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Clinical Practice Study

Factors associated with tobacco, alcohol, and other drug use among youth living in West Central Mexico

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Abstract**AIM**

To determine the prevalence of drug and substance abuse among high school students in Jalisco and its association with the severity of health, behavior and psychosocial problems in order to provide evidence for possible prevention and treatment needs.

METHODS

A multi-stage random sample of Jalisco high school students was given a paper-and-pencil survey based upon an adapted version of the drug use screening inventory (DUSI) ($n = 24699$; $n = 2832$). The DUSI showed adequate psychometric characteristics in this population. The statistical analyses accommodated the complex survey design with attention to unequal probability of selection and clustering of participants within schools and regions.

RESULTS

An estimated 44% of the students had smoked tobacco, one in five students was a current smoker, and one in four students used to smoke but had not smoked for one year or more. By contrast, 6.8% of the students reported having used marijuana, cocaine, or both. Behavioral problems, deviant peer affiliation, and troubled families were independently associated with drug use. One in two students who used tobacco or alcohol had used these drugs in the past year (46% and 54%, respectively), and one in four students who used marijuana or cocaine in their lifetime had used those drugs in the past year (28% in both cases).

CONCLUSION

The rates of cocaine use as well as the proportion of current users were higher than expected among high school students and indicate changing patterns of drug use in Mexico. These results corroborate that the general trend of drug use by youth in Mexico is increasing. Results from this study help us better understand the needs of at-risk youth and the need for new treatment and prevention strategies.

Key words: Tobacco; Alcohol; Marijuana; Illegal drugs; Mexico; Students; Epidemiology

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Core tip: Drug and substance use is a public health problem around the world. Prevention efforts are carried out with varying results. One of the main targets in prevention is the risk factors associated with drug use. There are several instruments to study the risk factors which provide critical information to establish guidelines to control and prevent drug use. We used a well known validated and accepted instrument (drug use screening inventory) to investigate the prevalence and psychosocial factors associated with tobacco, alcohol and drug use in high school students in Mexico. We found higher prevalence of substance use than expected: 44% of the students had smoked tobacco and one in five students was a current smoker while over 40% had history of binge drinking. On the other hand, 6.8% of the students reported having used marijuana, cocaine, or both. Behavioral problems, deviant peer affiliation, and troubled families were independently associated with drug use. These results will help in the application of control and prevention

programs among high school students. This is the first survey representative of a West Central state in Mexico: Jalisco which is an important Mexican state because it has a significant drug production and trafficking problem, and on the other hand, it provides a great number of migrants to the United States creating social, cultural and health problems associated with risk behaviors.

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INTRODUCTION

Drug use is a public health problem with increasing trends in Mexico^[1-3] where only tobacco and alcohol products are legally available while other drugs such as marijuana (except the recently legalized medical marijuana)^[4], cocaine, heroin, methamphetamines, and synthetic drugs of abuse are not. In fact, although the 2016-2017 National Drug, Alcohol and Tobacco Consumption Survey may not provide an accurate comparison with previous surveys on account of the modified methodology^[3], according to the National Addiction Surveys (Encuesta Nacional de Adicciones, ENA)^[1,2], the prevalence of cocaine and marijuana use almost doubled in the past decade. More specifically, in 2012, 43% of the individuals between the ages of 12-25 reported being exposed to drug use, among them half experimented with drugs, and 13% used drugs frequently^[1,2]. In spite of recent efforts to provide up-to-date epidemiologic information, since 1991 there has not been a published regional or state drug abuse survey performed in Jalisco, a state in the West Central Region of Mexico with a population of over 8 million. The most recent available information from the Mexican National Survey from 2016 estimated that 15.3% of the 12- to 65-year-old population in Jalisco had never used drugs^[3]. Among youths of high school age, the ENA estimated that 2.7% of males and 1.1% of females have used illegal drugs^[2]. However, these figures may not apply directly to Jalisco given the significant heterogeneity within this particular region. To the extent that drug use differs across rural/urban areas in Mexico^[5-7], pooled drug use estimates for the region may mask important within-region differences.

Interest in drug use trends in the State of Jalisco is warranted in light of its large population and a very strategic geo-politic location as a narcotic production enclave and a route for drug trafficking directed to the United States^[8]. Jalisco is also a large contributor of documented and undocumented workers to the United States, many of which make frequent

roundtrips^[9]. In addition, drug use may correlate with other risk behaviors that increase the risk of HIV/AIDS, viral hepatitis, and other sexually transmitted infections^[10,11]. Therefore, it is important to recognize that health profiles and risk behaviors in one region, and even a sub-region, may have consequences in many other regions in spite of geographic, language, cultural, and legal barriers.

