

Risk and Protective Factors Predicting Frequent Drug use among Health Science Students in Arequipa, Peru

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Abstract

Introduction: The use of psychoactive drugs is a growing public health and social problem among university students worldwide.

Objective: This study aimed, firstly, to identify the factors of the criterion variable by grouping the drugs under study according to their frequency of use and, secondly, to evaluate, through three alternative prediction models, some risk and protective factors that contribute to explaining the increase or decrease in frequent use of toxic drugs.

Methods: The study employed a quantitative paradigm and a cross-sectional, explanatory-causal design. The sampling method was simple random probability sampling, and the sample consisted of 236 students. The data collection instrument demonstrated qualitative validity and reliability.

Data Analysis: First, factor analysis with Varimax rotation was used to group and establish the dimensions of the criterion or dependent variable. Second, multiple linear regression analysis was used to compare three alternative models that explain and predict the variance of the criterion variable. Third, the significance of the multiple regression model was verified using Snedecor's F-statistic, and the significance of the beta coefficients was assessed using Student's t-test. The product of the standardized beta and correlation coefficients of the final model was used to determine the proportion of the total variance of the dependent variable, Factor 2, explained by each predictor or independent variable.

Results: The study revealed, first, a two-factor matrix with eigenvalues greater than one, which together explain 44.5% of the total variance of the criterion variable, a proportion considered moderate. Second, the three-factor multifactorial regression model is statistically significant. This implies rejecting the null hypothesis: all regression coefficients in the model are zero in the population. However, the overall coefficient of determination is not very high; only 21% of the total variance of the dependent variable, Factor 2, is explained by the 12 predictor variables included in the final model. In particular, parental education is the variable that explains the largest proportion of variance (10%), followed by sexual relations under the influence of alcohol (3%) and the student's sex (2.7%). In summary, the coefficients of determination confirmed that risk factors, such as lower parental education, male sex, and sexual relations under the influence of alcohol, predict higher rates of frequent drug use among university students. Conversely, protective factors, such as higher parental education, lower exposure to alcohol consumption, and a greater perception of the health risks associated with cannabis and cocaine use, explain lower rates of frequent psychoactive drug use among students.

Conclusion: It is essential to consider risk and protective predictors when designing a program to prevent substance use among university students.

Keywords: Frequent drug use; risk factors; protective factors; health science students; multiple regression models.

Introduction

The significant increase in psychoactive drug use and related deaths, patterns of consumption and polydrug use, the risk of exacerbating mental health disorders and developing chronic illnesses, the reduction in the average age of initiation among users, etc. (United Nations Office on Drugs and Crime [UNODC], 2025; Urday-Concha et al., 2025; Alhammad et al., 2022), currently constitute a serious problem for public health and society. In particular, the number of people using illicit drugs, excluding tobacco and alcohol, reached 316 million in 2023, with cannabis, opioids, cocaine, amphetamines, ecstasy, etc., being the most commonly used. The situation is further aggravated by the fact that of the 64 million people suffering from mental disorders due to illicit drug use, only one in twelve receives specialized treatment (UNODC, 2025).

Substance abuse is a complex phenomenon requiring a multidimensional and multifactorial approach, with the most relevant factors being economic, social, cultural, biopsychological, political, environmental, and legal (Becoña, 2006; Pedrero-Pérez, 2015). Therefore, it is crucial to understand some of the risk factors that increase and protective factors that reduce the likelihood of substance abuse in order to contribute to the development of evidence-based universal, selective, and indicated prevention programs based on scientific evidence (National Institute on Drug Abuse [NIDA], 2014; Government of Spain, 2022).

In particular, drug use among young people and university students shows relationships of dependence with risk and protective factors. A risk factor is an individual attribute, situational condition, and/or environmental context that increases the likelihood of drug use and abuse, the experimentation and initiation phase, or a transition to the consolidation or maintenance of substance use (Clayton, 1992). Individual, family, social, psychological, and environmental risk factors increase people's vulnerability to the use of addictive substances (Becoña & Cortés, 2010; Alhammad et al., 2022).

A protective factor is a characteristic, individual attribute, situational condition, and/or environmental context that reduces, inhibits, or attenuates the likelihood of psychoactive substance use and/or abuse, or a transition in the level of involvement with psychoactive drugs (Clayton, 1992). Individual, family, social, psychological, and environmental protective factors minimize or enable a positive response to risk factors, reducing or counteracting them through the development in individuals and the community of cognitive, affective, and behavioral dimensions that allow for mediation in the dynamic and reciprocal relationships established between people and psychoactive substances (Becoña & Cortés, 2010; Lucas de, 2014).

Currently, the risk and protective factors associated with the use of legal drugs (alcohol and tobacco) and illegal drugs (marijuana, cocaine base, cocaine, inhalants, ecstasy, tranquilizers, and stimulants) are multicausal. One such multicausal model is the Social Development Model (SDM)

(López & Rodríguez-Arias, 2010; Cava et al., 2018; and the Center for Documentation and Studies [SIIS], 2015). These research advances reveal that there are multiple risk and protective factors that predict drug use, the most important being: biological/individual (sex and age), familial/educational (socioeconomic status, family environment, parents' educational level, risky sexual behaviors, etc.), and environmental/social (drug supply and purchase, access and availability, social perception of risk, etc.).

In line with advances in research on university students, particularly regarding biological/individual factors, a review of studies in Colombia (Scoppetta et al., 2022) in Latin America shows variable associations with sex, depending on the type of drugs consumed. Thus, there is a higher probability of illicit substance use among males; however, with regard to amphetamines and polydrug use, there is no clear association between sex and illicit drug use. Furthermore, a study of Spanish university students (Redondo-Martín et al., 2021) on the association between alcohol consumption in the last 12 months and risky sexual behaviors, unprotected sex, and experiencing sexual abuse reveals statistically significant differences ($p < 0.05$) between alcohol consumers and non-consumers.

