Logistic Regression Model and Bayesian Network of Factors Related to Drug Use Tendency

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Abstract

The aim of this study is to compare the likelihood of drug use tendency among individuals in addiction rehabilitation camps and members of Narcotics Anonymous (NA) using the logistic regression model and to identify the Bayesian network model of factors associated with drug use tendency. This research follows a descriptive-correlational design using the logistic regression model and Bayesian network. The study population includes individuals who, in the second half of 2020, attended NA meetings or one of the medium-term residential treatment centers in Isfahan Province. A total of 823 questionnaires were distributed to these centers using convenience sampling, and after eliminating incomplete responses, 769 questionnaires were analyzed. Drug use tendency was assessed using the Weed and Butcher Addiction Potential Scale, which had an alpha coefficient of 0.90. The logistic regression model indicated that the likelihood of drug use tendency was lower among NA members compared to others. The accuracy of the Bayesian network model algorithm was 93.37%, demonstrating its strong predictive capability for drug use tendency.

Keywords: Drug use tendency, Narcotics Anonymous, addiction rehabilitation camps.

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1. Introduction

Crime prevention is one of the key concepts in criminological literature and holds a significant position in criminal policy (Najafi Abrandabadi, 2003). The objective of prevention is to predict, identify, and assess the risk of crime occurrence and to adopt necessary measures and actions to eliminate or reduce it. These measures were first introduced by Enrico Ferri (Najafi Abrand Abadi & Sabouyi Pour, 2004). Since 1960, Iranian legislators have incorporated crime prevention into the country's criminal policy using different and sometimes contradictory approaches (Niazpour, 2004).

Criminologists classify crime prevention from multiple perspectives. One of the most well-known classifications is Kaplan's tripartite crime prevention model, which is derived from the epidemiological theory of medicine (Yazdani, 2006). Primary

prevention includes a set of actions, policies, and programs aimed at modifying and controlling crime-inducing conditions in the physical and social environment to improve social conditions and prevent individuals from committing any type of crime. Secondary prevention focuses on interventions for at-risk groups or populations (Shoaa Kazemi, 2006). Tertiary prevention aims to intervene in the rehabilitation and correction of offenders who have committed crimes and been convicted, preventing them from reoffending. Preventive efforts at this level seek to deter criminal behavior, rehabilitate offenders, and facilitate their reintegration into society to prevent recidivism (Kaldi, 2002).

In tertiary prevention, the Welfare Organization, through its Addiction Prevention Office, seeks to treat groups of individuals suffering from substance use disorders. Members of Narcotics Anonymous (NA) participate in group meetings where they learn from each other how to live without drugs and improve the consequences of addiction. Barrier crimes are those that place individuals on the verge of committing major offenses and carry significant potential risk (Alivardi Nia, 2010). Today, barrier crimes constitute a segment of criminal law, with various manifestations. Drug addiction is one such example. Addiction is considered a major public health, psychological, and social issue and is the primary driver of high-risk behaviors (Raijian Asli et al., 2015). The responsibility for addiction treatment in the country aligns with Article 3 of the Constitution of the Islamic Republic of Iran, which emphasizes public participation in determining their political, economic, social, and cultural destiny. The participation of the general public, families, and support for civil society organizations in prevention, harm reduction, and addiction treatment has been divided between public and private sectors.

Research on the performance of rehabilitation centers and addiction treatment associations indicates that they have not been successful in treating addiction and, in some cases, have even exacerbated substance use. Approximately 50% of individuals with addiction have attempted to quit at least three times but were unsuccessful. Furthermore, 80% of self-referred patients to treatment centers relapse within six months. Between 20% and 90% of individuals undergoing treatment experience relapse (Roozen et al., 2006).

The Addiction Prevention and Treatment Office of the Welfare Organization reports that there are over two million individuals with addiction in the country, with an annual increase of 8%. The Welfare Organization also states that 90,000 individuals are added to the addicted population each year. Given the high addiction rates in many countries, combating drug abuse, prevention, and treatment of individuals with substance use disorders are top priorities (Hedayati, 2005). In tertiary prevention, efforts focus on preventing criminal behavior to rehabilitate offenders and facilitate their reintegration into society, preventing reoffending (Kaldi, 2002). Since this type of prevention occurs after the crime has taken place, it falls under the domain of clinical criminology (Eslamdoost, 2010).