Surveys are one of the main sources of information to understand the nature and extent of drug abuse in different populations, and they support evidence-informed development of policies and practice guidelines^[12]. Thus, in this study, we sought to improve on the few existing studies about treatment needs for drug abuse among youths in Mexico. Hence, the aim of this study was to investigate the prevalence of substance use and associated factors amongst high school students from the Mexican West-Central State of Jalisco, to identify treatment and prevention needs, and to explore the association between drug involvement and selected psychosocial covariates. We conducted the first survey representative of Jalisco's sub-regions performed in the 21st century.

MATERIALS AND METHODS

Data were collected through a cross-sectional survey using a multi-stage, random sample of high school students, from 10 geo-political sub-regions in the State of Jalisco, Mexico. A total of 25 public high schools participated in the survey. The mean number of students per school was 524 with a maximum of 2242 and a minimum of 132 (the sample included regional high schools and smaller high school "modules"). The universe included 24699 students and a final sample of 2832 students participated. The project was approved by the University of Guadalajara's Research Committee of the Health Sciences Center. We obtained authorization from the principal of each participating high school, and no school refused to participate in the study. The inclusion criteria were regular attendance in the participating school and consenting to participate in the study. Irregular students and students who did not complete the survey were excluded. At the time of the survey, students were informed that their participation was voluntary and they could choose not to participate in the survey without any penalties. Almost all of the students consented to participate in the study (only 4 refused). Data confidentiality and anonymity were explained twice; once in their classroom at the time of randomization, and once in the auditorium where all participants were gathered.

Procedures

We used a self-administered, school-based paper-and-pencil anonymous questionnaire. In each school, the survey was conducted in one day, and it was administered by the principal investigator and

members of the research team. The survey was administered at the school's auditoriums. To assure and preserve confidentiality, no teachers or school staff members were allowed to be present in the auditorium at the time of the application, nor were they allowed to see the completed questionnaires. The questionnaires were scanned with an optical reader which recorded filled or blank dots.

Measures used

Students completed the abbreviated Spanish version of the drug use screening inventory (DUSI) for youth developed by Tarter^[13] and further adapted for the Mexican population by Diaz *et al.*^[14]. The abbreviated DUSI-RM includes 95 yes/no questions assessing the 10 domains of drug and alcohol use, psychiatric disorders, health status, behavior patterns, school performance, family system, peer relationships, social competence, work adjustment, and leisure/recreation. Of particular interest for the present analyses is the substance abuse domain which assesses the type and substance use on the day of the survey, as well as the past week, month, year, and before then. In addition, the survey questionnaire includes questions on demographics such as age, gender, high school grade, occupation, family income, school shift, and school location (urban vs rural).

As with the original DUSI and other adaptations for Latin American countries^[15], the DUSI-RM in this sample had good to excellent reliability, with a 0.79 Chronbach's alpha coefficient for the overall instrument and domain-specific scores^[16] ranging from 0.57 to 0.80. Due to non-normality of the data, each participant's domain-specific scores were recoded into three levels to contrast the bottom two deciles (No Problem) from the six subsequent deciles (Low Problem), and the highest two deciles (High Problem).

Statistical analysis

After exploratory data analyses to check for variable distribution and data preparation for multivariate analyses, logistic regression models were used to estimate the association of each DUSI-RM domain with tobacco use, alcohol use, as well as marijuana and cocaine use, while controlling for age, sex, and socio-economic status (SES). The analyses were done with STATA version 10.0 (STATA Corp, College Station, TX, United States), and they accommodated the complex survey design with attention to unequal selection probabilities and clustering of participants within schools^[17].

RESULTS

Table 1 summarizes results regarding drug involvement in the surveyed sample. More than half of the students (55.8%) had never used tobacco, one in five (20.2%) had smoked it in the past year, and about

Table 1 Drug and substance use by high school students in Jalisco, Mexico (n = 2816)

Prevalence	Tobacco use		Binge drinking		Marijuana		Cocaine		Any illegal	
	n	%	n	%	n	%	No.	%	n	%
Never	1564	55.77	1590	57.03	2596	92.48	2611	92.50	2517	89.47
Past year	556	20.21	984	35.01	129	4.41	127	4.84	191	6.83
Former	696	24.02	242	7.96	91	3.11	78	2.66	108	3.70

Table 2 Cross-tabulation of past-year tobacco, alcohol, and illicit drug use by socio-demographic characteristics and drug use screening inventory problem areas (n = 2816)

