

Original Article

Factors influencing the consumption of tobacco, alcohol, and psychoactive substances using machine learning

DOI: 10.5377/alerta.v8i3.20719

Xochitl Sandoval López¹, David A. Tejada^{2*}

1. National Institute of Health, San Salvador, El Salvador.

2. National Health Observatory, National Institute of Health, San Salvador, El Salvador.

*Correspondence

✉ david.tejada@salud.com

1.  0000-0002-0988-1313

2.  0000-0003-2502-1433

Abstract

Introduction. Addiction to psychoactive substances is a global challenge that impacts physical, mental, and emotional health, generating significant social and economic consequences influenced by individual, psychological, family, and social factors. **Objective.** Analyze the sociodemographic and mental health factors that influence dependence on alcohol, tobacco, and psychoactive substances in El Salvador. **Methodology.** A cross-sectional analytical study was conducted using data from the 2022 National Mental Health Survey. All participants were included and categorized according to their risk of tobacco, alcohol, or psychoactive substance use. Descriptive and inferential statistical analyses were performed, along with correlation, clustering, and logistic regression analyses. The programs used were RStudio 4.3.2 and QGIS 3.34.3. **Results.** The national rate of high tobacco use was 0.36%, alcohol use was 0.5 %, and moderate use of psychoactive substances was 3.2 %. There was a strong correlation between high alcohol use and moderate tobacco use (0.96), tobacco use and moderate substance use (0.93), and moderate alcohol use and moderate substance use (0.90). In the multivariate model, being female, having resilience, and having a partner are protective factors, while living in an urban area, anxiety and depression are risk factors for substance use. **Conclusion.** Geographical environment impacts substance use and is associated with mental health problems, and the use of one substance correlates with the use of additional substances.

Keywords

Substance-Related Disorders, Tobacco Use Disorder, Alcoholism, Risk Factors, Mental Health.

Resumen

Introducción. Las adicciones a sustancias psicoactivas son un desafío global que impacta la salud física, mental y emocional, generando consecuencias sociales y económicas significativas, influenciadas por factores individuales, psicológicos, familiares y sociales. **Objetivo.** analizar los factores sociodemográficos y de salud mental que influyen en la dependencia al alcohol, tabaco y sustancias psicoactivas en El Salvador. **Metodología.** Se realizó un estudio transversal analítico con datos de la Encuesta Nacional de Salud Mental, 2022. Se incluyó a todos los participantes y se categorizaron según el riesgo de consumo de tabaco, alcohol o sustancias psicoactivas. Se realizaron análisis estadísticos descriptivos e inferenciales, así como análisis de correlación, *clustering* y regresión logística. Los programas utilizados fueron RStudio 4.3.2 y QGIS 3.34.3. **Resultados.** La tasa nacional de consumo alto de tabaco fue 0,36 %, de alcohol 0,5 %, y de consumo moderado de sustancias psicoactivas 3,2 %. Hubo una fuerte correlación entre el consumo alto de alcohol y el moderado de tabaco (0,96), el consumo de tabaco y moderado de sustancias (0,93), y el moderado de alcohol y moderado de sustancias (0,90). En el modelo multivariado, ser mujer, tener resiliencia y pareja son protectores, mientras que vivir en área urbana, la ansiedad y la depresión son riesgos para el consumo de sustancias. **Conclusión.** El entorno geográfico impacta el consumo de sustancias, el consumo está asociado a problemas de salud mental y el uso de una sustancia se correlaciona con el consumo de otras adicionales.

Palabras clave

Trastornos Relacionados con Sustancias, Tabaquismo, Alcoholismo, Factores de Riesgo, Salud Mental.



OPEN ACCESS

Factores que influyen en el consumo de tabaco, alcohol y sustancias psicoactivas mediante machine learning

Suggested citation:

Sandoval López X, Tejada DA. Factors influencing the consumption of tobacco, alcohol, and psychoactive substances using machine learning. 2025;8(3):245-257. DOI: 10.5377/alerta.v8i3.20719

Editor:

Hazel García.

Received:

September 19, 2024.

Accepted:

June 24, 2025.

Published:

July 31, 2025.

Author contribution:

XSL¹, DAT²: study conception, manuscript design, literature search, data collection, data or software management, data analysis, writing, revising and editing.

Conflicts of interest:

No conflicts of interest.

Introduction

Addiction to psychoactive substances is a global challenge that affects the physical, mental, and emotional health of millions of people

around the world.ⁱ This phenomenon not only has individual consequences but also generates a significant social and economic impact, contributing to increased criminality, family dissolution, and overloaded health systems.ⁱ

According to the World Health Organization (WHO), in the year 2022, approximately 275 million people consumed some type of drug, and more than 36 million presented consumption-related disorders. In the same year, in Latin America and the Caribbean, at least 4.4 million men and 1.2 million women suffered from drug use disorders.ⁱⁱ

By 2020, 22.3 % of the world's population was using tobacco.ⁱⁱⁱ By 2021, it was estimated that 7 % of the world's population (400 million) suffered from tobacco use disorders, while 3.7 % (209 million) had alcohol dependence.^{iv}

Addiction to psychoactive substances, including alcohol and tobacco, is a multifactorial phenomenon involving genetic, biological, psychological, social, and environmental aspects.^v These elements may vary according to the culture and context of each region. In El Salvador, scientific evidence on the causality of the phenomenon is limited, which prevents a complete understanding of the particular factors that determine the problem in this population.

In this context, the National Mental Health Survey of El Salvador (ENSM) provides important data on the prevalence of mental disorders and the use of psychoactive substances in different demographic groups. The use of advanced statistical techniques, computational methods, and machine learning models allows a deeper and more accurate analysis of these data, contributing to the identification of addressing knowledge gaps in the population of El Salvador.

Therefore, the objective of the research was to analyze the sociodemographic and mental health factors that influence dependence on alcohol, tobacco, and psychoactive substances in El Salvador using machine learning techniques. This will allow a deeper understanding of the problem and contribute to the design of more effective interventions to address this issue in El Salvador.

Methodology

An analytical cross-sectional study was conducted using secondary data from the ENSM. This survey was conducted by the Ministry of Health of El Salvador through the National Institute of Health. It was designed to obtain nationally representative information on mental health problems in the population from three years of age. For this purpose, specific questionnaires were administered to children (aged three to 12 years), adolescents (aged 13 to 17 years), adults (aged 18 years or older), and older adults (aged 60 years or older). These questionnaires were validated and reviewed by

psychologists and psychiatrists. Data collection took place between August and November 2022, involving 11 269 participants.^{vi}

The study To assess living conditions, the following operational definitions were constructed. Unsatisfied Basic Needs (UBN) were defined as the lack of an individual or household in at least one of the following aspects: access to housing, access to health services, access to education, and economic capacity. Access to housing was evaluated based on the criteria outlined in "The method of unsatisfied basic needs and its applications in Latin America" by the Economic Commission for Latin America and the Caribbean (ECLAC), specifically focusing on the variables of overcrowding and housing quality. Housing was considered inadequate if it had a dirt floor, dirt walls, roofs made of natural fibers such as straw or palm leaves, or was constructed from waste materials. Overcrowding was defined as three or more people sharing the same room.

Access to sanitation was assessed according to the type of excreta disposal system and the availability of basic services. Access to education was measured by the attendance of school-age children to educational institutions. Economic capacity was analyzed in terms of the probability of insufficient income, taking into account the age, educational level, household size, and employment status of household members. To classify the risk of substance use, the WHO screening test for alcohol, tobacco, and substance use (ASSIST) was used.

For continuous variables, the Anderson-Darling normality test was performed (p -value < 0.05), and the median was used, along with interquartile ranges (IQR). Additionally, frequency tables were constructed, including percentages, 95 % confidence intervals, and p -values for differences in proportions.

El Salvador is politically divided into five regions, which in turn are subdivided into 14 departments categorized by age group, sex, and place of origin. The Mann-Whitney U test was used to compare the medians between the groups based on sex and urban or rural origin. Similarly, the Kruskal-Wallis test was used to assess the differences among groups based on region, department, and educational level. To analyze differences in proportions, the Chi-square test was applied. To identify specific differences between more than two groups or measures, the Bonferroni correction was used.