There are various methods for addiction treatment, and many individuals with addiction have attempted multiple approaches. However, addiction rates remain high. Therefore, in addition to focusing on treatment methods, it is essential to consider the individual and social variables that influence addiction treatment. Consequently, it is necessary to examine the model of factors affecting drug use tendency in different addiction treatment methods and to compare the effectiveness of different rehabilitation centers and NA in reducing drug use tendency. From a methodological perspective, this study is the first to apply a data mining approach to identify valid, useful, and comprehensible patterns within the data. Previous addiction studies have typically focused on a limited number of related factors, often yielding inconsistent conclusions. The findings of this research will contribute to the existing knowledge on tertiary prevention by identifying the factors associated with drug use tendency and determining the relational model of these factors for different addiction treatment centers. Practically, the study's results can help reduce addiction-related costs, minimize associated psychological and counseling expenses, and assist policymakers and senior managers in improving the quality of treatment centers based on their specific needs.

Recently, various data mining methods such as neural networks, decision trees, Bayesian networks, and support vector machines have been employed for classification and prediction. The accuracy of the models obtained from these methods is evaluated using metrics such as sensitivity, transparency, precision, and accuracy, allowing for the comparison and selection of the most suitable model based on the data.

The present study aims to identify the best predictive and classification model using data mining techniques to examine the factors influencing drug use tendency. To achieve this, neural networks, Bayesian networks, various decision tree algorithms, and support vector machines are applied to the data. The study seeks to determine which model is most suitable for predicting

drug use tendency in authorized treatment and harm reduction centers. Additionally, it investigates whether NA membership and participation in its sessions reduce individuals' tendency toward drug use.

2. Methodology

The population of this study consists of individuals who were undergoing treatment at Narcotics Anonymous (NA) or at one of the medium-term residential treatment centers (addiction rehabilitation camps) in Isfahan Province during the second half of 2020. The objective of this research is to compare the performance of Narcotics Anonymous with other centers. In a preliminary phase, 50 questionnaires were completed by members of NA and by individuals enrolled in addiction rehabilitation camps. The mean drug use tendency in the first group was 50.54 with a standard deviation of 7.74, and in the second group, it was 48.88 with a standard deviation of 3.22. These descriptive findings were entered into G*Power under the section for calculating sample size for comparing the means of two groups. With a 95% confidence level and 0.05 error rate, the required sample size was determined to be 748 participants. Considering a 5% non-response or invalid-response rate, 785 questionnaires were distributed using convenience sampling. After coordinating with the administrators of these centers, a number of questionnaires were provided to them, which they, in turn, gave to individuals who visited the centers. Once completed, the questionnaires were returned to the researchers. In the end, after discarding invalid questionnaires and those with more than 30% missing data, 769 questionnaires were deemed suitable for analysis. Missing data in these questionnaires were replaced using the multiple imputation method in the “mice” package (v3.5.3).

For measuring drug use tendency, the Addiction Potential Scale developed by Weed and Butcher (1992) was utilized. The Iranian version of the Addiction Potential Scale was created by Zargar (2006) (). In a criterion validity assessment, this questionnaire effectively distinguished between addicted and non-addicted groups. Construct validity of the scale was determined by correlating it with a 25-item scale of clinical symptoms (r = 0.45), which was statistically significant. The reliability of the scale, measured by Cronbach’s alpha, was 0.90, indicating a favorable reliability level. In this study, factors influencing drug use tendency were first identified from the literature and then quantified using a questionnaire. Subsequently, the relational model of these factors was determined via Bayesian network, neural network, support vector machine, and various decision tree algorithms in SPSS Modeler (Clementine). The predictive power of these models in anticipating drug use tendency among individuals attending authorized addiction treatment centers and NA was then compared. The variables examined were collected in five sections using a questionnaire. The first section covered personal information, including gender, age, educational level, father’s and mother’s educational level, father’s and mother’s occupation, the individual’s occupation, marital status, income, place of residence, and housing status. The second section concerned information about the first instance of substance use, including the first substance used, age at first use, parents’ marital status at the time of first use, marital status at first use, occupational status at first use, the person who first suggested substance use, and family reactions upon discovering substance use. The third section focused on current substance use, including the substance being used, duration of substance involvement, cigarette smoking, family history of addiction, and having friends who are addicted. The fourth section included membership in NA, regular attendance at a center, adherence to therapeutic recommendations, center inefficiency, follow-up by the treatment team, type of addiction treatment center (NA or a camp), number of quit attempts, length of abstinence, and the person who referred the individual to the center. The fifth section included individual, family, spousal, social, economic, and cultural factors that prompt a person toward substance use. The sixth section featured the 41-item scale measuring drug use tendency on a Likert-type scale.

3. Findings

A total of 769 individuals who attended addiction rehabilitation camps in Isfahan Province or were members of addiction recovery associations participated in this study. Of these, 23 were female and 746 were male, with 503 participants (65.4%) showing a low tendency toward drug use and 266 (34.6%) showing a high tendency. Among the participants, 202 were members of NA, while 567 were visitors to the province’s addiction rehabilitation camps. The mean age of NA members was 35.9 years with a standard deviation of 10.47, and the mean age of camp visitors was 33.67 with a standard deviation of 7.97.