Variables	Total (n %)	Past year smoking (n %)			Past year alcohol use (n %)			Past year illicit drug use (n %)		
		No	Yes	P value	No	Yes	P value	No	Yes	P value
Total	2816 (100)	2260 (79.8)	556 (20.2)	n/a	1832 (65.0)	984 (35.0)	n/a	2721 (96.6)	191 (6.8)	n/a
Age (yr)										
>16	2358 (83.7)	1875 (79.2)	483 (20.8)	0.112	1482 (62.8)	876 (37.2)	< 0.001	2183 (92.5)	175 (7.5)	0.005
≤ 16	458 (16.3)	385 (82.8)	73 (17.2)		350 (76.1)	108 (23.9)		442 (96.3)	16 (3.7)	
Gender										
Female	1460 (52.0)	1223 (83.7)	237 (16.3)	< 0.001	1050 (71.8)	410 (28.2)	< 0.001	1413 (96.8)	47 (3.2)	< 0.001
Male	1356 (48.0)	1037 (75.5)	319 (24.5)		782 (57.6)	574 (42.4)		1212 (89.3)	144 (10.7)	
Employment										
Not working	1937 (69.5)	1590 (81.5)	347 (18.5)	0.013	1279 (65.9)	658 (34.1)	0.097	1828 (94.2)	109 (5.8)	0.01
Employed	879 (30.5)	670 (75.9)	209 (24.1)		553 (62.9)	326 (37.1)		797 (90.7)	86 (9.3)	
Behavioral pattern										
No problem	622 (22.5)	558 (89.6)	64 (10.4)	< 0.001	497 (79.5)	125 (19.5)	< 0.001	607 (98.0)	15 (2.0)	< 0.001
Low	1651 (58.2)	1341 (81.0)	310 (19.0)		1094 (66.3)	557 (33.7)		1556 (94.1)	95 (5.9)	
High	543 (19.3)	361 (64.7)	182 (35.3)		241 (44.2)	302 (55.8)		462 (84.8)	81 (15.2)	
Psychiatric disorder										
No problem	564 (19.9)	471 (83.4)	93 (16.6)	0.002	403 (71.6)	161 (28.4)	< 0.001	534 (94.7)	30 (5.3)	0.104
Low	1692 (60.1)	1377 (80.9)	315 (19.1)		1122 (65.9)	570 (34.1)		1585 (93.6)	107 (6.4)	
High	560 (20.0)	412 (72.9)	148 (27.1)		307 (55.8)	253 (44.2)		506 (90.4)	54 (9.6)	
Social competence										
No problem	565 (19.8)	463 (81.2)	102 (18.8)	0.44	364 (65.1)	201 (35.0)	0.016	525 (92.9)	40 (7.1)	0.741
Low	1683 (60.2)	1339 (79.2)	344 (20.8)		1074 (63.5)	609 (36.5)		1567 (93.1)	116 (6.9)	
High	568 (20.0)	458 (80.0)	110 (20.0)		394 (69.3)	174 (30.7)		533 (93.7)	35 (6.3)	
Family system										
No problem	574 (20.3)	510 (88.4)	64 (11.6)	< 0.001	474 (83.6)	100 (16.4)	< 0.001	560 (97.8)	14 (2.2)	< 0.001
Low	1676 (60.0)	1352 (80.2)	324 (19.8)		1083 (63.9)	593 (36.1)		1570 (93.6)	106 (6.5)	
High	566 (19.7)	398 (69.8)	168 (30.2)		275 (49.0)	291 (51.0)		495 (87.2)	71 (12.8)	
School adjustment										
No problem	824 (29.3)	747 (90.2)	77 (9.8)	0.001	659 (80.1)	165 (19.9)	< 0.001	805 (98.1)	19 (1.9)	< 0.001
Low	1425 (50.7)	1161 (81.1)	264 (18.9)		946 (66.2)	479 (33.8)		1364 (95.5)	61 (4.5)	
High	567 (20.0)	352 (61.2)	215 (38.8)		227 (39.7)	340 (60.3)		456 (80.1)	111 (19.9)	
Peer relationship										
No problem	596 (21.4)	543 (91.2)	53 (8.8)	< 0.001	481 (81.3)	115 (18.7)	< 0.001	592 (99.3)	4 (0.7)	< 0.001
Low	1656 (58.5)	1340 (80.3)	316 (19.7)		1089 (65.5)	567 (34.5)		1581 (95.5)	75 (4.5)	
High	564 (20.1)	377 (66.3)	187 (33.7)		262 (46.2)	302 (53.8)		452 (79.8)	112 (20.2)	
Leisure/recreation										
No problem	573 (19.9)	511 (88.6)	62 (11.4)	< 0.001	452 (80.3)	121 (19.7)	< 0.001	560 (98.3)	13 (1.7)	< 0.001
Low	1677 (60.2)	1362 (80.6)	315 (19.4)		1112 (65.8)	565 (34.2)		1571 (93.4)	106 (6.7)	
High	566 (19.9)	387 (68.4)	179 (31.6)		268 (47.2)	298 (52.8)		494 (87.5)	72 (12.5)	