To construct the logistic regression model, a correlation matrix was generated, and a cut-off point between -0.7 and 0.7 was established to include the variables in the model. The balance of the model was eva-

lated by analyzing the outcome variables and comparing the proportions of positive and negative consumption risk records using distribution plots. In addition, the Chi-square test was applied to verify whether there were significant differences in the distribution of the outcome variable.

To address the class imbalance, the over-sampling method was employed using the "ROSE" package in RStudio and the "ovun.sample" function with the "over" method to increase the number of minority class samples and balance the training data.

Binomial logistic regression with machine learning was performed using a 77 % training set and a 23 % test set for smoking, as well as a 75 % training set and a 25 % test set for alcohol and psychoactive substance use.

The effect of confounding variables was controlled by stratification and covariate adjustment techniques in the model. The goodness of fit of the model was determined using likelihood ratio, Wald, ROC curve, and confusion matrix tests. For the geospatial analysis, specific rates were calculated by department and type of substance and represented in a choropleth map at the departmental level, stratified through a clustering analysis.

For data processing and analysis, RStudio version 4.3.2 was used. For geospatial analysis, QGIS version 3.34.3 was used, with the WGS 1984/EPSSG: 4326 coordinate system.

The research was carried out in accordance with good clinical practice. The database was coded to maintain the confidentiality of the participants, and the study protocol was approved by the INS ethics committee under registration CEINS/2024/005.

Results

Demographics

A total of 7260 adults were analyzed, 55.4 % of whom were from rural areas, $p < 0.01$. The median age of the population was 45 years (IQR = 31-61), with a minimum age of 18 years and a maximum of 97 years, $p < 0.01$. The median age of males was 47 years (IQR = 31-63), and of females was 44 years (IQR = 31-60), $p < 0.001$.

According to their origin, the median age of people from urban areas was 48 years (IQR = 34-64), while those from rural areas was 43 years (IQR = 30-59), $p < 1$. Regarding the regions, the metropolitan area had the highest median age at 48 years (IQR = 33-64), while the lowest was observed in the eastern region at 43 years (IQR = 30-60), $p < 0.001$. Post-hoc comparisons showed differences between the metropolitan region and the western, eastern, and paracentral regions.

The paracentral region had the highest proportion of the rural population (66.5 %), while by the department, it was La Unión (78.8 %), $p < 0.001$. In contrast, San Salvador had the highest proportion of urban population (77.8 %), $p < 0.001$. San Miguel showed no differences in the origin of the participants ($p < 0.599$).

Of the participants, 69.9 % were women ($p < 0.001$). The paracentral and western regions showed the highest proportions of women, with 71.9 % and 71.5 %, respectively ($p < 0.001$). At the departmental level, the highest proportions of women were found in Cabañas (74 %), Sonsonate (73.3 %), and La Paz (72.4 %), $p < 0.01$.

Sociodeographic, psychological, and smoking variables

94.1 % of the population presented a low level of risk of tobacco use, while 5.7 % presented a moderate risk and 0.2 % a high risk. The metropolitan region had an 8 % moderate risk, and the urban area had a 6.5 % moderate risk, $p < 0.001$. In terms of age group, the group aged 20 to 29 years had the highest percentage of moderate risk (7.1 %) and was second in high risk (0.4 %). The group younger than 20 years had the highest proportion of high-risk (0.5 %). According to sex, men had the highest proportions of moderate (14.7 %) and high (0.7 %) risk compared to women (1.8 and 0 % respectively), $p < 0.001$.

People with a mental health diagnosis showed a higher percentage of moderate (8.2 %) and high (0.4 %) risk compared to those without a diagnosis, $p < 0.01$. Anxiety and its different degrees showed a significant association with tobacco use, observing that as the degree of anxiety increases, consumption differences also increase ($p < 0.001$).

General stress status showed no significant differences ($p = 0.617$), general post-traumatic stress disorder (PTSD) ($p = 0.003$), and PTSD severity scale ($p < 0.001$) showed significant differences. Persons with suicidal ideation and behavior had higher percentages of moderate risk in tobacco use (8.7 % and 18.1 %, respectively), $p < 0.001$. People with depression and its degrees also showed differences in tobacco use ($p = 0.012$ and $p = 0.008$, respectively) (Table 1).

Sociodeographic, psychological, and alcohol variables

96.9 % of the participants had a low level of risk in alcohol consumption, while 2.9 % had a moderate risk and 0.3 % had a high risk. The metropolitan region had 3.9 % moderate risk, followed by the western and

paracentral regions with 3 % and 2.8 %, respectively, showing significant differences in moderate risk ($p < 0.001$) but not in high risk ($p = 0.334$).

The urban area registered 3.3 % moderate risk and 0.3 % high risk, with significant differences in moderate risk ($p < 0.001$) but no differences in high risk ($p = 0.627$). Male sex presented higher moderate (7.5 %) and high (0.7 %) consumption compared to the female sex, with 0.9 % and 0.1 %, respectively, $p < 0.001$.

The younger than 20 years groups and 20-29 years showed a higher moderate risk, with 4.5 % and 3.6 %, respectively, with significant differences in both moderate and high risk, $p < 0.001$. Significant differences were also found between mental health diagnosis and moderate risk of alcohol use, as well as having experienced discrimination ($p < 0.01$). In addition, PTSD, depression, and anxiety showed significant differences with moderate and high-risk levels of alcohol consumption ($p < 0.01$) (Table 2).

Sociodemographic and psychological variables of psychoactive substance use

96.8 % of the participants presented a low risk of psychoactive substance use, while 3.2 % showed a moderate risk. Only one person was classified as high risk. This was a 44-year-old woman, originally from Santa Ana, with high consumption of sedatives, negative thoughts, low resilience, stressful situations due to her illness, depression, and a violent situation. The metropolitan region had the highest percentage of moderate consumption (5.2 %), followed by the paracentral region (3.7 %) and the central region (3.5 %), with a significant difference ($p < 0.001$). Urban areas also had higher moderate consumption (3.7 %), with those under 20 years, 20-29 years, and 40-49 years showing the highest levels of moderate consumption, at 5.5 %, 3.6 %, and 3.8 %, respectively.

Men had a higher moderate risk of psychoactive substance use (5.7 %) compared to women (2.2 %), $p < 0.001$. Persons who are divorced (6.5 %) and single (4.4 %) showed higher moderate use compared to those with a partner ($p < 0.001$).

People with a mental health diagnosis had a higher risk of moderate consumption (9.0 %) compared to those without a diagnosis (3.0 %), $p < 0.001$. Likewise, those who reported negative thoughts presented a higher moderate risk (4.3 %) compared to those who did not (3.0 %), $p < 0.001$. Those with low and moderate levels of resilience showed higher rates of moderate use (3.8 %

and 3.1 %, respectively) compared to those with high resilience (2.6 %), $p < 0.001$. Significant statistical differences were found between levels of depression and anxiety and psychoactive substance use ($p < 0.01$), as well as among people with suicidal ideation and behavior ($p < 0.001$) (Tabla 3).

Rates per 100 000 population of tobacco, alcohol, and psychoactive substance use

Regarding the risk of tobacco use, the national rate of moderate risk of tobacco use was 9.4 %. Cabañas had the highest rate, with 13.9 %, followed by San Vicente (13.4 %) and Santa Ana (13.3 %). For high risk, the national rate was 0.36 %, with San Vicente (2.5 %) and Cabañas (2.1 %) being the departments with the highest rates.

Regarding alcohol consumption, the national rate for moderate risk was 4.7 %. San Vicente had the highest rate, with 8.4 %, followed by Chalatenango (7.7 %) and Morazán (7.2 %). For high risk, the national rate was 5.3 %, with Cabañas (2.1 %) and Sonsonate (1.2 %) showing the highest rates per department.

Regarding the use of psychoactive substances, the national rate for moderate risk was 5.3 %. San Vicente had the highest rate, with 10.9 %, followed by Cabañas (9.6 %) and La Paz (8.6 %).

Clustering analysis

In the K-means clustering model applied to the standardized rates of smoking (high and moderate), alcohol consumption (high and moderate), and psychoactive substance use (moderate) in the different departments, three clusters were defined. The high-risk cluster included San Salvador, while the moderate-risk cluster grouped the departments of San Miguel, Santa Ana, Sonsonate, and La Libertad (Figure 1).