Secondly, regarding family/educational factors, research advances concerning the educational level variable related to the consumption of legal drugs, a study by He et al. (2018), shows that the population with a university education has a lower probability of consuming alcohol ($OR = 1.60$) and tobacco ($OR = 2.87$) compared to the population with a secondary education level, for alcohol consumption ($OR = 1.85$) and tobacco use ($OR = 3.22$), with the baseline being the population with no education. Furthermore, in the case of cannabis use, a report on Colombian school students by Martínez-Torres et al. (2018), regarding the association between the educational level of their mothers, highlights those children of students whose mothers have no education ($OR = 1.15$) or only a high school diploma ($OR = 1.67$) show a greater probability of using marijuana than children whose mothers have higher education. However, there is no association between the two variables under study.

Third, regarding environmental and social factors, a prerequisite for the consumption of psychoactive substances is their presence, accessibility, and availability. In this respect, a study of Mexican university students by Palacios-Arenas and Terrones-Saldívar (2019) found a positive association between ease of access and cannabis use in the past year ($X^2 = 26.779$, $P = 0.001$), compared to students who believe it is impossible to obtain marijuana. Indeed, ease of access to illegal psychoactive drugs is a risk factor that correlates positively with higher consumption and increased risk among users; while difficulty and restriction of access could become a protective factor regarding illicit drug use.

Fourth, regarding the social perception of health risks/dangers, studies published on university students highlight, firstly, that a lower perceived risk of licit and illicit drug use is associated with a higher probability of using psychoactive

substances (Pradican Project, 2013; Preden/Devida Project, 2017). Secondly, in multivariate analysis, Scoppetta (2020) also shows that a low perceived risk or danger of cannabis use increases the likelihood of its use (OR = 3.24; 95% CI 2.75–3.81). In short, university students who perceive a low risk or danger of cannabis use are 3.24 times more likely to use marijuana than non-users.

Finally, considering the reported academic literature and research advances, particularly in Peru and the city of Arequipa, most publications only reach a level of descriptive correlational bivariate analysis (Drosican Project, 2009; Pradican Project, 2013; Preden/Devida Project, 2017). However, there is a gap in the use of statistical techniques for dependence and interdependence in probabilistic samples. Specifically, in the field of disciplinary and interdisciplinary research, factor analysis and the study of cause-and-effect relationships through the use of regression models demand specific investigations in the field of addictions and health.

In this context, the present study aims, on the one hand, to establish the factors or dimensions of the dependent variable based on the prevalence of frequent drug use and, on the other hand, to evaluate to what extent the independent variables of three alternative risk and protection models could explain and predict the performance of the dependent variable (frequent drug use) in young university students in the Health Sciences area of Arequipa, Peru.

Materials and Methods

Research Approach and Design

An epidemiological study with a quantitative approach and non-experimental design was conducted, using a cross-sectional correlational (Hernández et al., 2014) and predictive-causal (Burns & Grove, 2004) approach. The units of analysis were third-year university students, semesters V and VI, from the professional programs of Nursing, Psychology, Dentistry, and Medical Technology in the Health Sciences area of a private university in metropolitan Arequipa, Peru.

Participants

The study population consisted of 653 students, and inclusion and exclusion criteria were considered for sample selection. The sampling method was simple random probability sampling, representative and proportional to the estimated population size for a 95% confidence level and a standard error margin of $\alpha = 0.05$. Finally, after eliminating questionnaires with incomplete information or missing data, the final sample and multivariate data analysis of the tables and figures was based on 236 university students of both genders, with a female majority (75%).

Measuring Instrument

The “Epidemiological Survey on Public Health in University Students” was used. This survey was developed by the Inter-American Drug Observatory (OID) and subsequently agreed upon and validated by expert judgment from the Inter-American Drug Abuse Control Commission (CICAD) and professionals

from the Andean Community (CA). To ensure its validity and reliability, the experts conducted a pilot test with students from public and private universities in each member country of the Andean Community, with a dual purpose:

First, the clarity, coherence, and relevance of the questions and response options were evaluated, and after making the necessary corrections, the final version was prepared. Second, regarding reliability, criteria of sufficiency, comparability, and verifiability were considered, with the aim of generating reliable and comparable data on drug use among university students in the Andean Community. In Peru, the questionnaire was applied in three specific national studies: the Drosican Project (2009), the Pradican Project (2013), and the Preden/Devida Project (2017).

Research Variables

The study revealed two types of variables, considering the proposed objective and the formulated working hypotheses. First, the variable to be predicted (dependent or criterion) and, second, the predictor variables (independent or explanatory) of interest and control. Table 0 shows the recoded characteristics that define the dependent and independent variables that are the subject of our central interest.

It is appropriate to note some observations from Table 0, regarding the variables to be included in the final multiple regression model. With respect to the dependent variable, the factor analysis grouped in Factor 2 the frequent consumption of toxic drugs of legal trade (alcohol and tobacco) and illegal trade (marijuana, cocaine and pbc).

Regarding the explanatory or independent variables of interest: the values assigned to the variables associated with the parents' level of education reflect how they were constructed: they take the value of 1 if the specified level is the highest completed by the student's parents. Thus, parents with higher education have a value of 1 in the “Higher” variable and 0 in the rest.