Approximately 33% of NA members and 35% of camp visitors demonstrated a high tendency toward drug use. Around 52% of individuals currently residing in short-term residential centers for addiction treatment were also members of NA.

In this study, a Bayesian network was used to explore potential relationships among variables, and logistic regression was employed to predict the likelihood of drug use tendency based on the variables in the study. The Bayesian approach is a powerful graphical method for modeling data that can handle both quantitative and qualitative variables. Its accuracy compared to other data mining and statistical methods was investigated in the studies by McNeil and Wending (2007), indicating that Bayesian networks can compete with other approaches {Kiani, 2012 #128601}{McNeil, 2007 #128603}. Bayesian networks are well-suited for representing probabilistic relationships among a large number of variables. Jensen (1996) defines a Bayesian network as comprising three elements: a node (variable), a directed edge (connecting two nodes), and a probability distribution table for each variable. If two variables are connected by a single edge, it suggests a probable relationship. The node preceding another node is called the "parent" node, while the subsequent node is termed the "child" node {Ramazanian, 2012 #128608}.

Logistic regression is used when the dependent variable is binary or multinomial, and the independent variables can be of any type (Antonojeirges, Panagiotaks, Pezrftis, & Tzuno, 2009). Advantages of using a logistic regression model, beyond modeling observations, include the ability to predict the probability that an individual belongs to one of the levels of the dependent variable and to directly calculate the odds ratio from the model coefficients (Sedehi, Mehrabi, Kazemnejad, & Hadaegh, 2009).

A logistic regression model was fitted to the data. In logistic regression, the Cox and Snell R^2 and the Nagelkerke R^2 are analogous to the R^2 index in ordinary regression. These values were 0.579 and 0.824, respectively, indicating that the variables in the 24th step explained approximately 82% of the variance in drug use tendency, confirming a suitable model fit. The classification accuracy, or the percentage of correctly classified observations, was 94.8% for non-tendency to use drugs and 89.5% for tendency to use drugs.

Gender, father's occupation, mother's educational level, marital status, the individual's occupation, income level, place of residence, housing status, age at first substance use, the person who first suggested substance use, family reactions, the substance used, duration of substance involvement, membership in NA, number of quit attempts, the longest abstinence period, spousal and family factors, social factors, and cultural factors significantly influenced drug use tendency.

Men were more likely than women to have a tendency toward drug use. Individuals whose fathers were unemployed had a higher tendency than those whose fathers held other occupations. According to the exp(B) column, those whose fathers were employed as office workers had only 0.13 times the likelihood of a drug use tendency compared to those with unemployed fathers. As maternal educational level rose, drug use tendency decreased. Participants whose mothers had an elementary or middle school education were about three times more likely to tend toward drug use compared to those whose mothers had higher education. Individuals in a marital relationship had only 0.009 times the tendency to use drugs compared to those on the verge of divorce. Unemployed individuals exhibited a higher likelihood of drug use than those in other occupations. As income increased, the likelihood of drug use decreased. Those living in their own homes had only 0.172 times the likelihood of drug use compared to those in rental housing. Employed individuals had a higher likelihood of drug use compared to the unemployed. A lower age at first drug use correlated with an increased drug use tendency. Individuals whose parents were still married had 0.022 times the likelihood of drug use compared to those whose parents were divorced. Receiving the first suggestion to try drugs from friends increased the probability of a drug use tendency more than receiving the suggestion from others. Among individuals who faced parental guidance and were referred to treatment centers by their families, the likelihood of drug use was much lower than among those who experienced violence, conflict, or aggression from their families. The longer a person has been involved with drug use, the higher their likelihood of a drug use tendency. Those who visited treatment centers more often exhibited a higher tendency than those who visited fewer times. Individuals with a longer period of abstinence were less prone to drug use tendency. Family and spousal factors, along with social and cultural factors, significantly influenced drug use tendency.

This research found no significant difference in drug use tendency between those who were NA members and those who visited addiction rehabilitation camps, because 50% of the individuals who attended the camps were also NA members. However, the significance test of NA membership showed that the likelihood of a drug use tendency among NA members was 0.019 times that of non-members.