Correlation analysis

A strong correlation was observed between high alcohol consumption and moderate tobacco consumption (0.96). A high correlation was also found between moderate tobacco consumption and moderate consumption of psychoactive substances (0.93). In addition, there was a significant correlation between moderate alcohol consumption and moderate consumption of psychoactive substances (0.90), as well as between high tobacco consumption and moderate consumption of psychoactive substances (0.88).

Table 1. Distribution of tobacco use by psychological and mental health factors.

Variable	Category	Level of risk									Total	%	**p value
		Low	%	IC 95 %	Moderate	%	IC 95 %	High	%	IC 95 %			
Mental health diagnosis	Yes	244	91,4	(88,0-94,8)	22	8,2	(4,9-11,5)	1	0,4	(-0,4-1,1)	267	3,7	<0,01
	No	6481	94,3	(93,7-94,8)	380	5,5	(5,0-6,1)	15	0,2	(0,1-0,3)	6876	94,7	<0,01
	No data	106	90,6	(85,3-95,9)	11	9,4	(4,1-14,7)	0	0	(0,0-0,0)	117	1,6	<0,01
Negative thinking	Yes	1073	93,5	(92,1-94,9)	71	6,2	(4,8-7,6)	3	0,3	(0,0-0,6)	1147	15,8	<0,01
	No	5758	94,2	(93,5-94,9)	342	5,6	(5,0-6,2)	13	0,2	(0,1-0,3)	6113	84,2	<0,01
Discrimination	Yes	1043	93,0	(91,5-94,5)	74	6,6	(5,2-8,0)	5	0,4	(0,1-0,7)	1122	15,5	<0,01
	No	5788	94,3	(93,6-95,0)	339	5,5	(4,9-6,1)	11	0,2	(0,1-0,3)	6138	84,5	<0,01
Stress by COVID-19	Yes	6502	94,3	(93,6 , 95,0)	394	5,5	(4,9 , 6,1)	12	0,2	(0,1 , 0,3)	6908	95,2	<0,01
	No	329	19,0	(16,0 , 22,0)	19	1,0	(0,5 , 1,5)	4	1,1	(0,1-2,1)	352	4,8	<0,01
COVID-19 stress levels	No	329	93,5	(90,6-96,4)	19	5,4	(3,1-7,7)	4	1,1	(0,1-2,1)	352	4,8	<0,01
	Very low	2970	93,8	(92,9-94,7)	189	6,0	(5,2-6,8)	7	0,2	(0,1-0,3)	3166	43,6	<0,01
	Low	2971	94,3	(93,4-95,2)	173	5,5	(4,7-6,3)	5	0,2	(0,0-0,3)	3149	43,4	<0,01
	Moderate	532	94,5	(92,4-96,6)	31	5,5	(3,6-7,4)	0	0	-	563	7,8	<0,01
	High	29	96,7	(91,3-100,0)	1	3,3	(0,0-9,7)	0	0	-	30	0,4	<0,01
Resilience	Low	1436	94,6	(93,2-96,0)	76	5,0	(3,9-6,1)	6	0,4	(0,1-0,7)	1518	20,9	<0,01
	Moderate	4795	94,1	(93,3-94,9)	291	5,7	(5,1-6,3)	10	0,2	(0,1-0,3)	5096	70,2	<0,01
	High	600	92,9	(90,6-95,2)	46	7,1	(5,2-9,0)	0	0	-	646	8,9	<0,01
Stressful situation	Yes	2593	93,8	(92,8-94,8)	163	5,9	(5,0-6,8)	9	0,3	(0,1-0,5)	2765	38,1	<0,01
	No	4238	94,3	(93,5-95,1)	250	5,6	(4,9-6,3)	7	0,2	(0,1-0,3)	4495	61,9	<0,01
PTSD*	Yes	411	92,8	(90,0-95,6)	30	6,8	(4,4-9,2)	2	0,5	(0,0-1,2)	443	6,1	<0,01
	No	6420	94,2	(93,6-94,8)	383	5,6	(5,1-6,1)	14	0,2	(0,1-0,3)	6817	93,9	<0,01
PTSD* Grades	No	6420	94,2	(93,6-94,8)	383	5,6	(5,1-6,1)	14	0,2	(0,1-0,3)	6817	93,9	<0,01
	Mild-moderate	343	93,2	(90,6-95,8)	23	6,3	(3,8-8,8)	2	0,5	(0,0-1,2)	368	5,1	<0,01
	Moderate-severe	64	91,4	(84,6-98,2)	6	8,6	(2,0-15,2)	0	0	-	70	1,0	<0,01
	Severe-extreme	4	80,0	(44,9-115,1)	1	20,0	(0,0-55,1)	0	0	-	5	0,1	<0,01
Depression	Yes	4355	93,8	(93,1 , 94,5)	277	6,0	(5,3 , 6,6)	13	0,3	(0,1 , 0,4)	4645	64,0	<0,01
	No	2476	94,7	(93,8 , 95,5)	136	5,2	(4,3 , 6,1)	3	0,1	(0,0 , 0,2)	2615	36,0	<0,01
Degrees of depression	No	2476	94,7	(93,7-95,5)	136	5,2	(4,4-6,1)	3	0,1	(0,0-0,3)	2615	36,0	<0,01
	Minimum	2801	93,8	(92,7-94,7)	177	5,9	(5,2-6,8)	7	0,2	(0,1-0,5)	2985	41,1	<0,01
	Slight	1230	93,9	(92,5-95,1)	75	5,7	(4,6-7,1)	5	0,4	(0,1-0,9)	1310	18,0	<0,01
	Moderate	236	93,7	(89,8-96,3)	16	6,3	(3,7-10,2)	0	0	(0,0-1,5)	252	3,5	<0,01
	Moderately severe	59	90,8	(80,7-96,5)	5	7,7	(2,6-17,0)	1	1,5	(0,0-8,3)	65	0,9	<0,01
	Severe	29	87,9	(70,8-96,0)	4	12,1	(4,0-29,2)	0	0	(0,0-10,5)	33	0,5	<0,01
Anxiety	Yes	1318	93,3	(91,8-94,5)	90	6,4	(5,2-7,8)	5	0,4	(0,1- 0,9)	1413	19,5	<0,01
	No	5513	94,3	(93,5-94,9)	323	5,5	(5,0-6,1)	11	0,2	(0,1-0,3)	5847	80,5	<0,01
Degrees of anxiety	No	5513	94,3	(93,5-94,9)	323	5,5	(5,0-6,1)	11	0,2	(0,1-0,3)	5847	80,5	<0,01
	Slight	1081	93,3	(91,6-94,7)	74	6,4	(5,1-7,9)	4	0,3	(0,1-0,8)	1159	16,0	<0,01
	Moderate	181	94,8	(90,4-97,4)	10	5,2	(2,6-9,6)	0	0	(0,0-1,9)	191	2,6	<0,01
	Severe	56	88,9	(77,8-95,8)	6	9,5	(3,6-19,6)	1	1,6	(0,0-8,6)	63	0,9	<0,01
Suicidal ideation	Yes	451	90,9	(87,8-93,3)	43	8,7	(6,4-11,5)	2	0,4	(0,1-1,4)	496	6,8	<0,01
	No	6380	94,3	(93,6-94,9)	370	5,5	(5,0-6,0)	14	0,2	(0,1-0,4)	6764	93,2	<0,01
Suicidal behavior	yes	86	81,9	(73,0-88,4)	19	18,1	(11,6-27,0)	0	0	(0,0-3,4)	105	1,4	<0,01
	No	6745	94,3	(93,6-94,9)	394	5,5	(5,0-6,0)	16	0,2	(0,1-0,4)	7155	98,6	<0,01
Total	-	6831	94,1	(93,3-94,7)	413	5,7	(5,2-6,2)	16	0,2	(0,1-0,4)	7260	100	-

*PTSD: Post-traumatic stress disorder.

** P-value of difference of proportions of risk level.

Table 2. Distribution of alcohol consumption by psychological and mental health factors.