Respecting the explanatory control variables included: a) the specific characteristics of the parents and their student children: parents' education (average) – a relevant factor in their children's psychosocial development – and the breakdown of students by sex and their predisposition to use legal and illegal drugs when engaging in sexual activity under the influence of alcohol; b) students' perceptions of the risks involved in frequent use (within the 30 days prior to the survey) of marijuana and/or cocaine base. In this case, the values assigned to the variables associated with student perception – calculated with respect to a student who perceives no risk in frequent marijuana and cocaine base use – take the value of 1 depending on the specified risk level: low, moderate, or high; and c) difficulty in acquiring marijuana and/or cocaine base on the informal market: difficult or easy.

Table 0: Recoded variables used in the study to constitute the final multiple regression model.

Name	Guy	Description	Sign Expected
Dependent variable			
Factor 2	Numeric	Consumption of legal and illegal substances: alcohol, cigarettes, marijuana, cocaine and crack cocaine	
Explanatory variables of interest			
Primary	Dummy	It takes two values: 1 = If the highest level achieved by the parents is primary education; and 0 = If it is not.	-
Secondary	Dummy	It takes two values: 1 = If the highest level achieved by the parents is secondary education; and 0 = If it is not.	-
Technique	Dummy	It takes two values: 1 = If the highest level achieved by the parents is technical education; and 0 = If it is not.	-
Superior	Dummy	It takes two values: 1 = If the highest level achieved by the parents is higher education; and 0 = If it is not.	-
Explanatory control variables			
Sex	Dummy	Student's gender: 1 = Male; 0 = Female	+
Sex, alcohol	Dummy	Sexual relations under the influence of alcohol: 1 = If they take place; and 0 = Otherwise	+
Mild (marijuana)	Dummy	Risk perception if you try marijuana frec*: 1 = Mild; 0 = Other case	-
Moderate (marijuana)	Dummy	Risk perception if trying marijuana frec*: 1 = Moderate; 0 = Other case	-
High (marijuana)	Dummy	Risk perception if trying marijuana frec*: 1 = High; 0 = Other case	-
Mild (pbc)	Dummy	Risk perception if pbc test frec*: 1 = Mild; 0 = Other case	-
Moderate (pbc)	Dummy	Risk perception if pbc test frec*: 1 = Moderate; 0 = Other case	-
High (pbc)	Dummy	Risk perception if pbc test frec*: 1 = Stop; 0 = Other case	-
Adqdrogas	Dummy	Difficulty in acquiring marijuana and/or PBC: 1 = Difficult; 0 = Easy	-

(*): frequently.

Furthermore, all the explanatory and control variables of interest in the table above potentially influence university students' choices regarding exposure to legal and illegal psychoactive substances. Therefore, it is essential to consider their effects if we intend to isolate the impact of parental education.

Considering the characteristics of the dependent and explanatory variables, multiple linear regression analysis consists of obtaining a linear function of a series of independent variables (Xi) that allows us to explain or predict the value of the dependent variable (Y), called Factor 2. Therefore, the final multiple linear regression model that we intend to estimate can be summarized in the following equation:

$$\text{Factor 2} = \beta_0 + \beta_1 \text{Secundaria} + \beta_2 \text{Tecnica} + \beta_3 \text{Superior} + \beta_4 \text{Sexo} + \beta_5 \text{Sexoalcohol} + \beta_6 \text{Riesgo_marih} + \beta_7 \text{Riesgo_pbc} + \beta_8 \text{Adqdrogas} + \mu$$

Where:

Factor 2 = frequent consumption of alcohol, tobacco, marijuana, PBC and cocaine.

β_0 = constant or intercept of the regression line.

$\beta_1 = \beta_2 = \beta_3$ explanatory variables of interest.

$\beta_4, \beta_5, \beta_6, \beta_7, \beta_8$ = explanatory control variables, including random error μ_i

Procedure

Once the information was collected and processed, post-Covid-19 pandemic, in October 2022, the primary data matrix was reviewed to perform univariate and bivariate analyses of the information regarding drug use associated with sex, age groups, and family income. Furthermore, in January 2023, the primary data was reviewed and systematized again to carry out the estimations and multivariate statistical analysis for the present study for the second time.

Data Analysis

Various statistical analyses were performed in consecutive phases to achieve the proposed objective.

First, a factor analysis was performed on all legal (alcohol and tobacco) and illegal (marijuana, crack cocaine, cocaine, ecstasy, inhalants, stimulants, and tranquilizers) drugs under study, using the Varimax orthogonal rotation statistical method. This method allowed us to achieve two objectives regarding the constitution of the dependent variable: first, to empirically reduce the number of frequently used drugs; and second, to group the coefficients of frequently used drugs into a factor matrix in a manner similar to how they are used by university students, based on the frequencies with high loadings or saturations on a smaller number of specific variables (factors or dimensions) of the dependent variable. Specifically, a coefficient with a large loading indicates that the factor and the variable are highly correlated.

Secondly, multiple linear regression analysis was used to construct alternative models and determine the extent to which the independent and control variables of interest in Table 0 could explain the involvement of university students in the frequent use of psychoactive substances in factors 1 and 2 (observed in the rotated factor matrix of Table 1), and finally, to indicate their percentage contribution to predicting the total variance of the dependent variable. In these cases, multiple regression analysis was employed using the stepwise method, as it allows for the detection of the contribution of each of the independent or explanatory variables and each of the sets of predictor variables, resulting in a step-by-step process of selecting specific variables to introduce a new variable into the regression equation (Lucas de, 2014), concluding with the consideration of the selection and elimination criteria.

Furthermore, the significance of the multiple regression model was verified using Snedecor's F-statistic, while the significance of each of the beta (β) coefficients in the regression equation was measured with Student's t-test. These two significance tests allowed us to determine the probabilities of inferring the sample statistics to their corresponding population parameters.