one in four (24%) had used tobacco at some time more than a year before. Also, more than half (57.0%) stated they had never gotten drunk, one third (35.0%) had experienced it in the past year, and an additional 8% had gotten drunk at some time more than a year before. In total, 7.5% of the students reported to have used marijuana on at least one occasion, and 4.4% had used it in the past year. A similar proportion of students had a history of cocaine use, and 4.8% had used in the past year. Although there can be much overlapping between marijuana and cocaine use, it is important to note that close to one in 15 students

(6.8%) had ever used an illegal drug, the majority of them within the past year.

Table 2 provides data on sample characteristics and rates of past year use of tobacco, alcohol, and illicit drugs based on age, sex, working status, and DUSI domains. The age range of the participants was 14 to 22 years, and most (83.7%) were 16 years of age or older; 52% were female, and 48% were male. About a third of the students (30.5%) had a part-time or full-time job. The overall percentage distribution of students by DUSI-problem area score conformed to the expected 20% for the top scores (high problem),

Table 3 Association of past year tobacco, alcohol, illicit drug use and drug use screening inventory-RM domains among high school students in the State of Jalisco, Mexico (*n* = 2816)

Variables	Past year smoking				Past year alcohol use				Past year illicit drug use			
	aOR	95%CI		P value	aOR	95%CI		P value	aOR	95%CI		P value
Age (yr)												
>16	1.00		Reference		1.00		Reference		1.00		Reference	
≤ 16	0.94	0.70	1.24	0.628	0.56	0.46	0.69	< 0.001	0.56	0.34	0.90	0.020
Gender												
Female	1.00		Reference		1.00		Reference		1.00		Reference	
Male	1.26	0.93	1.72	0.127	1.61	1.36	1.91	< 0.001	2.28	1.44	3.61	0.001
Employment												
Not working	1.00		Reference		1.00		Reference		1.00		Reference	
Employed	1.14	0.83	1.56	0.412	0.81	0.66	1.01	0.058	1.03	0.73	1.46	0.870
Behavioral pattern												
No problem	1.00		Reference		1.00		Reference		1.00		Reference	
Low	1.63	1.21	2.19	0.002	1.43	1.09	1.88	0.012	2.04	1.03	4.02	0.040
High	2.62	1.91	3.59	< 0.001	2.34	1.72	3.18	< 0.001	3.11	1.51	6.40	0.004
Psychiatric disorder												
No problem	1.00		Reference		1.00		Reference		1.00		Reference	
Low	0.79	0.63	0.99	0.045	0.84	0.71	1.01	0.063	0.60	0.24	1.46	0.244
High	0.89	0.66	1.22	0.458	0.88	0.67	1.15	0.329	0.58	0.23	1.45	0.230
Social competence												
No problem	1.00		Reference		1.00		Reference		1.00		Reference	
Low	1.86	1.45	2.40	< 0.001	1.83	1.47	2.27	< 0.001	1.65	1.09	2.49	0.019
High	3.00	2.26	3.98	< 0.001	2.40	1.87	3.06	< 0.001	2.93	1.53	5.65	0.003
Family system												
No problem	1.00		Reference		1.00		Reference		1.00		Reference	
Low	1.23	0.91	1.65	0.168	2.01	1.60	2.53	< 0.001	1.70	0.91	3.16	0.092
High	1.53	1.04	2.24	0.031	2.75	2.16	3.50	< 0.001	2.29	1.29	4.06	0.007
School adjustment												
No problem	1.00		Reference		1.00		Reference		1.00		Reference	
Low	1.80	1.18	2.74	0.008	1.57	1.18	2.10	0.004	1.54	0.63	3.78	0.326
High	3.51	2.25	5.45	< 0.001	3.25	2.30	4.58	< 0.001	4.77	1.65	13.78	0.006
Peer relationship												
No problem	1.00		Reference		1.00		Reference		1.00		Reference	
Low	1.90	1.41	2.56	< 0.001	1.54	1.19	1.99	0.002	3.82	1.09	13.43	0.038
High	2.47	1.70	3.61	< 0.001	2.01	1.49	2.71	< 0.001	11.53	2.80	47.44	0.002
Leisure/recreation												
No problem	1.00		Reference		1.00		Reference		1.00		Reference	
Low	1.37	0.89	2.12	0.140	1.53	1.22	1.92	0.001	2.35	1.17	4.70	0.018
High	1.72	1.15	2.59	0.011	2.12	1.48	3.05	< 0.001	2.43	1.21	4.87	0.015

All estimates were obtained accommodating the complex sample design. aOR: Adjusted odds ratio.