Variable	Category	Level of risk									Total	%	**p-value
		Low	%	IC 95 %	Moderate	%	IC 95 %	High	%	IC 95 %			
Mental health diagnosis	Yes	254	95,1	(91,6-97,2)	13	4,9	(2,8-8,4)	0	0,0	-	267	3,7	<0,001
	No	6664	96,9	(96,4-97,3)	192	2,8	(2,4-3,2)	20	0,3	(0,3-0,4)	6876	94,7	<0,001
	No data	115	98,3	(93,5-99,5)	2	1,7	(0,5-6,5)	0	0	-	117	1,6	<0,001
Negative thinking	Yes	1109	96,7	(95,4-97,6)	31	2,7	(1,9-3,8)	7	0,6	(0,3-1,3)	1147	15,8	<0,001
	No	5924	96,9	(96,4-97,3)	176	2,9	(2,5-3,3)	13	0,2	(0,2-0,4)	6113	84,2	<0,001
Discrimination	Sí	1068	95,2	(93,6-96,4)	48	4,3	(3,2-5,6)	6	0,5	(0,2-0,9)	1122	15,5	<0,001
	No	5965	97,2	(96,6-97,6)	159	2,6	(2,2-3,0)	14	0,2	(0,3-0,5)	6138	84,5	<0,001
Stress by COVID-19	Yes	6692	96,9	(96,4-97,3)	197	2,9	(2,5-3,3)	19	0,3	(0,3-0,4)	6908	95,2	<0,001
	No	341	96,9	(94,0-98,2)	10	2,8	(1,5-5,1)	1	0,3	(0,0-1,0)	352	4,8	<0,001
COVID-19 stress levels	No	341	96,9	(94,0-98,2)	10	2,8	(1,5-5,1)	1	0,3	(0,0-1,0)	352	4,8	<0,001
	Very low	3064	96,8	(96,0-97,4)	95	3,0	(2,4-3,6)	7	0,2	(0,3-0,7)	3166	43,6	<0,001
	Bajo	3055	97,0	(96,2-97,6)	84	2,7	(2,1-3,3)	10	0,3	(0,5-1,0)	3149	43,4	<0,001
	Moderate	543	96,4	(94,5-97,6)	18	3,2	(2,0-5,0)	2	0,4	(0,1-1,1)	563	7,8	<0,001
	High	30	100,0	(88,4-100)	0	0,0	-	0	0	-	30	0,4	<0,001
Resilience	Low	1471	96,9	(95,7-97,7)	43	2,8	(2,1-3,8)	4	0,3	(0,1-0,7)	1518	20,9	<0,001
	Moderate	4934	96,8	(96,1-97,3)	147	2,9	(2,5-3,3)	15	0,3	(0,2-0,5)	5096	70,2	<0,001
	High	628	97,2	(95,4-98,2)	17	2,6	(1,6-4,1)	1	0,2	(0,0-1,0)	646	8,9	<0,001
Stressful situation	Yes	2662	96,3	(95,4-97,0)	91	3,3	(2,7-4,0)	12	0,4	(0,2-0,7)	2765	38,1	<0,001
	No	4371	97,2	(96,5-97,7)	116	2,6	(2,1-3,1)	8	0,2	(0,1-0,4)	4495	61,9	<0,001
PTSD*	Yes	415	93,7	(90,7-95,6)	21	4,7	(3,1-7,1)	7	1,6	(0,7-3,3)	443	6,1	<0,001
	No	6618	97,1	(96,6-97,5)	186	2,7	(2,4-3,1)	13	0,2	(0,1-0,3)	6817	93,9	<0,001
PTSD* Grades	No	6618	97,1	(96,6-97,5)	186	2,7	(2,4-3,1)	13	0,2	(0,1-0,3)	6817	93,9	<0,001
	Mild-moderate	345	93,8	(90,6-95,9)	17	4,6	(2,8-7,3)	6	1,6	(0,6-3,5)	368	5,1	<0,001
	Moderate-severe	67	95,7	(87,8-98,5)	2	2,9	(0,7-9,9)	1	1,4	(0,2-7,7)	70	1,0	<0,001
	Severe-extreme	3	60,0	(17,1-92,7)	2	40,0	(7,3-82,9)	0	0	-	5	0,1	<0,001
Depression	Yes	4482	96,5	(95,7-97,1)	146	3,1	(2,7-3,7)	17	0,4	(0,2-0,6)	4645	64,0	<0,001
	No	2551	97,6	(96,8-98,1)	61	2,3	(1,8-3,0)	3	0,1	(0,0-0,3)	2615	36,0	<0,001
Degrees of depression	No	2551	97,6	(96,8-98,1)	61	2,3	(1,8-3,0)	3	0,1	(0,0-0,3)	2615	36,0	<0,001
	Minimum	2893	96,9	(96,1-97,5)	85	2,8	(2,3-3,5)	7	0,2	(0,1-0,5)	2985	41,1	<0,001
	Slight	1259	96,1	(94,8-97,1)	46	3,5	(2,6-4,6)	5	0,4	(0,1-0,9)	1310	18,0	<0,001
	Moderate	239	94,8	(91,2-97,0)	9	3,6	(1,8-6,6)	4	1,6	(0,5-4,0)	252	3,5	<0,001
	Moderately severe	63	96,9	(89,3-99,2)	2	3,1	(0,8-10,7)	0	0	-	65	0,9	<0,001
	Severe	28	84,8	(68,1-93,8)	4	12,1	(4,8-26,6)	1	3,0	(0,5-14,9)	33	0,5	<0,001
Anxiety	Yes	1352	95,7	(94,4-96,7)	51	3,6	(2,7-4,7)	10	0,7	(0,4-1,2)	1413	19,5	<0,001
	No	5681	97,2	(96,6-97,6)	156	2,7	(2,3-3,1)	10	0,2	(0,1-0,3)	5847	80,5	<0,001
Degrees of anxiety	No	5681	97,2	(96,6-97,6)	156	2,7	(2,3-3,1)	10	0,2	(0,1-0,3)	5847	80,5	<0,001
	Slight	1113	96,0	(94,5-97,1)	38	3,3	(2,4-4,5)	8	0,7	(0,3-1,3)	1159	16,0	<0,001
	Moderate	182	95,3	(91,0-97,7)	8	4,2	(2,0-8,2)	1	0,5	(0,1-2,8)	191	2,6	<0,001
	Severe	57	90,5	(80,0-95,9)	5	7,9	(3,3-17,6)	1	1,6	(0,3-8,4)	63	0,9	<0,001
Suicidal ideation	Yes	459	92,5	(89,7-94,5)	31	6,3	(4,4-8,8)	6	1,2	(0,5-2,6)	496	6,8	<0,001
	No	6574	97,2	(96,7-97,6)	176	2,6	(2,3-3,0)	14	0,2	(0,1-0,3)	6764	93,2	<0,001
Suicidal behavior	Yes	94	89,5	(82,0-94,1)	10	9,5	(5,2-16,8)	1	1,0	(0,2-5,4)	105	1,4	<0,001
	No	6939	97,0	(96,5-97,4)	197	2,8	(2,4-3,1)	19	0,3	(0,2-0,4)	7155	98,6	<0,001
Total	-	7033	96,9	(96,5-97,2)	207	2,9	(2,5-3,3)	20	0,3	(0,2-0,4)	7260	100	<0,001

*PTSD: Post-traumatic stress disorder.

** P-value of difference of proportions of risk level.

Table 3. Distribution of psychoactive substance use by psychological and mental health factors.