For the selection of the best model, two indices were taken into consideration in terms of goodness of fit: the coefficient of determination/ R-squared (R^2) to measure the proportion of total variance of the dependent variable (frequent drug use of factors 1 and 2) explained by the set of independent variables, and the mean squared standard error, R^2 – adjusted, (rmse) which corrects probable overestimations of the fit to the alternative models resulting from the inclusion of new predictor variables, increasing only in cases where such variables respond to a better fit in the data.

Ethical Considerations

The statistical information was obtained through the research project "Predictors of Risk and Protective Factors for Drug Use in University Students." This project was approved and registered with the Postgraduate Unit of the Faculty of Medicine, National University of San Agustín (UNSA), by means of Directorial Decree (DD) No. 067-2022-UPG-FM-UNSA. The ethical principles applicable to all research involving human subjects were considered in the execution of the study: respect for autonomy, beneficence, and justice. Prior to self-administering the questionnaire, students received information about the study's objectives, their voluntary, anonymous, and confidential participation, etc. Finally, they were required to sign an informed consent form.

Results

Factor analysis for the constitution of the dimensions of the dependent variable

Given the qualitative nature of the independent variables under study (sex, perceived risk of drug use, parental education, etc.), associated with frequent drug use—conducted during the month prior to the survey—of both legal and illegal drugs, the dimensions of the dependent variable (criterion or outcome) were obtained through a factor analysis with Varimax rotation,

based on the prevalence of frequent drug use. After performing the principal component analysis using factor analysis, Table 1 shows the following results:

Table 1: Rotated factor matrix* of psychoactive drugs, based on their frequent use †

Substances	Factor 1	Factor 2
Tobacco		0.5190
Alcohol		0.6292
Tranquilizers +	0.4120	
Inhalants +	0.7812	
Marijuana		0.6061
Cocaine		0.5613
Cocaine base paste		0.4601
Ecstasy +	0.8502	
Self-values	1,750	1,367
% of variance explained	25.006	19,526

*Extraction method: Principal Component Analysis. Rotation method: Varimax with Kaiser normalization.

+Of the total sample studied, very few students have tried these substances: tranquilizers (8.5%), inhalants (0.8%) and ecstasy (0.8%). †Saturation below 0.40 are not included.

First, the psychoactive drugs under study were reduced and grouped, based on their frequency of use, into two groups called factors or dimensions. Tranquilizers, inhalants, and ecstasy loaded onto the first explanatory factor (Factor 1); while tobacco, alcohol, marijuana, cocaine, and crack cocaine loaded onto the second explanatory factor (Factor 2). It is important to note that these two factors, in the rotated factor matrix, do not include loadings with weights or coefficients lower than 0.40, and each factor contains at least three items that demonstrate both inter- and intra-factor reliability.

Second, it is important to highlight that, while Factor 1 comprises the linear combination of variables (tranquilizers, inhalants, and ecstasy) that explains the largest amount of variance in the dependent variable (25%) in the analyzed sample, it presents a serious problem regarding the number of students who reported having tried these substances in the last 30 days. Specifically, of the total sample of 236 cases analyzed, only 0.8% reported using inhalants and/or ecstasy (2 cases each), while 8.5% (20 cases) reported using tranquilizers. Overall, the number of observations is too small not only to establish reliable associations with control variables but also to draw statistical estimates and valid conclusions.

The opposite is true for the specific variables of Factor 2 (comprising tobacco, alcohol, marijuana, cocaine, and crack cocaine), whose prevalence of frequent use is sufficient for the relevant analyses. Indeed, the significant differences between the prevalence of frequent use of the drugs in Factor 1 and Factor 2 could likely produce opposing regression models: one showing that the independent variables have no effect on the dependent variable, and the other showing that they do.

In summary, two constructs or factors with eigenvalues greater than one were extracted (Factor 1: 1.750 and Factor 2: 1.367). Furthermore, together, these two factors explain 44.5% of the total variance of the criterion variable, a proportion that can be considered moderate. Moreover, these two factors specifically demonstrate, on the one hand, the set of toxic substances most frequently consumed by students in the Health Sciences area and, on the other hand, that in practice there are indeed two patterns of polydrug use comprised of all the substances in each factor revealed by the rotated factor matrix.

Third, the limitations revealed by Factor 1, described above, become apparent when we run the corresponding multiple regression model with the explanatory and control variables of interest that can theoretically explain and predict the performance of Factor 1 of the dependent variable, comprised of tranquilizers, inhalants, and ecstasy.

According to the information gathered in the questionnaire, the independent variables are related to parental education, student sex, sexual activity under the influence of alcohol, the student's perceived risk associated with frequent use of ecstasy, inhalants, and tranquilizers, and access to drugs on the market. The summary results of this regression model are as follows:

Number of obs	= 236
F (12, 223)	= 0.51
Prob > F	= 0.9054
R-squared	= 0.0363
Root MSE	= 1.0078

Indeed, as the results show, the estimated coefficients of determination, taken together, are not significantly different from zero in the population, since the obtained probability ($\text{Prob} > F = 0.9054$) is much higher than the theoretical probability, $\alpha = 0.05$. Furthermore, its explanatory power for the total variance of Factor 1 only reaches 3.6% ($R^2 = 0.0363$). Therefore, the model with Factor 1 is inconsequential, and

the probability of accepting the null hypothesis—the absence of impact of the independent variables on the dependent variable—is high.

Finally, having discarded dimension 1 (Factor 1) of the criterion variable, the estimations, analyses, and conclusions drawn from this point forward will be based on the regression equation observed in previous pages. That is, they will consider, on the one hand, the independent and control variables of interest from Table 0 and, on the other hand, dimension 2 (Factor 2). This includes the frequent consumption of tobacco, alcohol, marijuana, cocaine, and crack cocaine.