50%-60% for those with intermediate scores (low problem) and 20% for those with the lowest scores (no problem level).

Results of the bivariate analyses for smoking tobacco in the past year are presented in columns 3 to 5 of Table 2. No statistically significant difference was observed based on age, but the rate was higher among males compared to females (24.5% vs 16.3% respectively; $P < 0.001$), and among youth who studied and worked, compared to those who did not (24.1% vs 18.5%, respectively; $P < 0.02$). The rate of smoking in the past year was also higher in the student population with the top 20% scores in DUSI problem areas compared to those with lower scores ($P < 0.001$).

As presented in columns 6 to 8 of Table 2, an estimated 35% of the students reported alcohol consumption within the past-year, and the rate was higher among older students (those 16 and older, 37.2%), males (42.4%), and those with higher DUSI

scores, except the "Social Competence" domain.

Results in terms of illegal drug use (mainly marijuana or cocaine) are summarized in the last three columns of Table 2. The overall prevalence of past-year illegal drug use (mainly marijuana or cocaine), was 6.8%. Similar to tobacco and alcohol use, the prevalence of illicit drug use was higher in older students compared to younger students (7.5% vs 3.7%, respectively, $P = 0.005$). The rates were also higher among males compared to their female counterparts (10.7% vs 3.2%, respectively, $P < 0.001$), those who worked and studied compared to those who did not (9.3% vs 5.8%, respectively, $P < 0.001$), and those with higher DUSI scores ($P < 0.001$) in most problem areas.

Multivariate analyses were conducted to examine the association between different DUSI domains with past year tobacco, alcohol, and drug use while controlling for participants' socio-demographic characteristics. Table 3 summarizes the results,

including adjusted odds ratios (aOR) and 95%CI.

Past year tobacco use showed no statistically significant association with age, gender, or employment status. However, the odds were higher among students who had the top 20% scores in the DUSI problem areas, specifically on "Behavioral Pattern" (aOR = 2.62); "Social Competence" (aOR = 3.00); "Family System" (aOR = 1.53); "School Adjustment" (aOR = 3.51); "Peer Relationships" (aOR = 2.47) and "Leisure/Recreation" (aOR = 1.72) (Table 3). An association with tobacco smoking in the past year was also observed for the group with intermediate scores (*i.e.*, the 20-80 percentiles grouped together) in certain DUSI problem areas, such as "Behavioral Patterns" (aOR = 1.63); "Social Competence" (aOR = 1.86); "School Adjustment" (aOR = 1.80); and "Peer Relationships" (aOR = 1.90). On the other hand, an inverse association was observed between smoking in the past year and the students with top 20% scores on the "Psychiatric Disorder" domain (aOR = 0.89).

In terms of binge drinking in the past year, students who were 16 years and younger had about half the odds compared to older students (aOR = 0.56; 95%CI: 0.46-0.69; $P < 0.001$), and odds were higher in males than females (aOR = 1.61; 95%CI: 1.36-1.91; $P < 0.001$) (Table 3). Those employed had lower odds of alcohol consumption during the past year, albeit with borderline statistical significance (aOR = 0.81; 95%CI: 0.66-1.01; $P = 0.058$). The odds were also higher for students with the highest scores in the DUSI problem areas. Students who had the top 20% of scores on most DUSI domains had consistently higher odds of alcohol consumption in the past year compared to those in the lowest 20%; the domains included "Behavioral Pattern" (aOR = 2.34); "Social Competence" (aOR = 2.40); "Family System" (aOR = 2.75), "School Adjustment" (aOR = 3.25), "Peer Relationships" (aOR = 2.01), and "Leisure/Recreation" (aOR = 2.12). With somewhat attenuated associations, participants who scored within higher than 20% and lower than 80% in most domains, had higher odds of past year's alcohol use compared to those who scored within the bottom 20%. For example, for students with intermediate scores in "Behavioral Pattern", the odds of past year drinking were about 1.5 times higher (aOR = 1.43; 95%CI: 1.09-1.88; $P = 0.012$), and so forth.