Variable	Category	Level of risk						Total	%	**p-value
		Low	%	IC 95 %	Moderate	%	IC 95 %			
Mental health diagnosis	Yes	243	91,0	[86,9 - 93,8]	24	9,0	[6,2 - 13,1]	267	3,7	<0,001
	No	6670	97,0	[96,5 - 97,4]	205	3,0	[2,6 - 3,5]	6875	94,7	<0,001
	No data	113	96,6	[91,5 - 98,6]	4	3,4	[1,4 - 8,5]	117	1,6	<0,001
Negative thinking	Yes	1098	95,7	[94,4 - 96,7]	48	4,3	[3,3 - 5,6]	1146	15,8	<0,001
	No	5928	97,0	(96,4 - 97,4)	185	3,0	(2,6 - 3,6)	6113	84,2	<0,001
Discrimination	Yes	1066	95,0	(93,5 - 96,2)	56	5,0	(3,8 - 6,5)	1122	15,5	<0,001
	No	5960	97,1	(96,5 - 97,5)	177	2,9	(2,5 - 3,5)	6138	84,5	<0,001
Stress by COVID-19	Yes	6684	96,8	(96,3 - 97,3)	223	3,2	(2,7 - 3,7)	6908	95,2	<0,001
	No	342	97,2	(94,6 - 98,6)	10	2,8	(1,4 - 5,4)	352	4,8	<0,001
COVID-19 stress levels	No	342	97,2	(94,6 - 98,6)	10	2,8	(1,4 - 5,4)	352	4,8	<0,001
	Very low	3059	96,6	(95,9 - 97,1)	106	3,4	(2,9 - 4,1)	3166	43,6	<0,001
	Bajo	3056	97,0	(96,4 - 97,5)	93	3,0	(2,5 - 3,6)	3149	43,4	<0,001
	Moderate	539	95,7	(93,7 - 97,1)	24	4,3	(2,9 - 6,3)	563	7,8	<0,001
	High	30	100,0	(88,7 - 100,0)	0	0	-	30	0,4	<0,001
Resilience	Low	1461	96,2	(95,1 - 97,0)	56	3,8	(3,0 - 4,9)	1518	20,9	<0,001
	Moderate	4936	96,9	(96,4 - 97,3)	160	3,1	(2,7 - 3,6)	5096	70,2	<0,001
	High	629	97,4	(95,7 - 98,4)	17	2,6	(1,6 - 4,3)	646	8,9	<0,001
Stressful situation	Yes	2656	96,1	(95,3 - 96,8)	108	3,9	(3,2 - 4,7)	2765	38,1	<0,001
	No	4370	97,2	(96,6 - 97,6)	125	2,8	(2,4 - 3,4)	4495	61,9	<0,001
PTSD*	Yes	413	93,2	(90,4 - 95,2)	30	6,8	(4,8 - 9,6)	443	6,1	<0,001
	No	6613	97,0	(96,5 - 97,4)	203	3,0	(2,6 - 3,5)	6817	93,9	<0,001
PTSD* Grades	No	6613	97,0	(96,5 - 97,4)	203	3,0	(2,6 - 3,5)	6817	93,9	<0,001
	Mild-moderate	347	94,3	(91,3 - 96,2)	21	5,7	(3,8 - 8,7)	368	5,1	<0,001
	Moderate-severe	63	90,0	(80,2 - 95,3)	7	10,0	(4,7 - 19,8)	70	1,0	<0,001
	Severe-extreme	3	60,0	(17,0 - 92,7)	2	40,0	(7,3 - 83,0)	5	0,1	<0,001
Depression	Yes	4466	96,1	(95,4 - 96,6)	178	3,9	(3,4 - 4,6)	4645	64,0	<0,001
	No	2560	97,9	(97,2 - 98,4)	55	2,1	(1,6 - 2,8)	2615	36,0	<0,001
Degrees of depression	No	2560	97,9	(97,2 - 98,4)	55	2,1	(1,6 - 2,8)	2615	36,0	<0,001
	Minimum	2881	96,5	(95,7 - 97,1)	103	3,5	(2,9 - 4,3)	2985	41,1	<0,001
	Slight	1264	96,5	(95,3 - 97,3)	46	3,5	(2,7 - 4,7)	1310	18,0	<0,001
	Moderate	235	93,3	(89,4 - 95,8)	17	6,7	(4,2 - 10,6)	252	3,5	<0,001
	Moderately severe	57	87,7	(77,0 - 93,9)	8	12,3	(6,1 - 23,0)	65	0,9	<0,001
	Severe	29	87,9	(71,8 - 95,6)	4	12,1	(4,4 - 28,2)	33	0,5	<0,001
Anxiety	Yes	1351	95,6	(94,3 - 96,6)	62	4,4	(3,4 - 5,7)	1413	19,5	<0,001
	No	5675	97,1	(96,5 - 97,5)	171	2,9	(2,5 - 3,5)	5847	80,5	<0,001
Degrees of anxiety	No	5675	97,1	(96,5 - 97,5)	171	2,9	(2,5 - 3,5)	5847	80,5	<0,001
	Slight	1114	96,1	(94,7 - 97,1)	45	3,9	(2,9 - 5,3)	1159	16,0	<0,001
	Moderate	176	92,1	(87,4 - 95,1)	15	7,9	(4,9 - 12,6)	191	2,6	<0,001
	Severe	61	96,8	(88,8 - 99,1)	2	3,2	(0,9 - 11,2)	63	0,9	<0,001
Suicidal ideation	Yes	455	91,7	(88,8 - 93,9)	41	8,3	(6,1 - 11,2)	496	6,8	<0,001
	No	6571	97,1	(96,6 - 97,5)	192	2,9	(2,5 - 3,4)	6764	93,2	<0,001
Suicidal behavior	Yes	89	84,8	(76,5 - 90,4)	16	15,2	(9,6 - 23,5)	105	1,4	<0,001
	No	6937	97,0	(96,5 - 97,4)	217	3,0	(2,6 - 3,5)	7155	98,6	<0,001
Total	-	7026	96,8	(96,3 - 97,2)	233	3,2	(2,8 - 3,7)	7260	100	<0,001

*PTSD: Post-traumatic stress disorder.

** P-value of difference of proportions of risk level.

Multivariate analysis

In tobacco use, age ($OR=0.99$; $p < 0.01$), higher educational level ($OR=0.63$; $p < 0.01$), and female sex ($OR=0.09$; $p < 0.01$) showed a protective effect, whereas living in urban areas was associated with an increased risk of tobacco use ($OR=1.46$; $p < 0.01$). Anxiety ($OR=1.81$; $p < 0.01$), having a mental health diagnosis ($OR=1.41$; $p < 0.01$), and depression ($OR=1.29$; $p < 0.01$) were associated with an increased risk of tobacco use, while a better work environment presented a protective association ($OR = 0.95$; $p = 0.01$).

For alcohol consumption, older age ($OR = 0.97$; $p < 0.01$) and female sex ($OR = 0.08$; $p < 0.01$) showed a protective association, while living in an urban area was associated with a risk ($OR = 1.79$; $p < 0.01$). Work environment had a significant protective association ($OR=0.95$; $p < 0.001$), while anxiety ($OR = 2.01$; $p < 0.01$) and depression ($OR=1.47$; $p < 0.01$) were associated with risk.

In the consumption of psychoactive substances, older age ($OR = 0.99$; $p < 0.01$) and female sex ($OR = 0.09$; $p < 0.01$) showed a protective association, while urban areas represented risk ($OR = 1.46$; $p < 0.01$).

Significant protective associations were found for work environment ($OR = 0.95$; $p = 0.013$), community participation index ($OR = 0.92$; $p = 0.009$), adequate economic income ($OR = 0.81$; $p = 0.005$), having a partner ($OR = 0.88$; $p = 0.013$), higher education level ($OR = 0.63$; $p < 0.01$), with the risk factors

being anxiety ($OR = 1.81$; $p < 0.01$), mental health diagnosis ($OR = 1.41$; $p = 0.005$), and depression ($OR = 1.29$; $p < 0.01$) (Tabla 4).

Discussion

This study provides an overview of the demographic and psychological characteristics of the use of tobacco, alcohol, and psychoactive substances in adults in El Salvador.

One of the most relevant findings was the strong correlation between the consumption of different substances, where individuals who consume one are highly likely to consume others. These patterns are consistent with previous research, which suggests that consumption is a gradual process that usually involves polyconsumption.^{vii}

Substance use showed differentiated patterns according to origin, with higher risk levels in the metropolitan region and urban areas, similar to what has been observed in other research, which suggests that consumption is due to greater availability of drugs,^{viii,jx} advertising, and social acceptance of them,^{xxi} increasing the probability of consumption and development of addictions.^{xii}

Likewise, the cluster analysis confirmed the grouping of departments with similar consumption characteristics, revealing significant variations between groups. This finding coincides with previous studies that show regional and territorial differences, highlighting how the geographical context influences consumption patterns.^{xiii,xiv}