Alternative regression models for predicting frequent drug use in Health Sciences students

This study aims to compare three alternative models to explain and predict the total variance of Factor 2 of the criterion or dependent variable. Specifically, based on the information, recoding, and operationalization of the characteristics of the explanatory and control variables of interest (see Table 0), the study seeks to compare three alternative multiple linear regression models shown in Table 2.

As shown in Table 2, the first model includes only three explanatory variables: one of interest (parents' education level) and two control variables (students' sex and sexual activity among young people due to frequent alcohol consumption). The second model adds three control variables to the predictor variables of the first model: perception of risk (marijuana), perception risk-pbc, and drug acquisition. The coefficients of determination (R^2) were estimated with the usual standard errors of ordinary least squares (OLS), that is, without the necessary adjustment. The third model also incorporates the same explanatory variables as model 2; however, it records the particularity of obtaining standard errors robust to heteroscedasticity (data heterogeneity), given the suspicion that the variance of the unobservable error μ is not constant.

Table 2: Alternative regression models and selection of the final model for predicting frequent drug use.

Variable	Model 1	Model 2	Model 3
Parent-educator			
- Secondary Coef.	-0.337	-0.270	-0.270
P	0.069	0.146	0.300*
- TechniqueCoef	-0.667	-0.645	-0.645
P	0.000	0.001	0.011
- Superior Coef.	-1.095	-1.060	-1.060
P	0.000	0.000	0.000
Sex Coef.	0.356	0.304	0.304
P	0.011	0.036	0.091
Sex/alcohol Coef.	0.439	0.367	0.367
P	0.004	0.019	0.023
Percept. risk-marijuana			
- Slight Coef.		0.098	0.098
P		0.802	0.759*
- Moderate Coef.		-0.320	-0.320
P		0.085	0.033
- High Coef.		-1.430	-1.430
P		0.126	0.000
Percentage risk-pbc:			
- Slight Coef.		-1.460	-1.460
P		0.148	0.001
- ModerateCoef.		-1,670	-1,670
P		0.084	0.000
- High Coef.		-2.090	-2.090
P		0.044	0.000
Difficulty acquiring drugs:			
Coef.		-0.287	-0.287
P		0.038	0.050
- Cons Coef.	0.301	2,210	2,210
P	0.078	0.025	0.000
Number of observations	236	236	236
R2	0.144	0.167	0.210
emse	0.922	0.913	0.913
* The effect observed by coefficients that are not different from zero is explained later in one of the categories of an ordinal explanatory variable.			

The results of the three alternative regression models, considering the coefficients and probabilities of the variables of interest and control, are also presented in Table 2. In a preliminary assessment, we can conclude that the linear regression model three (model 3) best fits the observed data. Two empirical reasons support this conclusion:

In terms of goodness of fit, first, the coefficient of determination (R^2) of the multiple linear regression is higher ($R^2 = 0.210$) than that observed in each of the two remaining models ($R^2 = 0.144$ and $R^2 = 0.167$). This means that the independent or predictor variables of model 3 explain a greater proportion of

the variance of Y (the dependent variable): 21% versus 14.4% and 16.7%, respectively. Second, model 3, compared to model 1, reports a lower mean squared standard error (rmse = 0.913 vs. rmse = 0.922), although it does not differ from that reported by model 2 (rmse = 0.913), but with the advantage of having a higher coefficient of determination ($R^2 = 21\%$). This means that 79% of the variation in model 3 comes from unobserved variables, not included in the model, which essentially constitute the error terms.

In summary, of the three alternative multiple regression models, the choice of model 3 is clear: it exhibits a higher

coefficient of determination (R^2) and a lower root mean squared standard error (RMSE). Therefore, from this point forward, all estimations, analyses, and interpretations will be based on multiple regression model 3.

Estimation of the final multiple regression model: analysis and interpretation of the estimated coefficients

The linear function of the explanatory and control variables, evidenced in the regression equation (see subtopic 2.4), which allow explaining and predicting the value of the total variability of the dependent variable, called Factor 2, is reported in Table 3. From the results obtained, it is appropriate to focus on the analysis and final interpretation of the estimated coefficients.

The overall multivariate model three (see Table 2) is statistically significant. This implies rejecting the null hypothesis: all the model's coefficients of determination are 0 in the population. However, the coefficient of determination (R^2) is not very high; only 21% of the total variance of the dependent variable, Factor 2, is explained by the predictor variables included in the model. That is, 79% of its variation stems from unobserved variables, not included in the model, which essentially constitute the error terms. However, based on similar studies, it is very likely that the omission of psychosocial variables, academic performance, social relationships, etc., observed by students both inside and outside the educational institution, explains the magnitude of the proportion not explained by the regression model, despite reporting statistically significant partial coefficients.

Table 3: Multiple linear regression model: analysis and interpretation of the final coefficients of determination.