The last three columns of Table 3 convey the estimated association between past-year illegal drug use and DUSI psychosocial covariates, adjusted for all variables shown in the table. Younger students had lower odds of drug use than older students (aOR = 0.56; 95%CI: 0.34-0.90; $P = 0.02$). Males were estimated to have twice the odds of past-year drug use than females (aOR = 2.28; 95%CI: 1.44-3.61; $P = 0.001$). Most DUSI problem areas showed that students with higher scores had higher odds of illegal drug use than those with lower scores; these domains included "Behavioral Patterns" (aOR = 3.11; 95%CI: 1.51-6.40; $P = 0.004$); "Social Competence" (aOR =

2.93; 95%CI: 1.53-5.65; $P = 0.003$); "Family System" (aOR = 2.29; 95%CI: 1.29-4.06; $P = 0.007$); "School Adjustment" (aOR = 4.77; 95%CI: 1.65-13.78; $P = 0.006$); "Peer Relationships" (aOR = 11.53; 95%CI: 2.80-47.44; $P = 0.002$); and "Leisure/Recreation" (aOR = 2.43; 95%CI: 1.21-4.87; $P = 0.015$).

DISCUSSION

The DUSI has been used to measure the severity of problems in 10 different domains to allow identification of drug use problem areas and their relationship with psycho-social adjustment^[13,18]. The main findings of the present study demonstrate higher rates of tobacco (20.2%), alcohol (35%), and illegal drug use (6.8%) among high school adolescents in Jalisco, Mexico, compared to national rates reported by the ENA in 2002 (10.1%, 25.7%, and 4.6%, respectively), 2008 (alcohol 26.6%, illegal drugs 5.2%), and in 2012 (16%, 14.5%, and 1.6, respectively)^[1,2,19]. Compared to studies conducted in Mexico city with a similar research design to the present study, our findings are similar to those reported for tobacco (22.8%), alcohol (35.2%), and marijuana (3.95%) in high school students^[20]. The lifetime rate of cocaine use was higher than expected in this population (7.5%) and higher than the 1.6%-4.0% rates in comparable Mexico City surveys^[20,21]. This higher rate of cocaine use may indicate that the epidemiologic situation is changing and new patterns of drug use in Mexico are rising, which may be creating new treatment needs and complexities. The high combined rates of marijuana and cocaine use demonstrate a critical problem with illegal drug use in Jalisco's high schools, which add to the already high rate of binge drinking in this population.

There has been an increasing trend in drug use in Mexico^[3,22]. Reasons for this increase may be multi-factorial including the transition from a mainly trafficking country to a user country^[21,23,24], as well as the increased use of addictive "legal" substances, such as alcohol and tobacco, by youth. Therefore, it is important to understand the psychological and socio-demographic profile of youth at risk of developing substance use disorder in order to propose and develop effective local treatment and prevention interventions.

In this study, older age was significantly associated with past year use of alcohol, which is consistent with other studies^[25-28]. This may mean that older students in Jalisco also face a higher risk of alcohol-related consequences (*e.g.*, aggression, unprotected sexual activities, *etc.*) compared to younger students^[21,28]. Smoking among young people in Mexico increased from 10.1% in 2002 to 14.9% in 2008, and to 16% in 2012^[1,2,19]. This evidence calls for targeted school-based preventive interventions, along with better enforcement of regulatory measures, which has been recognized as a weak point in public health

policy^[30]. The results showed no age differences in the past year use of tobacco. This is problematic because it may be due to one or a combination of the following possibilities: (1) Youths are experimenting tobacco at younger ages; (2) those who initiate may be transitioning faster to regular tobacco use; (3) starting younger students may be finding it harder to quit. Each of these possibilities would require further investigation. In addition, it is important to note that these students are still within the age range with highest risk for experimenting or becoming a regular tobacco user, which highlights the importance of prevention and cessation interventions^[31].

Gender was found to be an important factor associated with higher odds of alcohol and illegal drug use, but not the use of tobacco products (Table 3), which is not consistent with findings from other studies^[26,27,32,33]. Replication of these findings and future research is needed to understand if there have been changes in cultural norms that have protected women from being exposed to opportunities to use tobacco (and other drugs)^[34,35].