Table 1. Variables in the Equation

Variable	B	S.E.	Wald	df	Sig.	Exp(B)
Gender(1)	-7.199	2.587	7.747	1	.005	.001
Age	5.896	3	.117			
Age(1)	.225	1.081	.043	1	.835	1.253
Age(2)	1.248	.966	1.669	1	.196	3.484
Age(3)	.072	.996	.005	1	.943	1.074
Educational level	4.922	4	.295			
Educational level(1)	-.665	1.540	.187	1	.666	.514
Educational level(2)	.501	.963	.271	1	.603	1.651
Educational level(3)	1.289	.954	1.825	1	.177	3.630
Educational level(4)	-.398	1.198	.110	1	.740	.671
Father’s educational level	9.426	4	.051			
Father’s educational level(1)	-.346	.830	.174	1	.677	.707
Father’s educational level(2)	-1.599	.801	3.986	1	.046	.202
Father’s educational level(3)	-.892	.952	.879	1	.348	.410
Father’s educational level(4)	-2.347	.845	7.715	1	.005	.096
Father’s occupation	25.520	6	.000			
Father’s occupation(1)	-3.716	1.337	7.725	1	.005	.024
Father’s occupation(2)	-3.014	1.984	2.308	1	.129	.049
Father’s occupation(3)	-8.590	3.452	6.191	1	.013	.000
Father’s occupation(4)	-6.298	1.841	11.702	1	.001	.002
Father’s occupation(5)	-7.917	1.889	17.563	1	.000	.000
Father’s occupation(6)	-6.098	1.649	13.670	1	.000	.002
Mother’s educational level	17.009	4	.002			
Mother’s educational level(1)	1.648	1.819	.821	1	.365	5.199
Mother’s educational level(2)	1.349	.651	4.295	1	.038	3.853
Mother’s educational level(3)	-1.645	.788	4.353	1	.037	.193
Mother’s educational level(4)	-1.506	1.425	1.117	1	.290	.222
Mother’s occupation	12.745	6	.047			
Mother’s occupation(1)	2.559	1.306	3.841	1	.050	12.926
Mother’s occupation(2)	1.727	1.486	1.350	1	.245	5.623
Mother’s occupation(3)	.958	1.300	.543	1	.461	2.606
Mother’s occupation(4)	1.179	1.445	.665	1	.415	3.250
Mother’s occupation(5)	-1.137	1.644	.478	1	.489	.321
Mother’s occupation(6)	1.184	1.591	.554	1	.457	3.267
Marital status	19.406	4	.001			
Marital status(1)	-4.812	1.190	16.360	1	.000	.008
Marital status(2)	-4.674	1.172	15.900	1	.000	.009
Marital status(3)	-9.982	3.862	6.681	1	.010	.000
Marital status(4)	-5.312	1.532	12.018	1	.001	.005
Occupation	23.511	7	.001			
Occupation(1)	-4.382	1.108	15.650	1	.000	.013
Occupation(2)	-2.360	.979	5.817	1	.016	.094
Occupation(3)	-3.756	1.690	4.940	1	.026	.023
Occupation(4)	-.286	1.477	.038	1	.846	.751
Occupation(5)	-2.423	.866	7.835	1	.005	.089
Occupation(6)	-2.921	3.069	.906	1	.341	.054
Occupation(7)	1.241	1.886	.433	1	.510	3.460
Income level	17.517	4	.002			
Income level(1)	2.118	.992	4.556	1	.033	8.318
Income level(2)	1.579	1.062	2.210	1	.137	4.851
Income level(3)	.726	.982	.547	1	.460	2.067
Income level(4)	3.998	1.124	12.639	1	.000	54.472