Factor2	Coef.	Robust Std. Err.	t	P> t	[95% Conf. Interval]	
Parents_educ						
Secondary	-.2702574	.2599256	-1.04	0.300	-.7824822	.2419674
Technical	-.6453637	.2508659	-2.57	0.011	-1.139735	-.1509925
Superior	-1.063633	.2665277	-3.99	0.000	-1.588869	-.5383981
Sex	.304118	.1793998	1.70	0.091	-.0494178	.6576539
Sexalcohol	.3674279	.1603752	2.29	0.023	.051383	.6834728
Marij_risk						
Mild	.0972563	.3176034	0.31	0.759	-.5283617	.7234142
Moderate	-.3201069	.1492563	-2.14	0.033	-.6142401	-.0259737
High	-1.427225	.2216991	-6.44	0.000	-1.864118	-.9903317
Pbc_risk						
Mild	-1.455176	.4200039	-3.46	0.001	-2.28286	-.6274912
Moderate	-1.674111	.336532	-4.97	0.000	-2.337301	-1.010921
High	-2.085434	.4471999	-4.66	0.000	-2.966713	-1.204156
Drug_acq	-.2865453	.1454962	-1.97	0.050	-.5732687	.0001781
_cons	2.209296	.4628949	4.77	0.000	1.297088	3.121504

Furthermore, before analyzing and interpreting the regression model results, two preliminary observations are necessary. First, the contribution of each of the twelve independent variables in the model, as shown in Table 3, to predicting the scores or values of the outcome variable, Factor 2, differs both in magnitude and in its relationship to frequent substance use: tobacco, alcohol, marijuana, cocaine, and crack cocaine. Second, regarding the explanatory variable of interest, "parental education," to demonstrate the influence of parental education on the frequent use of psychoactive drugs by their student children, it is necessary that the impact effects of the variables associated with educational level—calculated with respect to parents with only primary education—all be negative and increasing in absolute value. Therefore, the final results of the multiple regression model show:

First, the negative and increasing absolute value of the coefficients of determination associated with the three specific variables of "Parents' Education" (secondary, technical, and

higher education) confirms that having completed any level of education reduces the consumption of legal and illegal toxic drugs under study (Factor 2) by their children, compared to those from homes where parents report only primary education. Specifically, the coefficients of determination for the parents' education variable confirm that drug use in the last 30 days tends to decrease as the parents' level of education increases. Thus, the negative sign of the coefficients indicates that psychoactive drug use decreases by 1.06 percentage points (10.6%) when the average parents' educational level increases from primary to higher education, holding all other factors constant (*ceteris paribus*). Furthermore, although the probability coefficient of the Student's *t*-ratio for the secondary level is not statistically significant at the alpha level of 0.05 ($t = -1.04$, $P > |t| = 0.300$), the following two coefficients are significant.

Furthermore, considering the dichotomous nature of the regressors shown, the fact that their coefficients increase in absolute value provides evidence that each subsequent level

exhibits a positive marginal contribution to reducing substance use among their students. In short, the empirical evidence revealed not only confirms that the most significant marginal reduction in substance use occurs when parents attain higher education, but also that this level could potentially act as a protective factor against addictive use of legal and illegal drugs (Factor 2).

Secondly, the positive signs revealed by the coefficients of determination associated with the Dummy control variables “Sex” and “Sex-Alcohol” (Sexual relations under the influence of alcohol) are as expected. The data show that male university students consume, on average, more psychoactive drugs, 0.30 percentage points (3%), both legal and illegal, which constitute Factor 2, compared to their female counterparts, all other factors being equal. Regarding the variable “Sexual relations under the influence of alcohol” (Sex-Alcohol), frequent substance use also increases by a similar proportion, 0.37 percentage points (3.7%), compared to university students who report not having engaged in such relations. Furthermore, this evidence leads us to infer that the combination of sexual relations and alcohol consumption exacerbates the use of marijuana and/or crack cocaine, thus contributing to a clinical picture of polydrug use.

Moreover, although the probability coefficient of the sex variable is not statistically significant at the critical level of 0.05; however, the sex-alcohol control variable is significant at the alpha level of 0.05. Therefore, the analyzed data confirms, on the one hand, that the consumption of toxic drugs of Factor 2 tends to be higher in male students, and even more so when they engage in sexual relations under the influence of alcohol and, on the other hand, that the dummy variables sex and sex-alcohol are powerful risk factors for a higher probability of frequent consumption of psychoactive drugs.

Third, regarding the explanatory control variable “Risk Perception” for health, associated with frequent marijuana use (Risk-marijuana) and cocaine base (Risk-cocaine), the results show negative coefficients of determination overall, except for the Low risk level indicated by the “Risk-marijuana” variable. These coefficients demonstrate, first, that as the degree of risk perception increases from “No risk” to “High risk,” frequent marijuana use decreases by 1.43 points (14.3%) and cocaine base use by 2.08 points (20.8%), while the other predictor variables remain constant. Second, the marginal reduction in frequent drug use is associated with the students’ accurate risk perception.

Furthermore, while the Student’s t-ratio probability coefficient for the “Risk-marijuana” perception at the low level was not statistically significant at the alpha level of 0.05 ($t = 0.31$, $P > |t| = 0.759$), the subsequent coefficients for the “Risk-marijuana” and “Risk-cocaine” perceptions were statistically significant. Indeed, the statistical results confirm that the consumption of illegal psychoactive substances (marijuana and cocaine) by university students tends to decrease as their perceived risk of frequent use increases. Therefore, a higher perceived health risk associated with frequent cannabis and cocaine use is a

clear protective factor, while a lower perceived risk among students is a potential risk factor.

And, fourth, regarding the explanatory control dummy variable “Drug Acquisition” (Acq-drugs), specifically illicit cannabis and cocaine base and/or cocaine, associated with frequent use, the coefficient of determination shows that frequent substance use tends to decrease as the acquisition of psychoactive drugs on the market becomes more difficult. The coefficient of determination, $R^2 = -0.287$, reveals that frequent substance use decreases by 0.29 percentage points (2.9%) when drug acquisition changes from “Easy” to “Difficult.” In summary, the data confirm that frequent use of marijuana, cocaine base, and/or cocaine tends to decrease if the degree of difficulty in acquiring them on the illicit market increases. Therefore, greater difficulty in accessing these drugs on the market is a powerful protective factor for students’ health; conversely, less difficulty in accessing them is a clear risk factor for their health.