The psychosocial factors explored in this study were found to be associated with the outcome measures in most of the domains. The predictive values and validity of the DUSI have been well documented in prior reports^[13,18,36,37]. Consistent with other research, higher scores in the subscale measuring problems of *Behavior Pattern* (aggressiveness and impulsivity) were found to be associated with substance use and could serve as a tool for screening, early detection, and intervention design^[26,27,38-41]. Higher scores in the subscale of *Psychiatric Disorders* were also associated with drug involvement. The utility of the DUSI for implicating current psychiatric diagnosis in adolescents has been demonstrated^[42]. In prior research, individuals with behavior and affection problems were estimated to be at a greater risk of using illegal drugs^[32,38,39]. In the present study, the bivariate analyses showed an association between "*Psychiatric disorders*" and both past-year smoking and alcohol use, but even with this large sample size, the study lacked sufficient statistical power to detect associations with past-year substance abuse. We could not find a significant association between this domain and past year use of any substances in the multivariate analyses either, but this could be due to the strong correlation between psychiatric disorders and the other DUSI domains simultaneously controlled for in the analysis, in addition to the relatively low statistical power. Of note is that there may be a misclassification of problem substance use disorders for up to 28% of the cases, which may as well bias the estimates towards the null hypothesis^[13]. Another explanation could be related to neurobehavioral disinhibition as explained by indicators of executive cognitive functioning, emotion regulation, and behavior control^[43], which we did not explore in this study. It has also been reported that the correlates from the psychiatric domain have not been able to

differentiate between experimenters and users^[44], which could be another possibility in our study.

Nevertheless, the findings highlight the importance of detecting mental health problems earlier and referring cases for specialized care^[26]. In this study, consistent with previous research, problems with "*Family System*" were associated with higher odds of using tobacco, alcohol, and illegal drugs. Family factors have been demonstrated to influence drug and substance use particularly at younger ages^[27]. Family issues are major risk factors to the overall health among children and adolescents, and they include parental adjustment problems, inadequate parental communication and affection, negative family interaction patterns, and poor relationship or weak parent-child bonding^[26,38-41]. On the other hand, family factors such as family attention, parental monitoring, and living in a two-parent household can also act as resilient factors^[25,32,45]. The subscale on "*Social Competence*" measures problems in areas such as social skills, assertiveness, and social interaction. In this study, participants with the highest scores in "*Social competence*" problems had higher odds of substance use. However, the opposite has also been observed by other researchers: those with stronger social competence skills had lower risks of alcohol use^[40]. These factors are important internal resources and can inform preventive interventions that specifically support those students in greater need.

The relationship between the use of substances such as tobacco products, alcohol, and illegal drugs and health problems is well documented^[26,46]. Tobacco is the leading cause of death globally, killing almost 480000 individuals every year in the United States alone^[47]. There is evidence of higher likelihood of disease and more severe addiction among those with early initiation of substance use^[25,28,38]. Programs that include school-based interventions have been shown to reduce tobacco use amongst youths and subsequently decrease the burden of diseases^[48]. Using alcohol and illegal drugs have severe social implications as well, including violence, absenteeism, poor academic performance, crime, and family disruptions^[16,38,39,49]. The social consequences increase with the level of abuse and addiction^[50,51]. Therefore, early identification and treatment of students with substance abuse will have greater impact on the individual lives, families, schools, and society. Control and prevention of drug use could be achieved using standardized screening instruments to identify those students with treatment needs and those with higher risk of getting involved with substances, followed by school-based interventions^[52]. However, interventions should be coordinated among different providers such as the National Prevention Program based on Clinics for the Attention and Prevention of Addictions and other organizations like the education department with its *Safe School* program^[53], in close collaboration with families and the surrounding community. Finally,

environmental interventions have proven to be very effective in reducing the risk of substance use. Some examples include enforcing age restrictions for sale and consumption to limit the access to and reduce the use of alcohol and tobacco products among high school students and correcting the exaggerated perception of normative values for using substances by peers^[54] to mention a few. Intervening through social networks, especially in partnership with student leaders, may be a promising approach in promoting healthy behaviors by influencing the social norms and reducing peer pressure in high schools^[55].

Mexico is a large and populous country, and there are stark regional differences (*i.e.*, North, Central, and South). Those differences are particularly evident in terms of the epidemiology and prevalence of drug use. Jalisco is one of the largest and most resourceful states in Mexico, but generalizing the results from the present study to other States should be done with caution. Another limitation of this study is that we only included youths at school, and there is an important segment of the youth population with no school access or attendance. Also, we are aware of the limitations of a cross-sectional study in terms of looking at "risk factors" as opposed to a longitudinal study. Nevertheless, data for the present analyses come from the first survey on drug use in the State of Jalisco in the 21st century, which used a probability sampling and is representative of the high school population of the State of Jalisco. The data were collected using a standardized questionnaire that was adapted and tested for the Mexican population. One limitation of this questionnaire (DUSI-RM) is that it asks about the time of use, but it does not measure frequency or the amount of substance use, or in the case of tobacco, the number of cigarettes. It does, however explore the relation of psycho-social factors with drug or substance use.