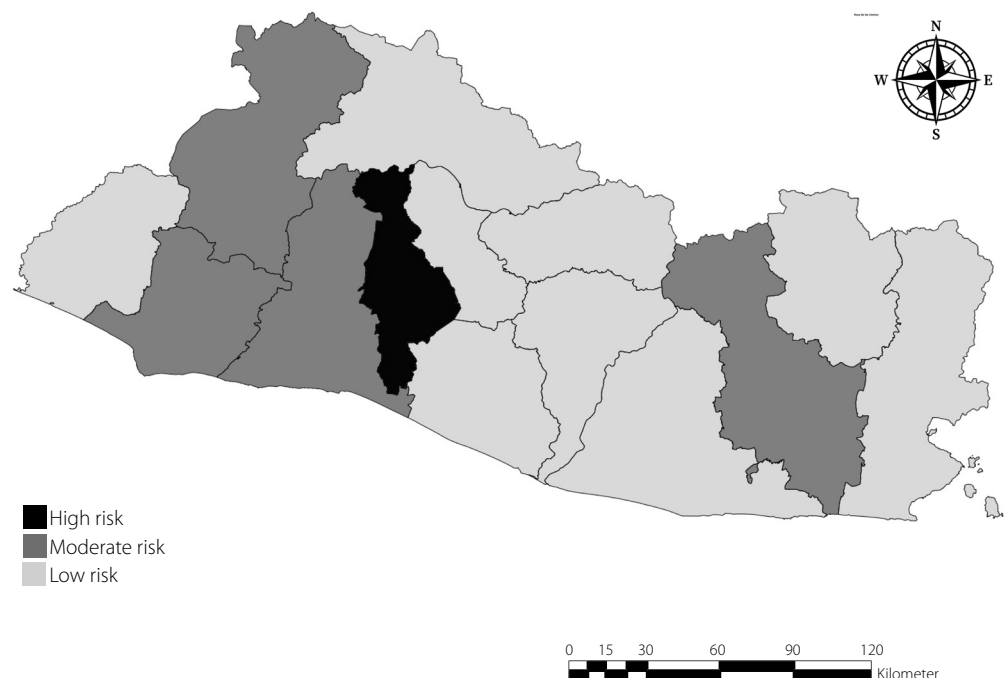


Figure 1. Geospatial analysis of substance use and risk through clusters in El Salvador, ENSM 2022

Young people showed a higher risk of consumption than older adults, consistent with previous studies indicating that the consumption of addictive substances usually begins in adolescence and young adulthood, thus explaining the observed patterns.^{xiii,xv,xvi} Significant differences in substance use were identified between men and women, with the risk being higher in men, a finding widely documented in the scientific literature.^{xiii} Sociocultural factors, such as masculinity norms, socialization patterns, and substance availability, could contribute to these differences.^{xviii-xix}

People with lower educational levels showed a higher risk of substance use compared to those with higher educational levels, a pattern supported by previous research associating lower education with a higher prevalence of substance use.^{xiv,xvii,xx} This could be related to a lower perception of risk, lack of access to information and adequate coping strategies, as well as unfavorable socioeconomic conditions that may increase vulnerability to this type of consumption.^{xiv,xx,xxi}

Single people presented a higher risk of consumption, which is consistent with the literature, which indicates that the lack of a social support network and exposure to environments prone to consumption and addictions may influence this behavior.^{xxii} The lack of a stable partner and family structure could increase the vulnerability of single adults to substance use. However, multiple other factors also influence this behavior.^{xx}

The multivariate analysis determined that the better the working conditions, the lower the probability of consumption. This association was described by other studies that consider that unemployment or precarious working conditions can generate an environment that increases anxiety and stress and thus increases susceptibility to addictions.^{iv,xviii,xx} In this sense, an adequate economic income was associated as a protective factor for tobacco consumption but as a risk factor for alcohol consumption. Economic factors play a complex role in addictions since greater economic capacity can facilitate access to substances and increase the frequency of consumption.^{xvii} In contrast, adverse economic conditions can increase stress and anxiety, predisposing individuals to resort to consumption as a coping mechanism; however, multiple factors converge in the phenomenon of addictions and influence their development.^{xxi,xxiii}

An association was found between various mental health problems and the use of psychoactive substances; a comprehensive approach to mental health, as well as

strategies to prevent and address drug use and addictions, could contribute to solving these problems.^{xxiv,xxv}

Regarding depressive or anxious symptoms, the multivariate model found that these were associated with an increased risk of substance use. The relationship between mental health problems and substance use has been widely documented, relating substance use as a coping mechanism.^{xxiv,xxv}

Other studies point to the influence of neurobiological and genetic factors in the development of mental disorders and addictions.^{xxv} However, other research indicates that psychological problems condition a lower capacity for control and a greater propensity to addiction.^{xxvii}

PTSD also showed an association with psychoactive substance use, similar to that observed in other studies that found a relationship between PTSD and substance use as a mechanism to manage trauma.^{xxviii} This association highlights the need to implement interventions that not only address substance use but also consider the psychological and social factors related to addictions.^{xxix}

The COVID-19 pandemic has also contributed to the aggravation of addictions. Recent studies documented an increase in substance use as a way to cope with uncertainty and isolation.^{xxx} Other studies reported a significant increase in substance use as a consequence of high levels of stress and anxiety related to COVID-19.^{xxxi,xxxii}

In this study, community involvement acted as a protective factor for substance use. Some studies indicate that supportive social networks provide an environment that promotes resilience and emotional well-being, which reduces vulnerability to substance use.^{xxxii,xxxiii} Social support is central to addiction prevention and treatment, highlighting its importance as an integral part of intervention strategies.^{xxvii}

Resilience also acted as a protective factor, coinciding with the literature, which indicates that people with coping skills, especially those with family resilience, can face life's difficulties without resorting to the use of addictive substances.^{xxxiv}

Finally, behavioral theories consider that the human being is the result of multiple interactions among biological, psychological, and social factors that condition the development and course of addictions.^{vii} Similarly, addictions are also seen as developmental disorders influenced by risk factors accumulated throughout life.^{xxxv}

The main limitations of the study are related to its cross-sectional design, which prevents the establishment of causal relationships and

Tabla 4. Multivariate analysis of factors associated with the use of tobacco, alcohol, and psychoactive substances in the adult population, ENSM 2022

Substance	Variables	Coefficients	OR	Standard error	z-value	95% CI	p-value
Tobacco *	(Intercept)	2,14	-	0,29	7,5	(4,84 - 14,89)	<0,01
	Age	-0,01	0,99	0,00	-4,7	(0,99 - 1,00)	<0,01
	Female sex	-2,36	0,09	0,05	-43,5	(0,08 - 0,11)	<0,01
	Urban area	0,38	1,46	0,06	6,8	(1,31 - 1,62)	<0,01
	Can read and write	-0,03	0,97	0,08	-0,4	(0,83 - 1,14)	0,71
	Community participation index	-0,08	0,92	0,03	-2,6	(0,87 - 0,98)	0,01
	Has a partner	-0,13	0,88	0,05	-2,5	(0,80 - 0,97)	0,01
	Higher education level	-0,47	0,63	0,09	-5,4	(0,53 - 0,74)	<0,01
	Work environment	-0,05	0,95	0,02	-2,5	(0,92 - 0,99)	0,01
	Negative thinking	0,12	1,13	0,07	1,7	(0,98 - 1,29)	0,09
	Adequate economic income	-0,21	0,81	0,08	-2,8	(0,70 - 0,94)	0,00
	Mental health diagnosis	0,34	1,41	0,12	2,8	(1,11 - 1,78)	0,00
	Depression	0,25	1,29	0,06	4,4	(1,15 - 1,44)	<0,01
	Anxiety	0,59	1,81	0,07	8,8	(1,59 - 2,07)	<0,01
	Works	-0,26	0,77	0,18	-1,4	(0,54 - 1,10)	0,15
	NBI**	-0,15	0,86	0,07	-2,0	(0,74 - 1,00)	0,06
Alcohol +	(Intercept)	1,54	-	0,31	4,95	(2,54 - 8,61)	<0,01
	Age	-0,03	0,97	0	-16,2	(0,97 - 0,97)	<0,01
	Female sex	-2,57	0,08	0,06	-44,89	(0,07 - 0,09)	<0,01
	Urban area	0,58	1,79	0,06	9,86	(1,59 - 2,01)	<0,01
	Can read and write	-0,58	0,56	0,08	-6,89	(0,48 - 0,66)	<0,01
	Community participation index	-0,24	0,78	0,03	-7,47	(0,74 - 0,84)	<0,01
	Has a partner	-0,28	0,76	0,05	-5,17	(0,68 - 0,84)	<0,01
	Higher education level	0,03	1,03	0,08	0,31	(0,87 - 1,21)	0,754
	Work environment	-0,06	0,95	0,02	-2,79	(0,91 - 0,98)	0,005
	Negative thinking	-0,07	0,93	0,07	-0,94	(0,81 - 1,08)	0,349
	Adequate economic income	0,38	1,47	0,08	4,95	(1,26 - 1,71)	<0,01
	Mental health diagnosis	-0,11	0,9	0,14	-0,74	(0,68 - 1,19)	0,461
	Depression	0,39	1,47	0,06	6,51	(1,31 - 1,65)	<0,01
	Anxiety	0,7	2,01	0,07	10	(1,75 - 2,30)	<0,01
	Works	1,65	5,18	0,22	7,41	(3,35 - 8,01)	<0,01
	NBI**	0,04	1,04	0,07	0,51	(0,90 - 1,20)	0,611
Psychoactive substances ^	(Intercept)	0,915	-	0,253	3,62	(1,52 - 4,10)	<0,001
	Age	-0,008	0,99	0,001	-6,23	(0,99 - 0,99)	<0,001
	Female sex	-1,235	0,29	0,046	-26,95	(0,27 - 0,32)	<0,001
	Urban area	0,458	1,58	0,045	10,28	(1,45 - 1,73)	<0,001
	Can read and write	-0,187	0,83	0,067	-2,79	(0,73 - 0,95)	0,005
	With partner	-0,137	0,87	0,043	-3,19	(0,80 - 0,95)	0,001
	Negative thinking	0,194	1,21	0,057	3,42	(1,09 - 1,36)	0,001
	Mental health diagnosis	0,921	2,51	0,093	9,9	(2,09 - 3,01)	<0,001
	Depression	0,872	2,39	0,052	16,73	(2,16 - 2,65)	<0,001
	Resilience	-0,635	0,53	0,228	-2,79	(0,34 - 0,83)	0,005
	PTSD symptoms*** 0.696	0,696	2,01	0,082	8,46	(1,71 - 2,36)	<0,001
	Anxiety	0,132	1,14	0,057	2,32	(1,02 - 1,28)	0,02