Furthermore, what proportion of the variance in the dependent variable, Factor 2, does each predictor variable explain? This question is answered by multiplying the beta coefficients (standardized coefficients)—those that best represent the contribution of each independent variable to the prediction of Y—and the correlation coefficients of the final model under consideration. Table 4 provides information on this contribution.

First, “Parental Education” is the independent variable that explains the largest proportion of variance (10%), followed by “Sexual Relations Under the Influence of Alcohol” (3%). These two predictor variables alone explain 13% of the total variance in Y, more than half of the total explained. Second, the contribution of the variables “Risk-Marijuana” and “Risk-PBC” is very modest, which may lead to reconsidering their inclusion in future studies.

Finally, in summary and as a future challenge, the overall multiple regression model analyzed is statistically significant and acceptable.

Table 4: Percentage of variance of Y that each independent variable manages to explain.

Variables	R1	Beta2	r*□
Father-ed.	-0.332	-0.296	0.100
Sex	0.203	0.132	0.027
Sex, alcohol	0.203	0.143	0.030
Risk – marijuana	-0.053	-0.145	0.010
PBC Risk	-0.079	-0.171	0.014
Acquisition of drugs	-0.202	-0.127	0.026
Total variance explained*	0.206		

¹Correlation coefficients of the final multiple regression model

²Standardized beta coefficients

*Due to rounding effects, it does not exactly match $R^2=0.208$

It can clearly be improved by including other relevant explanatory variables. In particular, those associated with academic performance, relationships with teachers and peers, use of free time, leisure habits, etc. Ultimately, since the final goal is to prevent the use of addictive substances, it is essential to identify the most relevant risk and protective factors to achieve a more robust, effective, efficient, and above all, parsimonious substantive logical multifactorial regression model that considers a smaller number of predictor variables.

Discussion

This research aimed, on the one hand, to establish the dimensions of the dependent variable and, on the other hand, to evaluate through three alternative models some risk and protective factors that contribute to predicting the frequent use of psychoactive drugs in young university students in the Health Sciences area of a private university in Arequipa, Peru.

First, a result of this work regarding the factor analysis for the constitution of the dimensions or factors of the dependent variable (frequent use of psychoactive substances) showed two dimensions or groups of drugs (Factor 1 and Factor 2), which together explain 44.5% of the total variance of the dependent variable (Y), a proportion that can be considered moderate. This evidence revealed a discrepancy with previous research that groups frequent use of toxic drugs into three factors in adolescent (Muñoz-Rivas, 2001; García, 2003) and university (Gil-García et al., 2013) populations, which together predict more than 50% of the total variability of the dependent variable.

However, the results of the aforementioned studies, including the present one, empirically corroborate how psychoactive substances are actually grouped and used. On the one hand, they show that single-drug use is virtually nonexistent among adolescents and university students. On the other hand, during periods of revelry, nightlife, and similar activities, multiple drug use predominates, a likely pattern of polydrug use involving various legal and illegal substances (Hernández Serrano et al., 2015; Isorna & Arias, 2022). In short, as international literature demonstrates, there is a typical escalation phenomenon (scoppetta et al., 2022) from legal to illegal drugs, which multiplies the toxicity and severity of their physical, psychological, and social consequences for user groups.

Secondly, regarding the multivariate regression analyses to specify the predictive value of the best risk and protective factors in frequent drug use (Factor 2). The results of regression model three revealed:

Regarding the explanatory variable of interest, "Parental Education," this study reported that substance use tends to decrease as the average level of education of parents increases. This information is consistent with the results reported in previous research on the general population (SIIS, 2014), adolescents (Melotti et al., 2011), and university students (Martín et al., 2022). Indeed, the multivariate statistical data analyzed show that a high level of education (university)

is a protective factor against drug use, while a low level of education (primary) constitutes a risk factor that increases the frequent use of psychoactive substances, particularly Factor 2 drugs: tobacco, alcohol, marijuana, crack cocaine, and cocaine. Regarding the explanatory control variables "Sex" and "Sexual relations under the influence of alcohol," the results of the coefficients of determination in this study revealed, first, that male university students, compared to their female counterparts, consume on average more legal and illegal drugs considered in Factor 2. This evidence is consistent with findings in the international literature. In adolescent and university populations in Portugal, it has been confirmed that males consume higher proportions of tobacco, alcoholic beverages, and marijuana, with statistically significant differences favoring the male gender (Martins et al., 2019); while in Mexican university populations, a similar trend is reported, including statistically significant differences favoring males (Landeros et al., 2021; Noroña et al., 2022). Therefore, the literature reports that sex, specifically male, is a risk factor that influences the more frequent consumption of cigarettes, alcohol, marijuana, and cocaine. On the other hand, being a woman is a protective factor against the consumption of the aforementioned psychoactive substances.

Second, students who had sex under the influence of alcohol consumed a higher proportion of toxic substances compared to young people who reported not having had sex. This finding corroborates data from three studies of university students. The first reveals that the use of addictive drugs is a risk factor for engaging in risky sexual behaviors (Nieves, 2010). The second shows that risky sexual behaviors, unprotected sex, and experiencing sexual abuse among alcohol consumers in the past year show significant differences ($P < 0.05$) compared to non-consumers (Redondo-Martín et al., 2021). The third confirms that consuming alcoholic beverages increases the likelihood of not using protection during sexual intercourse by 1.6 times (Gil-García et al., 2013).

