaviors in male prisoners using an LCA. We also determined the effect of a history of imprisonment in different classes.

### Methods

This cross-sectional study conducted including 2832 male inmates. The investigated prisoners' data were obtained from the database of Acquired Immunodeficiency Syndrome (AIDS) Research Center of Tehran University of Medical Sciences (TUMS). Moreover, the required data were collected from November 2013 to June 2014. The study participants were selected from a previous study on the prevalence of HIV infection among male prisoners in

Tehran (13). In total, 2840 cases were selected from the 6900 prisoners using Active Case Finding (ACF) technique. After clearing the data, 2832 of 2840 cases (18- to 65-year-olds) entered in this study.

The study was conducted using a questionnaire designed based on a form commonly used in Voluntary Counseling and Testing (VCT) centers in Iran. The necessary data were collected by a questionnaire containing information on high-risk behaviors, including heterosexual and homosexual intercourse, and the history of DUDs. Ten dichotomous variables were considered to assess risk-taking behaviors related to HIV. The variables included the following: heterosexual and homosexual intercourse, a history of drug injection, as well as cannabis, opium, crack, methamphetamine, heroin, cocaine, and morphine use.

This study was approved by the ethics committee of Iran University of Medical Sciences (approval code: 2979, ethics code: IR.IUMS.REC.1397.707). All of the study participants' data were obtained anonymously to observe their confidentiality.

SPSS, Stata, and WinLTA software were implemented to achieve the pattern of high-risk behaviors. Latent class analysis is a form of modeling latent variables that defines the observed characteristics in heterogeneous populations into more homogeneous subtypes (14). The percentages of risky behaviors are presented in Table 1. Furthermore, the G<sup>2</sup>, Akaike Information Criterion (AIC), and Bayesian Information Criterion (BIC) statistics were calculated to compare classes and to select the best model (Table 2).

### Results

The mean±SD age of the study participants was 30.68±7.65 years, with an age range of 18 to 65 years. Table 1 presents the distribution of characteristics associated with high-risk behaviors among the explored inmates.

To choose the best model, an LCA was conducted from class one to seven (Table 2). Among different models,

Table 1. The frequency of prisoners with positive responses to the questions about risk-taking behaviors

Variable	No.	%	95%CI*
Heterosexual contact	1891	75	73.3–76.6
Male-Male sex	257	10.2	9.0–11.3
IDU**	781	31.0	29.1–32.9
Methamphetamine use	1076	42.7	40.7–44.6
Heroin use	760	30.1	28.3–31.9
Opium use	200	7.6	7.0–9.1
Cocaine use	12	0.5	0.2–0.8
Morphine use	7	0.3	0.1–0.5
Cannabis (Hashish) use	61	2.4	1.8–3.1
Crack (pure form of heroin) use	107	4.2	3.4–5.0

\*CI: Confidence Interval.

\*\*IDU: Injection Drug Use.

Table 2. Comparing LCA models with different latent classes based on model selection statistics

Number of latent class	Number of estimated parameters	G <sup>2</sup>	df	AIC	BIC	Entropy	Maximum log-odds
1	10	757.65	1013	777.65	837.14	1.00	-9572.25
2	21	441.16	1002	483.16	608.08	0.48	-9414.00
3	32	299.40	991	363.40	553.76	0.45	-9343.12
4	43	248.69	980	334.69	590.48	0.44	-9317.76
5	54	204.08	969	312.08	633.32	0.48	-9295.46
6	65	178.27	958	308.27	694.94	0.57	-9282.56
7	76	157.33	947	309.33	761.44	0.58	-9272.09

Table 3. The five-class latent model of risk-taking behaviors

	Latent class				
	Low-risk	Moderate-risk	IDU	Heterosexual/ methamphetamine	High-risk
Latent class prevalence	0.2046	<b>0.2282</b>	<b>0.0806</b>	<b>0.3815</b>	<b>0.1051</b>
Item-response probabilities					
Heterosexual contact	0.4957	0.6838	0.7200	0.8926	0.8440
Male-Male sex	0.0264	0.0029	0.1838	0.1192	0.3026
IDU	0.1618	0.4454	<b>0.9518</b>	0.0457	<b>0.6034</b>
Methamphetamine use	0.1377	0.4461	0.0222	<b>0.5334</b>	<b>0.6671</b>
Heroin use	0.0266	<b>0.6399</b>	0.3359	0.0889	<b>0.7499</b>
Opium use	0.2374	0.0070	0.0003	0.0391	0.1600
Cocaine use	0.0039	0.0001	0.0000	0.0000	0.0326
Morphine use	0.0079	0.0000	0.0039	0.0014	0.0000
Cannabis (Hashish) use	0.0005	0.0000	0.0000	0.0503	0.0314
Crack(pure form of heroin) use	0.0065	0.0005	0.1560	0.0138	0.2094
Covariates	Reference	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)
Age, y (p<0.001)	Reference	0.3280 (0.1404–0.7663)	0.2975 (0.1300–0.6805)	0.0319 (0.0140–0.0725)	0.6464 (0.2125–0.9660)
Prison history (p<0.001)	Reference	1.0033 (0.9936–1.0132)	1.0164 (1.0068–1.0262)	1.0053 (0.9929–1.0179)	1.0211 (1.0129–1.0293)

Note: The probability of a “No” response can be calculated by subtracting the item-response probabilities demonstrated above.