**UBN: Unsatisfied Basic Needs.

***PTSD: Post-traumatic stress disorder.

*AUC del 85,8 %.

+AUC del 82,4 %.

^ AUC del 70,1 %.

Likelihood ratio test and Wald test (p <0,01).

may lead to the underestimation of substance use. However, the strength of the study lies in its representativeness at the national level, which provides an overview of the situation in El Salvador and allows for a comprehensive analysis, applying precise statistical models that strengthen the findings. Additionally, the use of artificial intelligence, machine learning, and clustering techniques has been crucial in optimizing the analysis and interpretation of the data.

The results obtained from the ENSM confirm the multifactorial nature of addictions, highlighting the need for interventions that integrate mental health services and address risk factors effectively.^{xxxvi}

Due to its multifaceted nature,^{xxxv,xxxvi} a comprehensive approach that considers mental health problems,^{xxiv,xxv} economic conditions, and access to social support networks^{xxvii} is recommended to offer interventions tailored to the needs of individuals. Furthermore, considering that addictions result from multiple interactions, it is necessary to integrate various disciplines and standardize care processes in health systems and to create regulations that address specific problems such as mental health and addictions.^{vii}

Conclusion

Young people presented a higher risk of substance use compared to older adults, highlighting vulnerability and the need to target prevention strategies for this group. Additionally, the geographical environment plays a key role in shaping consumption patterns, exhibiting significant variations that are closely tied to social and economic factors. A strong correlation was observed between mental health problems and the consumption of tobacco, alcohol, and psychoactive substances, suggesting that mental disorders are not only a consequence of consumption but also important predisposing factors for the development of addictions. A high correlation was observed between the consumption of different substances, where the use of one increases the probability of consuming others, which aggravates mental health problems and complicates the treatment of addictions.

These findings are important for designing prevention and intervention strategies to address the problem of addiction in El Salvador. In addition, they serve as a basis for generating new research questions and identifying areas of knowledge that require further study, thereby guiding future work on this problem.

Funding

The study was funded by researchers.

References

- i. El Informe Mundial sobre las Drogas 2023 de UNODC advierte sobre crisis convergentes a medida que los mercados de drogas ilícitas siguen expandiéndose. N. U. Oficina Las N. U. Contra Droga El Delito En México. Consulted date: April 15, 2024. Available at: <https://www.unodc.org/lpomex/es/noticias/junio-2023/el-informe-mundial-sobre-las-drogas2023-de-unodc-advierter-sobre-crisisconvergentes-a-medida-que-los-mercadosde-drogas-ilicitas-siguen-expandiendose>.
- ii. Abuso de sustancias OPS/OMS. Organización Panamericana de la Salud. 2023. Consulted date: April 3, 2024. Available at: <https://www.paho.org/es/temas/abuso-sustancias> iii.
- iii. Tabaco. Organización Panamericana de la Salud. 2023. Consulted date: August 7, 2024. Available at: <https://www.who.int/es/news-room/fact-sheets/detail/tobacco>
- iv. Alcohol. Organización Panamericana de la Salud. 2023. Consulted date: August 7, 2024. Available at: <https://www.who.int/es/news-room/fact-sheets/detail/alcohol>
- v. Ciucă Anghel D-M, Nițescu GV, Tiron A-T, Guțu CM, Baconi DL. Understanding the Mechanisms of Action and Effects of Drugs of Abuse. *Mol. Basel Switz.* 2023;28(13):4969. DOI: [10.3390/molecules28134969](https://doi.org/10.3390/molecules28134969)
- vi. Primera Encuesta Nacional de Salud Mental. Fondo Solidar. Para Salud. Consulted date: June 20, 2024. Available at: <https://fosalud.gob.sv/download/primerencuesta-nacional-de-salud-mental/>
- vii. Page S, Fedorowicz S, McCormack F, Whitehead S. Women, Addictions, Mental Health, Dishonesty, and Crime Stigma: Solutions to Reduce the Social Harms of Stigma. *Int. J. Environ. Res. Public. Health.* 2024;21(1):63. DOI: [10.3390/ijerph21010063](https://doi.org/10.3390/ijerph21010063)
- viii. Vilugrón F, Molina G. T, Gras-Pérez ME, Font-Mayolas S, Vilugrón F, Molina G. T, *et al.* Precocidad de inicio del consumo de sustancias psicoactivas y su relación con otros comportamientos de riesgo para la salud en adolescentes chilenos. *Rev. Médica Chile.* 2022;150(5):584-596. DOI: [10.4067/s003498872022000500584](https://doi.org/10.4067/s003498872022000500584)
- ix. Palma D, Continente X, López MJ, Vázquez N, Serral G, Ariza C, *et al.* Rasgos de la personalidad asociados al consumo de sustancias en jóvenes en contexto de