Moreover, the correlations continue to grow. According to Martins et al. (2019), Portuguese university students who consume alcoholic beverages are twice as likely to use tobacco ($OR = 2.40$) and almost three times more likely to use cannabis ($OR = 2.97$). Indeed, it is evident that alcohol consumption and engaging in sexual activity under its influence exacerbate the use of psychoactive drugs, fostering a clinical picture of polydrug use. Furthermore, sex, specifically being male, and engaging in sexual activity under the influence of alcohol represent risk factors for young university students; conversely, being female and not having consumed alcohol may be protective factors against the use of psychoactive drugs.

This research, regarding the variable "Risk Perception" for health, associated with the frequent consumption of toxic substances, cannabis, and crack cocaine, demonstrated that when the degree of risk perception increases from "Low" to "High," marijuana use decreases by 1.43 points and crack cocaine use by 2.08 points, while the other predictor variables remain constant. Two previous studies in university students

show concordant results: the first, when a high score was given for having irreversible health problems, showed that perception acts as a protective factor against cannabis use (Ruiz-Olivares et al., 2010); and the second, when a low score was given for having a traffic accident by a student who uses cocaine, indicated that the probability of cocaine use increases (Ruiz-Olivares et al., 2011).

Furthermore, two studies of Mexican university students also show converging data, revealing, on the one hand, a statistically significant negative relationship between risk perception and the amount of alcoholic beverages consumed (Rodríguez et al., 2022), and, on the other hand, that students who do not currently consume alcohol have a higher overall risk perception regarding the harmful effects of alcohol use on health, with a highly significant probability, $P = 0.000$ (Cortés et al., 2021). Therefore, the trend in research, including the present study, demonstrates that a higher perception of health risk associated with the consumption of marijuana, cocaine, alcohol, etc., is a clear predictor of lower consumption of these addictive substances and, consequently, becomes a clear protective factor for maintaining good health. While a lower perception of risk derived from the frequent consumption of the aforementioned toxic substances is a clear predictor for their greater probability of consumption and can become a risk factor for the health of consumers.

Finally, regarding the dummy variable “Drug Acquisition,” our study’s findings demonstrated that marijuana and cocaine base consumption decreases by 2.9% when the degree of accessibility to addictive substances changes from “Easy” to “Difficult.” This result corroborates the findings of two studies in university populations. The first, in the Andean countries, reports that greater ease of access to and availability of cannabis, cocaine base, and cocaine is related to higher consumption rates, particularly in Colombia and Ecuador (Preden/Devida Project, 2017). The second, in Colombian students, shows that university students who use illicit drugs are almost 3.6 times more likely ($OR=3.59$) to have obtained these substances in the past year compared to non-users (Scoppetta, 2020).

Furthermore, research in Latin America reports that adolescents with a high perception of the availability of drugs among their neighbors are more likely to increase their consumption over time ($OR=11.00$, Scheleimer et al., 2019). Additionally, low prices and drug availability near schools are risk factors for adolescents’ drug accessibility (Dash et al., 2020). Indeed, when access to drugs is more difficult, adolescents and young adults are less likely to use drugs. Therefore, less easy access to drugs is a potent risk factor; conversely, greater difficulty in accessing addictive drugs becomes a potent protective factor against psychoactive substance use.

Conclusions

A strength of this research was its use of a probabilistic sample of health sciences students to construct, through factor analysis, the dimensions of the dependent variable (Y) and to evaluate, using three alternative regression models, the extent

to which certain risk and protective factors (independent or predictor variables) have a causal relationship and contribute to explaining and predicting the performance of the criterion or dependent variable (frequent consumption of toxic substances). Furthermore, in the case of Arequipa, and especially in Peru, Latin America, and the Caribbean, there are few, if any, research studies that utilize multivariate statistical techniques in the analysis and interpretation of data.

This research compared three alternative multiple linear regression models to explain the total variance of the criterion variable (Y). Model three proved statistically significant, as the coefficient of determination (R^2) of the predictor variables explained a greater proportion (21%) of the variance of Y (the dependent variable) and showed a lower mean squared standard error (rmse). This did not differ from that reported by model two, but it exhibited a higher coefficient of determination. As a result, the aforementioned model identified the following as potential risk factors predicting more frequent psychoactive drug use: lower parental education level, male gender, and sexual activity under the influence of alcohol; lower perceived health risks associated with marijuana and cocaine base; and easier access to illicit drugs on the market.

Second, the study also revealed clear protective factors that reduce the rates of frequent psychoactive substance use: the higher average level of education among parents, less frequent alcohol consumption among students (which prevents both risky sexual behavior and polydrug use due to its effects), a greater perception of health risks associated with frequent marijuana and crack cocaine use, and greater difficulty in accessing addictive substances on the market. Indeed, the more difficult it is to access drugs on the market, the lower the likelihood of their use among university students.

In summary, the data resulting from this research could contribute to the advancement of knowledge in the area of addiction and health. First, it could include explanatory variables that can predict not only increased consumption (risk factors) but also reduction or abstinence (protective factors), in order to address the growing public health and social problem associated with the consumption of psychoactive substances among the university population. Second, it could contribute to the development of targeted prevention and support programs based on empirical evidence, aimed at steering university students away from the increasing consumption of toxic drugs, improving academic performance, and preserving the individual and collective well-being of the university population.

One limitation of this study is the failure to consider and evaluate compliance with the basic assumptions of multiple linear regression analysis before performing the analysis and final interpretation of the estimated coefficients of determination, which is necessary for making consistent and efficient inferences. We will address this gap in a future publication.

Recognition

With deep appreciation and respect, this posthumous tribute honors Lino Gustavo Benavente Butrón, a great researcher, colleague, and friend. This work was self-funded. However, we request the collaboration of social aid institutions to continue conducting academic research and contribute to promoting public health within the university community.

Conflict of Interest

The authors collectively declare that there are no conflicts of interest.

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