Place of residence	32.198	9	.000			
Place of residence(1)	-5.068	1.427	12.604	1	.000	.006
Place of residence(2)	.540	1.225	.194	1	.659	1.716
Place of residence(3)	-.582	1.623	.129	1	.720	.559
Place of residence(4)	1.642	1.667	.970	1	.325	5.165
Place of residence(5)	.122	1.304	.009	1	.925	1.130
Place of residence(6)	1.776	1.488	1.424	1	.233	5.905
Place of residence(7)	-.990	2.970	.111	1	.739	.372
Place of residence(8)	2.821	1.785	2.498	1	.114	16.798
Place of residence(9)	-.365	1.967	.034	1	.853	.694
Housing status(1)	-1.761	.586	9.022	1	.003	.172
First substance used	10.593	6	.102			
First substance used(1)	.032	1.057	.001	1	.976	1.032
First substance used(2)	.405	1.042	.151	1	.697	1.499
First substance used(3)	1.494	2.457	.370	1	.543	4.456
First substance used(4)	2.499	1.146	4.750	1	.029	12.168
First substance used(5)	-.213	1.312	.026	1	.871	.808
First substance used(6)	1.561	1.671	.873	1	.350	4.766
Age at first use	9.271	3	.026			
Age at first use(1)	-.840	1.282	.429	1	.512	.432
Age at first use(2)	2.056	1.028	3.999	1	.046	7.814
Age at first use(3)	1.629	.990	2.708	1	.100	5.098
Parents' marital status	27.570	4	.000			
Parents' marital status(1)	-3.818	1.708	4.997	1	.025	.022
Parents' marital status(2)	-4.248	1.875	5.134	1	.023	.014
Parents' marital status(3)	-.135	2.167	.004	1	.950	.874
Parents' marital status(4)	.263	1.836	.021	1	.886	1.301
Marital status at first use	2.294	3	.514			
Marital status at first use(1)	-2.016	3.769	.286	1	.593	.133
Marital status at first use(2)	-1.497	3.743	.160	1	.689	.224
Marital status at first use(3)	.272	4.213	.004	1	.949	1.312
Occupational status at first use	14.157	7	.048			
Occupational status at first use(1)	24.063	11878.840	.000	1	.998	28205348810.000
Occupational status at first use(2)	23.410	11878.840	.000	1	.998	14676873820.000
Occupational status at first use(3)	25.476	11878.840	.000	1	.998	115892455600.000
Occupational status at first use(4)	21.585	11878.840	.000	1	.999	2366263459.000
Occupational status at first use(5)	25.676	11878.840	.000	1	.998	141545124800.000
Occupational status at first use(6)	22.214	11878.840	.000	1	.999	4438316392.000
Occupational status at first use(7)	33.098	11878.849	.000	1	.998	236651783300000.000
First suggestion to use	18.136	4	.001			
First suggestion to use(1)	-2.598	.672	14.948	1	.000	.074
First suggestion to use(2)	-2.379	1.286	3.423	1	.064	.093
First suggestion to use(3)	-3.229	1.488	4.711	1	.030	.040
First suggestion to use(4)	-.166	.806	.042	1	.837	.847
Family reaction	22.964	6	.001			
Family reaction(1)	3.514	1.539	5.213	1	.022	33.594
Family reaction(2)	3.053	1.622	3.540	1	.060	21.171
Family reaction(3)	4.506	1.795	6.298	1	.012	90.534
Family reaction(4)	5.195	1.610	10.417	1	.001	180.384
Family reaction(5)	4.006	1.658	5.837	1	.016	54.908
Family reaction(6)	.606	1.517	.160	1	.689	1.834
Substance used	17.937	6	.006			
Substance used(1)	1.982	1.941	1.042	1	.307	7.256
Substance used(2)	-.550	.968	.323	1	.570	.577
Substance used(3)	1.701	1.282	1.762	1	.184	5.481
Substance used(4)	.625	1.133	.305	1	.581	1.869
Substance used(5)	4.375	1.613	7.359	1	.007	79.480
Substance used(6)	-1.010	.888	1.295	1	.255	.364
Duration of involvement	28.018	6	.000			
Duration of involvement(1)	-5.502	1.328	17.155	1	.000	.004