This study confirms trends of increasing prevalence of alcohol, tobacco, and illegal drug use among Mexican youths, with new patterns of drug use in Jalisco that may be creating new treatment needs. Drug use problems in Jalisco may be becoming more complex, requiring a set of prevention alternatives and control programs (as opposed to a one-fits-all approach). Appropriate interventions for both legal and illegal substances should be planned and executed accordingly. New prevention efforts are urgently needed to target youth at the early stages of drug use to stop or delay their further involvement. This is a new need as the proportion of new users is increasing.

ARTICLE HIGHLIGHTS

Research background

We sought to improve on the few existing studies about drug and substance abuse among high school students in Jalisco, Mexico; particularly its association with health, behavior and psychosocial problems in order to provide evidence for possible prevention and treatment needs. Jalisco is an important

state in Mexico for its strategic geo-politic location as a narcotic production enclave and a route for drug trafficking directed to the United States, and also because it is a large contributor of documented and undocumented workers to that country. The socio-economic change from a from a production entity to a consumer one could be taking place.

Research motivation

There has not been a published regional or state drug abuse survey performed in Jalisco, a state in the West Central Region of Mexico, for more than a decade. The most recent available information comes from the Mexican National Survey. However, the figures may not apply directly to Jalisco given the significant heterogeneity within this particular region on the one hand and on the other, because of the limitations of the methodology utilized for the national surveys: household and, most frequently, indirect interviews.

Research objectives

The aim objectives were to investigate the prevalence of substance use and associated factors amongst high school students from the Mexican West-Central State of Jalisco, to explore the association between drug involvement and selected psychosocial factors, and to identify treatment and prevention needs.

Research methods

We designed a cross-sectional survey using a multi-stage, random sample of 2832 high school students, from 25 public high schools distributed in 10 geopolitical sub-regions in the State of Jalisco, Mexico. The participants were given a paper-and-pencil survey based upon an adapted version of the drug use screening inventory (DUSI-RM). The DUSI showed adequate psychometric characteristics in this population. The statistical tests included multivariate analyses with logistic regression models to estimate the association of each DUSI-RM domain with the use of tobacco, alcohol, as well as marijuana and cocaine use, while controlling for age, sex, and socio-economic status. The analyses were done with STATA version 10.0 (STATA Corp, College Station, TX, United States).

Research results

An estimated 44% of the students had smoked tobacco and 35% of the students reported alcohol consumption within the past-year. The rate of alcohol use was higher among older students, males, and those with higher DUSI scores. By contrast, 6.8% of the students reported having used marijuana, cocaine, or both. Of all 10 DUSI domains behavioral problems, deviant peer affiliation, and troubled families were independently associated with drug use.

Research conclusions

The main findings of the present study demonstrate higher rates of tobacco, alcohol, and illegal drug use among high school students in Jalisco, Mexico, compared to national rates although similar to those reported for tobacco, alcohol, and marijuana in México city, the largest city in the country. Appropriate interventions for the use of both legal and illegal substances in young people should be planned and executed accordingly. New prevention efforts are urgently needed to target youth at the early stages of drug use to stop or delay their further involvement. These results suggest that there is an epidemiological transition in the prevalence and patterns of drug use in the state of Jalisco which could be influenced by geographical and economical factors like the local production of legal (alcohol) and illegal drugs (marijuana and methamphetamines). This is the first study representative of the West Central area in Mexico. These data corroborate national trends of increased prevalence of illegal drug use and, in some cases (cocaine), even higher rates. The results however, are similar to those from studies conducted in Mexico city, the largest city in the country. Some areas of the country, like Jalisco, may be changing from a predominantly productive area to a mixed productive-consumer area. We conducted a study in an area with a relatively high production of illegal drugs (marijuana and synthetic drugs) and obtained results of higher use rates than the national surveys and comparable to those obtained in the largest urban area of the country (Mexico city). Similar studies should be conducted in other high and low production areas to investigate the influence of production factors on drug use prevalence. With this study we could confirm the hypothesis that the prevalence of drug use in the State of Jalisco was higher than that reported

in national surveys. One of the reasons for those differences could be in the methods employed confidential direct anonymous questionnaires in this case compared to home indirect interviews in the national surveys. The methodology used for designing and conducting drug and substance use national surveys should be improved.

Research perspectives

We suggest that epidemiological studies by independent researchers with up-to-date methodology, similar to the one presented herein should be conducted in other Mexican states independently from official national surveys.

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