\*Item-response probabilities of >0.5 are in bold to facilitate interpretation.

based on the  $G^2$ , BIC, and AIC values, as well as the interpretability of the model, the authors should select the best one. Eventually, a 5-class model was developed as the final model. The results of the analysis of the 5-class model are presented in Table 3. The first section of this table describes the prevalence of each class. In the second part, the probability of engaging in each risk-related behavior per class was specified. These probabilities were the basis for the interpretation and labeling of classes.

The latent classes were named as follows: low risk (20%), moderate risk (23%), IDU (8%), heterosexual intercourse/methamphetamine use (38%), and high risk (11%). The smallest class belonged to class 3 (IDU) with a prevalence rate of 8% and an IDU history of approximately 100%. The largest category was class 4, with a prevalence rate of 38%. In this class, individuals were more likely to have heterosexual intercourse under the methamphetamine use effect.

The Odds Ratio (OR) indicated the odds of membership per class, compared to the low-risk (first-class) group. As per Table 3, for every year increase in age, the odds of membership in each class decreased, compared to the first class. Additionally, a history of imprisonment on the odds of membership in classes 2 and 4 was ineffective; however, it increased the odds of membership in classes 3 (IDU) and 5 (high-risk).

## Discussion

In the current study, using LCA, the patterns of high-risk behaviors associated with HIV based on observed variables were identified. Among all assessed high-risk behaviors in this study, heterosexual intercourse had the highest prevalence rate (75%).

The high prevalence of heterosexual behavior in prisoners compared to the general population has also been reported in previous studies (15-17). The lowest prevalence rate in the present study belonged to morphine use (0.3%).

Among the drugs, methamphetamine use was the most frequent substance with 42%; this finding is compatible with that of a study conducted in another country (18). Another study in Iran reported a higher prevalence rate of other substances (19) in this population. In this study, in class 1 (low-risk) with a prevalence of 20%, all HIV-associated risk factors had a very low probability. In class 2 (moderate risk) with a prevalence of 23%, having heterosexual intercourse and heroin use had the highest probability.

In class 2, although using opium, crack, cannabis, morphine, and cocaine were uncommon, but these substances were used through injection. Class 3 (IDU) data with a prevalence of 8% were compatible with those of another study (20). Class 4 had a prevalence rate of 38%, with high odds of having heterosexual contact and methamphetamine use. While some studies highlighted the co-occurrence of methamphetamine use and high-risk sexual behaviors, both of which increase the probability of HIV infection (21, 22). Class 4 had a high probability of heterosexual and methamphetamine use. Homosexual contact had a 30% probability in class 5 that is the highest rate among all latent classes.

Our results indicated that having heterosexual intercourse affected the clustering of study participants significantly. In other words, this behavior was highly prevalent in all latent classes. People Living With HIV (PLWH) are usually sexually-active and high-risk sexual behaviors are frequently reported in them (23). As a result, sexually-active prisoners who are HIV positive could significantly impact the spread of this infection.

Due to the lack of similar studies on implementing of LCA in high-risk HIV-related behaviors, considering different indicators and the lack of comparability, the findings of some of these investigations are difficult to be understood.

In a study on the acceptability of HIV testing in those exposed to high levels of HIV infection by an LCA (24), a

4-class model was proposed. Classes were as follows: low-risk ( $n=324$ , 21.6%), concurrent multiple sexual partners ( $n=346$ ; 23.0%), prisoners and substance users ( $n=293$ ; 19.5%), and having unprotected sex/with multiple sexual partners ( $n=538$ ; 35.8%). In this study, concurrent multiple sex partners were the most common practice (61%) in one class (class 2). The class 3 of the study presented high odds of alcohol and substance use; 75% of them reported cocaine or crack use, 43% reported another drug use, and 34% were exposed to HIV infection. The class 4 in the above-mentioned study was the largest class with a probability of 35%. Besides, the odds of having unprotected sex in this class were 79%, and 30% of them had 2-5 sexual partners.

A study investigated the pattern of HIV-related factors in injection drug users in Kermanshah (25). Subsequently, a 3-class model was generated as the most appropriate model in which the high-risk class had a 33% probability. In addition, in this class, a relatively high percentage (54%) of individuals used shared injection equipment, and 63% reported having unprotected sex.

In our study, a history of being in prison increased the odds of membership in the IDU class (OR=1.0053, 95%CI: 1.0068-1.0262). This finding was consistent with that of another international research (11).

As per the previous studies, the risk of sex-related high-risk behaviors and substance use among prisoners was higher than that of the general population.

In our study, data on prisoners explored in 2014 were used to facilitate the research process, as it required a long time to gather information from prisoners. The pattern of high-risk behaviors in prisoners may have varied from 2014 to 2018; thus, it cannot be demonstrated in this study. The cross-sectional nature of the current study also prevented the researchers from providing a causal interpretation of the achieved data.

### Conclusion

The obtained data suggested the co-occurrence of HIV-related high-risk behaviors in he investigated male prisoners through a 5-class model. A sexual relationship with the opposite sex in male inmates plays an essential role in classifying individuals; therefore, providing more effective education on a safe-sex is required for inmates. Despite all the efforts, injection drug use significantly impacts the classification of inmates. Accordingly, it is necessary to have IDU care programs as a key risk factor for HIV transmission.

### Acknowledgment

We would like to thank the Iranian Research Center for HIV/AIDS (IRCHA) affiliated to Tehran University of Medical Sciences (TUMS) and the prison staff, who assisted in data collection.

### Conflict of Interests

The authors declare that they have no competing interests.

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