Duration of involvement(2)	-4.828	1.241	15.130	1	.000	.008

Duration of involvement(3)	-5.682	1.402	16.418	1	.000	.003
Duration of involvement(4)	-4.554	1.385	10.816	1	.001	.011
Duration of involvement(5)	-2.578	1.364	3.573	1	.059	.076
Duration of involvement(6)	-5.586	1.486	14.123	1	.000	.004
Cigarette smoking(1)	.253	.613	.170	1	.680	1.288
Family history of addiction(1)	.339	.501	.457	1	.499	1.403
Addicted friend(1)	.528	.532	.987	1	.320	1.696
NA membership(1)	-1.731	.737	5.509	1	.019	.177
Regular attendance(1)	.399	.497	.646	1	.422	1.491
Following recommendations(1)	.292	.513	.323	1	.570	1.339
Ineffectiveness(1)	.143	.519	.076	1	.783	1.154
Treatment team follow-up(1)	-.013	.656	.000	1	.984	.987
Center(1)	-1.007	.586	2.956	1	.086	.365
Number of quit attempts	16.215	4	.003			
Number of quit attempts(1)	-2.412	.937	6.626	1	.010	.090
Number of quit attempts(2)	-1.907	.963	3.916	1	.048	.149
Number of quit attempts(3)	.290	1.014	.082	1	.775	1.336
Number of quit attempts(4)	1.070	1.144	.875	1	.350	2.916
Longest abstinence period	14.372	4	.006			
Longest abstinence period(1)	.459	1.007	.208	1	.649	1.582
Longest abstinence period(2)	2.029	1.042	3.793	1	.051	7.608
Longest abstinence period(3)	1.981	1.168	2.873	1	.090	7.247
Longest abstinence period(4)	2.871	1.066	7.260	1	.007	17.663
Referral to the center	2.896	4	.575			
Referral to the center(1)	-.614	1.767	.121	1	.728	.541
Referral to the center(2)	-.306	1.895	.026	1	.872	.737
Referral to the center(3)	-.433	1.848	.055	1	.815	.649
Referral to the center(4)	-1.901	1.888	1.014	1	.314	.149
Individual factors	13.778	7	.055			
Individual factors(1)	18.850	40192.970	.000	1	1.000	153634010.400
Individual factors(2)	-17.932	18711.429	.000	1	.999	.000
Individual factors(3)	3.156	2.237	1.991	1	.158	23.476
Individual factors(4)	-.057	1.667	.001	1	.973	.945
Individual factors(5)	3.258	1.341	5.901	1	.015	25.994
Individual factors(6)	-.296	1.219	.059	1	.808	.743
Individual factors(7)	.848	1.168	.528	1	.468	2.335
Spousal family factors	35.475	7	.000			
Spousal family factors(1)	-2.563	1.887	1.846	1	.174	.077
Spousal family factors(2)	5.448	2.713	4.033	1	.045	232.275
Spousal family factors(3)	-.526	1.853	.080	1	.777	.591
Spousal family factors(4)	-2.777	2.038	1.856	1	.173	.062
Spousal family factors(5)	3.058	1.030	8.808	1	.003	21.276
Spousal family factors(6)	-2.256	.697	10.472	1	.001	.105
Spousal family factors(7)	-2.808	.746	14.159	1	.000	.060
Family factors	17.575	5	.004			
Family factors(1)	-36.490	48406.926	.000	1	.999	.000
Family factors(2)	25.595	13698.505	.000	1	.999	130571474600.000
Family factors(3)	2.473	1.242	3.966	1	.046	11.858
Family factors(4)	-3.636	1.172	9.631	1	.002	.026
Family factors(5)	-.300	.715	.176	1	.675	.741
Social factors	15.628	6	.016			
Social factors(1)	-15.006	15481.408	.000	1	.999	.000
Social factors(2)	-3.554	2.292	2.404	1	.121	.029
Social factors(3)	3.631	1.524	5.674	1	.017	37.745
Social factors(4)	-.330	1.137	.084	1	.772	.719
Social factors(5)	1.517	1.013	2.240	1	.135	4.557
Social factors(6)	.234	.883	.070	1	.791	1.263
Economic factors	9.256	4	.055			
Economic factors(2)	-6.255	3.124	4.009	1	.045	.002
Economic factors(3)	2.109	2.895	.531	1	.466	8.243
Economic factors(4)	1.508	1.100	1.879	1	.170	4.519