- vulnerabilidad. *Gac. Sanit.* 2022;35:542-550. DOI: [10.1016/j.gaceta.2020.08.004](https://doi.org/10.1016/j.gaceta.2020.08.004)
- x. Paul B, Jean Simon D, Kondo Tokpovi VC, Kiragu A, Balthazard-Accou K, Emmanuel E. Tobacco use in Haiti: findings from demographic and health survey. *BMC Public Health.* 2023;23(1). DOI: [10.1186/s12889-023-17409-6](https://doi.org/10.1186/s12889-023-17409-6)
 - xi. Polanska K, Znyk M, Kaleta D. Susceptibility to tobacco use and associated factors among youth in five central and eastern European countries. *BMC Public Health.* 2022;22(1):72. DOI: [10.1186/s12889-02212493-6](https://doi.org/10.1186/s12889-02212493-6)
 - xii. Scoppetta O, Avendaño Prieto BL, Cassiani Miranda C. Factores Individuales Asociados al Consumo de Sustancias Ilícitas: Una Revisión de Revisiones. *Rev. Colomb. Psiquiatr.* 2022;51(3):206-217. DOI: [10.1016/j.rcp.2020.01.007](https://doi.org/10.1016/j.rcp.2020.01.007)
 - xiii. Silumbwe A, Sabastian MS, Michelo C, Zulu JM, Johansson K. Sociodemographic factors associated with daily tobacco smoking and binge drinking among Zambians: evidence from the 2017 STEPS survey. *BMC Public Health.* 2022;22(1):205. DOI: [10.1186/s12889022-12594-2](https://doi.org/10.1186/s12889022-12594-2)
 - xiv. Rastogi A, Manthey J, Wiemker V, Probst C. Alcohol consumption in India: a systematic review and modelling study for sub-national estimates of drinking patterns. *Addiction.* 2022;117(7):1871-1886. DOI: [10.1111/add.15777](https://doi.org/10.1111/add.15777)
 - xv. Simón Saiz MJ, Fuentes Chacón RM, Garrido Abejar M, Serrano Parra MD, Díaz Valentín MJ, Yubero S. Perfil de consumo de drogas en adolescentes. Factores protectores. *Med. Fam. SEMERGEN.* 2020;46(1):33-40. DOI: [10.1016/j.semerg.2019.06.001](https://doi.org/10.1016/j.semerg.2019.06.001)
 - xvi. Samudio Domínguez GC, Ortiz Cuquejo LM, Soto Meza MA, Samudio Genes CR, Samudio Domínguez GC, Ortiz Cuquejo LM, Soto Meza MA, Samudio Genes CR. Factores asociados al consumo de drogas ilícitas en una población adolescente: encuesta en zonas marginales de área urbana. *Pediatría Asunción.* 2021;48(2):107-112. DOI: [10.31698/ped.48022021004](https://doi.org/10.31698/ped.48022021004)
 - xvii. Shariful Islam M, AlWajeah H, Rabbani MG, Ferdous M, Mahfuza NS, Konka D, Silenga E, Zafar Ullah AN. Prevalence of and factors associated with tobacco smoking in the Gambia: a national cross-sectional study. *BMJ Open.* 2022;12(6):e057607. DOI: [10.1136/bmjopen-2021-057607](https://doi.org/10.1136/bmjopen-2021-057607)
 - xviii. Espinoza Aguirre A, Fantin R, Barboza Solis C, Salinas Miranda A. Características sociodemográficas asociadas a la prevalencia del consumo de tabaco en Costa Rica. *Rev. Panam. Salud Pública.* 2020;44:e17. DOI: [10.26633/RPSP.2020.17](https://doi.org/10.26633/RPSP.2020.17)
 - xix. Santos-de Pascual A, Saura-Garre P, López-Soler C, Santos-de Pascual A, Saura-Garre P, López-Soler C. Salud mental en personas con trastorno por consumo de sustancias: aspectos diferenciales entre hombres y mujeres. *An. Psicol.* 2020;36(3):443-450. DOI: [10.6018/analesps.36.3.399291](https://doi.org/10.6018/analesps.36.3.399291)
 - xx. Alotaibi SA, Durgampudi PK. Factors associated with tobacco smoking among Saudi college students: A systematic review. *Tob. Prev. Cessat.* 2020;6:36. DOI: [10.18332/tpc/122444](https://doi.org/10.18332/tpc/122444)
 - xxi. Colón-Rivera HA, Aoun EG, Vaezazizi LM. *Psiquiatría de las Adicciones: Revisión Integral.* Elsevier Health Sciences; 2023.
 - xxii. Nawi AM, Ismail R, Ibrahim F, Hassan MR, Manaf MRA, Amit N, Ibrahim N, Shafurdin NS. Risk and protective factors of drug abuse among adolescents: a systematic review. *BMC Public Health.* 2021;21:2088. DOI: [10.1186/s12889-021-11906-2](https://doi.org/10.1186/s12889-021-11906-2)
 - xxiii. Gersberg L, Trimboli A, Amador G, Placencia ID, Faur R, Giorgio A del, Guzmán GG, Isolabella M, Kameniecki MA, Lauriti S, *et al.* Clínica de las adicciones. Mitos y prejuicios acerca del consumo de sustancias: Intervenciones, abordajes, proyectos y dispositivos. Editorial Noveduc; 2020. 260p.
 - xxiv. Nath A, Choudhari SG, Dakhode SU, Rannaware A, Gaidhane AM. Substance Abuse Amongst Adolescents: An Issue of Public Health Significance. *Cureus.* 2022;14(11):e31193. DOI: [10.7759/cureus.31193](https://doi.org/10.7759/cureus.31193)
 - xxv. Rossi MJ, Altemburger JA, Picco RD, Romero JC, Cuevas WG, Melgarejo LR, Adorno HG, Adorno VR, Caballero MA, Rossi MJ, *et al.* Cribado de trastornos psiquiátricos y patrones de consumo de sustancias en estudiantes de Medicina. *An. Fac. Cienc. Médicas Asunción.* 2020;53(3):41-52. DOI: [10.18004/anales/2020.053.03.41](https://doi.org/10.18004/anales/2020.053.03.41)
 - xxvi. Lovelock DF, Tyler RE, Besheer J. Interoception and alcohol: Mechanisms, networks, and implications. *Neuropharmacology.* 2021;200:108807. DOI: [10.1016/j.neuropharm.2021.108807](https://doi.org/10.1016/j.neuropharm.2021.108807)
 - xxvii. MacKillop J, Agabio R, Feldstein Ewing SW, Heilig M, Kelly JF, Leggio L, LingfordHughes A, Palmer AA, Parry CD, Ray L, *et al.* Hazardous drinking and alcohol use disorders. *Nat. Rev. Dis. Primer.* 2022;8(1):80. DOI: [10.1038/s41572-022-00406-1](https://doi.org/10.1038/s41572-022-00406-1)
 - xxviii. Castaño G, Sierra G, Sánchez D, Torres Y, Salas C, Buitrago C, Castaño G, Sierra G, Sánchez D, Torres Y, *et al.* Trastornos mentales y consumo de drogas en la población víctima del conflicto armado en tres ciudades de Colombia. *Biomédica.* 2018;38:70-85. DOI: [10.7705/biomedica.v38i0.3890](https://doi.org/10.7705/biomedica.v38i0.3890)
 - xxix. Pa OC, L RR, Lm RS, F AC, F T-T, B PA. Psychological distress, intimate partner violence and substance use in a representative sample from Mexico:

- A structural equation model. *Front. Public Health*. 2023;11. DOI: [10.3389/fpubh.2023.1101487](https://doi.org/10.3389/fpubh.2023.1101487)
- xxx. Mengin AC, Rolling J, Porche C, Durpoix A, Lalanne L. The Intertwining of Posttraumatic Stress Symptoms, Alcohol, Tobacco or Nicotine Use, and the COVID-19 Pandemic: A Systematic Review. *Int. J. Environ. Res. Public Health*. 2022;19(21):14546. DOI: [10.3390/ijerph192114546](https://doi.org/10.3390/ijerph192114546)
- xxxi. James SA, Chen S, Dang JH, Hall S, Campbell JE, Chen MS, Doescher MP. Changes in alcohol consumption and binge drinking during the COVID-19 pandemic among American Indians residing in California and Oklahoma. *Am. J. Drug Alcohol Abuse*. 2024 Jun 6:1-11. DOI: [10.1080/00952990.2024.2344482](https://doi.org/10.1080/00952990.2024.2344482)
- xxxii. Mellos E, Paparrigopoulos T. Substance use during the COVID-19 pandemic: What is really happening? *Psychiatr. Psychol.* 2022;33(1):17-20. DOI: [10.22365/jpsych.2022.072](https://doi.org/10.22365/jpsych.2022.072)
- xxxiii. Fuentes-Parras J, Pilojo-Peñafiel B, Pin-Rivera E. La importancia del apoyo social y comunitario a jóvenes para prevenir y recuperarse de sus adicciones. *MQRInvestigar*. 2024;8:5636-5651. DOI: [10.56048/MQR20225.8.1.2024.56365651](https://doi.org/10.56048/MQR20225.8.1.2024.56365651)
- xxxiv. Ruiz BO, Zerbetto SR, Galera SAF, Barcellos Fontanella BJ, Gonçalves AMDS, ProttiZanatta ST. Resiliencia familiar: percepción de familiares de dependientes de sustancias psicoactivas. *Rev. Lat. Am. Enfermagem*. 2021;29:e3449. DOI: [10.1590/15188345.3816.3449](https://doi.org/10.1590/15188345.3816.3449)
- xxxv. Mesas-Hueraman R, Soto-Guaquin J, Soto-Salcedo A, Mesas-Hueraman R, SotoGuaquin J, Soto-Salcedo A. Programas de intervención y prevención en trastornos por abuso de sustancias en población infante-juvenil. Una revision sistemática. *Rev. Chil. Neuro-Psiquiatr*. 2023;61(3):351-362. DOI: [10.4067/s0717-92272023000300351](https://doi.org/10.4067/s0717-92272023000300351)
- xxxvi. Monasterio Astobiza A. Hacia un modelo situado de la adicción. *Límite Arica*. 2021;16:1-16. DOI: [10.4067/s071850652021000100216](https://doi.org/10.4067/s071850652021000100216)