Economic factors(5)	-.982	.692	2.015	1	.156	.374
Cultural factors	27.507	2	.000			
Cultural factors(1)	-4.398	.888	24.545	1	.000	.012
Cultural factors(2)	-.829	.617	1.806	1	.179	.437
Constant	-8.445	11878.842	.000	1	.999	.000

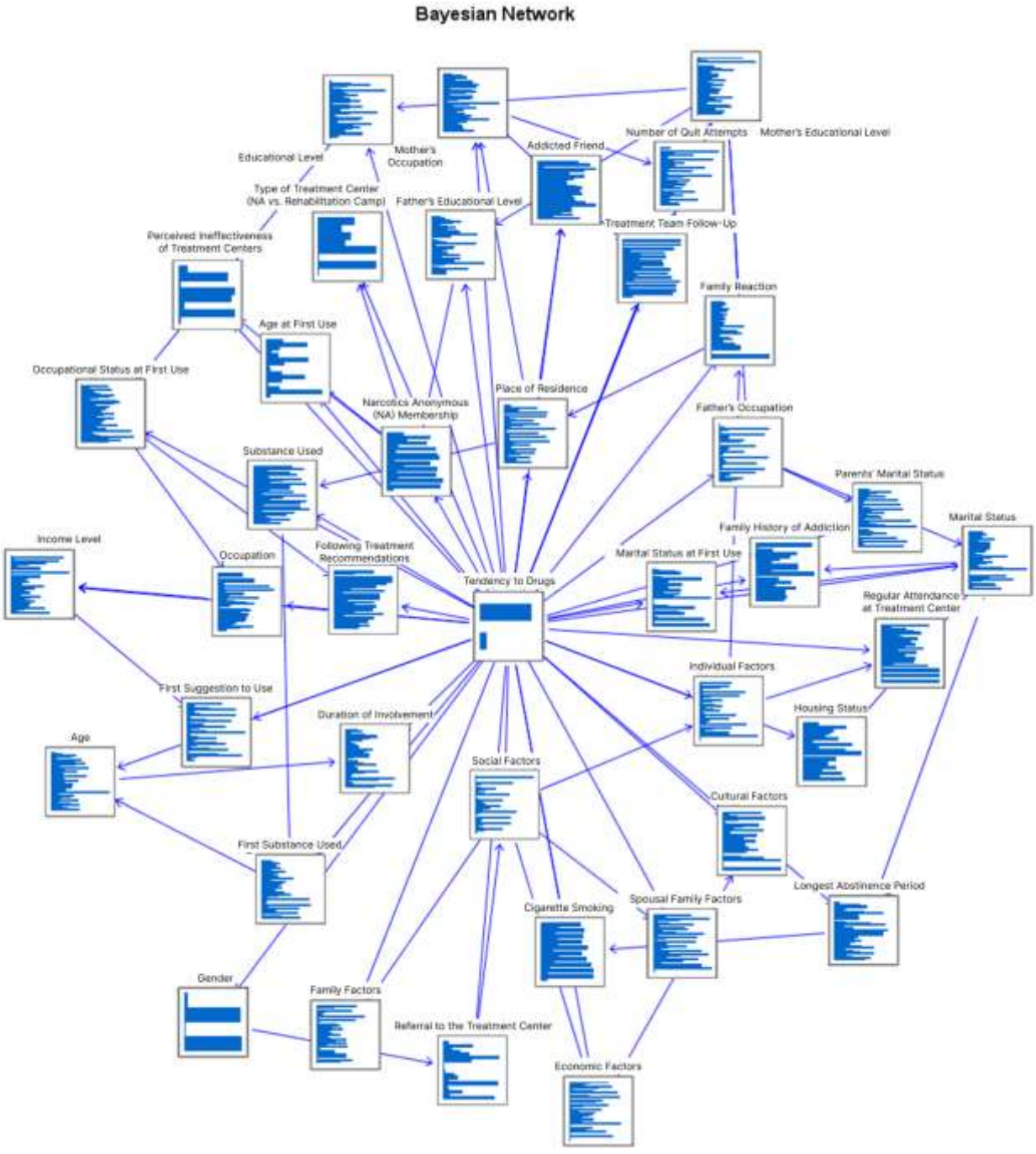

Figure 1. Bayesian Network

The Bayesian network chart fitted to the data is shown in the figure. This network has an accuracy of 93.37%, indicating a suitable fit with the data. Another way to evaluate the models is by using the Receiver Operating Characteristic (ROC) curve. Algorithm performance is usually assessed through sensitivity or detection indicators, but the ROC curve combines both to

show them as one curve. Essentially, the ROC curve plots the true positive rate against the false positive rate. By calculating the area under the curve (AUC), a quantitative indicator of model performance is obtained. This index ranges from 0 to 1, where values closer to 1 indicate a better model. Moreover, this index is used to calculate the Gini coefficient, which is twice the area under the ROC curve up to the diagonal. The Gini index of 0.934 and the AUC of 0.967 further confirm that the model fits the data well.

In Table 2, the conditional probability of drug use tendency for these factors is presented. The Bayesian network model reveals that the most influential variables on drug use tendency, in order of importance, are income level, occupation, economic factors, substance used, spousal family factors, cultural factors, mother's educational level, father's occupation, social factors, and individual factors.

Social factors were categorized into six levels. The highest probability of drug use tendency, at social factors level 5, occurs when individuals are compelled by their workplace or by arrest to attend treatment centers. The highest conditional probability of drug use tendency for individual factors is 0.81 at level 5 of individual factors, given level 5 of social factors. Those with more cultural problems (level 6) and fewer economic problems (level 2) have a 0.72 probability of drug use. The greatest drug use tendency for more severe spousal family problems happens when there are also greater social problems. Individuals whose current and initial occupations (at first substance use) are both driving show the highest likelihood of drug use. Those with low income who are also unemployed have the highest probability of drug use, at 0.83. If mothers hold a bachelor's degree or above and, upon discovering their children's substance use, guide them and refer them to treatment centers, the probability of non-tendency toward drugs is 0.79. Individuals whose fathers are laborers and whose mothers have a high school or diploma-level education have an 0.85 probability of drug use. The highest probability of drug use (0.78) is associated with heroin or sourche, conditional upon living in Shahreza, Dehaqan, or Podeh.

Table 2. Conditional Probability of Drug Use Tendency

Child Node	Parent Node	Highest Probability Level of Parent Node	Highest Probability Level of Child Node	Probability of Drug Use Tendency
Social Factors	Referral to Center	Workplace or Police Station	Level 5	0.64
Individual Factors	Social Factors	Level 2	Level 5	0.81
Cultural Factors	Economic Factors	Level 6	Level 2	0.72
Economic Factors	Social Factors	Level 2	Level 4	0.71
Spousal Family Factors	Social Factors	Level 6	Level 8	0.58
Occupation	Job Status at First Use	Driver	Driver	0.56
Income Level	Occupation	Unemployed	Below Minimum Wage	0.83
Mother's Education	Family Reaction	Guidance & Referral to Treatment Centers	Bachelor's & Above	0.79 (Non-Tendency)
Father's Occupation	Mother's Education	High School & Diploma	Laborer	0.85
Substance Used	Place of Residence	Heroin & Sourche	Shahreza, Dehaqan, Podeh	0.78

4. Discussion and Conclusion

Drug addiction is one of the examples of barrier crimes. Addiction is considered a major health, psychological, and social problem and the most significant factor contributing to high-risk behaviors. The tendency toward drug use and addiction is among the most critical issues of the present era. Due to the nature of this variable, the complexity of individual and social factors affecting it, and the various statistical methods used, researchers encounter multiple challenges. The study of delinquency from a sociological perspective seeks to understand the characteristics of criminogenic environments and compare them with non-criminogenic environments to identify the conditions and factors that lead individuals toward delinquency. This is one of the core themes of criminal sociology.

In this study, the logistic regression model demonstrated an acceptable predictive accuracy, showing that the variables of gender, father's occupation, mother's educational level, marital status, individual occupation, income level, place of residence, housing status, age at first use, the person who first suggested drug use, family reaction, type of substance used, duration of drug involvement, membership in Narcotics Anonymous (NA), number of quit attempts, longest abstinence period, spousal

family factors, family factors, social factors, and cultural factors all have significant effects on drug use tendency. Additionally, the Bayesian network model indicated that income level, occupation, and economic factors are the three most important variables influencing drug use tendency. A group of criminologists supporting the socialist school of thought considers the economy as the foundation of society and regards other social factors such as family, politics, law, crime, and morality as consequences of economic factors. They believe that the unjust distribution of wealth and social inequality lead to behavioral disorders and deviations, some of which manifest as criminal acts (Najafi Tavana, 2011).

Psychologists and sociologists alike agree that a disordered, unstable, and fragmented family plays an active role in leading individuals toward maladjustment and deviance. In some societies, despite the fulfillment of many basic needs, high living standards, proper healthcare, and adequate welfare facilities, behavioral disorders and deviance remain concerning. It appears that the root cause of behavioral deviation in such societies should be sought in cultural components, the erosion of moral values, the weakening of relationships, and the instability of fundamental family principles. Today, one of the most important tools for cultural development is mass media. The use of mass communication technologies for education and training, fostering correct cultural beliefs, intellectual growth, and moral development of a society's population can be highly effective. From a criminological perspective, mass media is of significant importance due to its unique influence on the development of personality and social norms, especially among children and adolescents, making it a highly impactful factor.

Individual factors refer to the set of characteristics related to the biological and psychological traits of a person. Kinberg defines individual factors as a set of reactive tendencies that exist at a specific moment in reality. These tendencies may be hereditary or acquired. Regarding individual factors, it is important to note that while an individual may be biologically predisposed to illness or criminal behavior, they will not necessarily commit a crime unless influenced by their social environment and existing factors, which direct them toward criminality.

The individual is the product of both individual and social factors. Many psychological characteristics are acquired and do not have biological or psychological roots; rather, they develop under the influence of educational, cultural, economic, and familial conditions surrounding the person. The Canadian criminologist Zabo, after extensive research on delinquency, emphasized the role of social factors so much that he referred to society as a "delinquency factory."

Eslamdoust (2010) categorizes the causes of drug addiction into three groups: individual risk factors, environmental risk factors, and social risk factors. Individual risk factors include hereditary predisposition, adolescence, personality traits, psychological disorders, aggression, positive attitudes toward drugs, and exposure to risky situations. Environmental and interpersonal risk factors include family influences, peer influence, school-related factors, and neighborhood conditions. Social risk factors include laws, the drug market, drug use as a social norm, lack of cultural, sports, and recreational facilities, and inadequate access to support, counseling, and treatment services. The meta-analysis by Safari Hajat Aghai and colleagues (2014) assessed the effect size of individual factors on addiction relapse as moderate and the effect of environmental factors as high (Safar Hajat Aghaei et al., 2014). Yusefi and colleagues (2010) demonstrated that factors such as having addicted parents or friends, lack of faith, lack of awareness, living in a high-risk neighborhood, unemployment, low self-confidence, and curiosity had the most significant influence on individuals' tendency toward drug use (Yousefi & Khaledin, 2012).

In this study, the probability of drug use tendency among members of Narcotics Anonymous was approximately 0.2, compared to individuals who were not members. As Razaghi (2003) demonstrated, there is a correlation between the continuous participation of addicts in NA meetings and their duration of sobriety. The more an addict participates and engages in NA activities, the longer their period of abstinence becomes (Razaghi, 2003). Hedayati (2005) examined the protective personal characteristics against addiction relapse among NA members in Shiraz (Hedayati, 2005).

One of the limitations of this study is that crime and delinquency are human phenomena influenced by individual and social conditions and are constantly changing. This makes it difficult to predict future events or provide definitive conclusions. Human behavior is influenced by environmental conditions, upbringing, personal characteristics, and social interactions, leading to inconsistent reactions. Therefore, when studying the causes of drug use tendency, it is impossible to claim absolute or definitive results.

Ethical Considerations

All procedures performed in this study were under the ethical standards.

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Conflict of Interest

The authors report no conflict of interest.

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