Subgrouping High School Students for Substance Abuse–Related Behaviors: A Latent Class Analysis

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Abstract

The aim of the current study was to characterize the prevalence of latent groups in terms of smoking, hookah, and alcohol in a sample of Iranian high school students. In this cross-sectional study, 4,422 high school students were assessed in East Azerbaijan Province, Iran. Latent class analysis was applied to determine the subgroups and prevalence of each class using the procLCA in SAS 9.2 software. The prevalence of hookah smoking was the highest among the other substances and had the greatest abuse among males than females. Nearly 86%, 9.5%, and 4.6% of the participants were low risk, tobacco experimenter, and high risk, respectively. The odds ratio indices of membership in each class, compared with the first class, associated with the independent variables. A fair number of students, males in particular, were identified as high risk-takers. Considering the simultaneous incidence of multiple high-risk behaviors, interventions must cover multiple aspects of the issue at the same time.

Introduction

Substance abuse is defined as a pattern of using a variety of substances such as alcohol, tobacco, and illicit drugs, which affects the mood of all age groups, adolescents in particular, with numerous side effects. In 2012, the United Nations Office on Drugs and Crime estimated that about 243 million (5.2%) of the world's population, generally youth, had used an illicit drug at least once in the previous year (Lemahieu & Me, 2014).

According to the literature, adolescents, compared with other age groups, are more engaged in risky behaviors such as alcohol and drug abuse, tobacco use, deviant behaviors, speeding, and unsafe sexual intercourse (Allahverdipour et al., 2007). In fact, adolescents may have feelings of invulnerability about the consequences of adventurous behaviors; thus, they engage in risky behaviors while not perceiving their risk and lack of safety out of ignorance about the consequences (O'Brien, VanEgeren, & Mumby, 1995; Seppa, 1997; Weinstein, 1980, 1987). Pumariega, Kilgus, and Rodriguez (2005) asserted that youth are confronted with a variety of issues such as peer pressure, school-related problem, and

sensation-seeking behaviors, which motivates or persuades adolescents toward substances use and abuse.

According to the World Health Organization (WHO; 2014), alcohol is a psychoactive substance, the excessive use of which leads to a large burden of diseases and problems for daily performance. The odds of dependency on alcohol among the adolescents who become alcoholic before the age of 15 years is four times greater than those who begin using alcohol at the age of 21 years (McNeely & Blanchard, 2010). The pattern of drinking alcohol varies worldwide. For example, 5.7% of Indian urban adolescents reported drinking in the past month (Mohanan, Swain, Sanah, Sharma, & Ghosh, 2014), 40% among both boys and girls in Arkhangelsk, Russia (Stickley et al., 2013), and 7.7% among Iranian college students

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(Mohammadpoorasl, Ghahramanloo, Allahverdipour, & Augner, 2014).

In addition to the side effect of alcohol on cognitive and neural functions of the brain (Squeglia, Jacobus, & Tapert, 2009), it is reported that violence among teenagers is related to the consumption of alcohol and marijuana as well as engagement in sexual relationships (Eaton, Davis, Barrios, Brener, & Noonan, 2007). Baskin-Sommers and Sommers (2006) have reported that drinking alcohol and using methamphetamine increased the risk of having multiple sexual partners and unprotected sexual intercourse.

In 2015, the National Institute on Drug Abuse reported that in spite of decrease in the drug abuse rate, 27.2% of the surveyed students had a history of illegal drug use in the year 2014. The past month use of marijuana among Grades 8, 10, and 12 students was 6.5%, 16.6%, and 21.2%, respectively (2014). In Iran, the rate of drug abuse was reported as 1.4% in one study (Mohammadpoorasl et al., 2012) and 8% in another (Mohammadpoorasl, Ghahramanloo, Allahverdipour, & Augner, 2014), which were lower than the global estimations. In 2014, the previous year use of ecstasy among Grade 10 American students was 2.3% (2014). Findings of an ethnographic investigation suggested that youth was aware of most of the side effects and social costs related to methamphetamine (Fast, Kerr, Wood, & Small, 2014). In Yugoslavia, 14.2% of the school pupils used psychoactive drugs, mostly marijuana, followed by amphetamines. An increased use of synthetic and psychoactive drugs among the youth was also reported (Pavlović & Jakovljević, 2008). In a study, it was indicated that 10% of Iranian adolescents had recently used ecstasy or heroine (Farhadinasab, Allahverdipour, Bashirian, & Mahjoub, 2008). Interestingly, associations among deaths from terrorism, war, one-sided violence, and increased alcohol and drug use have been reported globally (Kerridge, Khan, Rehm, & Sapkota, 2014).

In addition to drugs and alcohol, nicotine also causes brain cellular damage regardless of age (McNeely & Blanchard, 2010). Tobacco use in the youth, in addition to nicotine dependency, leads to head to toes complications and switching to other substances, and results in being engaged in other high-risk behaviors such as violence and unprotected sexual contact (WHO, 2009). American Cancer Society has reported a relationship between the earlier age of smoking initiation and increased risk of the related cancers during lifetime (2011-2012). Despite the confirmatory evidence of the side effects of tobacco use, the prevalence of smoking is still considerable (Warren et al., 2008). The global rate of smoking among students was estimated 9.5%, which varied from 3.8% to 8.4% in Iran (Mohammadpoorasl, 2013). As a new phenomenon, the use of hookah has been increasing worldwide; for example, in 2014, it was 22.9% among American Grade 12 students and 8.5% among Iranian adolescents (Mohammadpoorasl, Ghahramanloo, Allahverdipour, & Modaresi Esfeh, 2014).

A systematic investigation of these behaviors and the related factors can be instrumental in identifying the latent high-risk groups, which can enable us to design and implement interventional programs to alleviate the occurrence of risky behaviors. The interventions that focus on multiple factors or behaviors at the same time are most probably better and cost-effective. Numerous studies have been published on high-risk behaviors; however, very few have investigated the latent groups and their classification. The aim of this study was to identify the latent groups in a sample of Iranian high school students and to calculate its prevalence on the basis of smoking as well as use of hookah, alcohol, and drug. Additionally, the potential impact of age, gender, academic achievement score, living place, and presence of a smoker among family members or friends was also assessed using latent class analysis (LCA).

Method

The study was a part of a large project conducted in East Azerbaijan Province, Iran, between 2014 and 2015, with the goal of providing the information needed to prevent tobacco use among high school students. Two cities, Malekan and Ajabshir, were randomly selected and all high school students in these cities were invited to participate in the study ($n = 4,845$). Of 4,845 students, 391 (8.1%) were absent on the day of data collection, and 32 (0.7%) did not participate in the study. Hence, 4,422 (91.2%) students voluntarily participated in this study. The data were gathered using a self-administered written questionnaire. This project was carried out after receiving the approval from Ethics Committee of Tabriz University of Medical Sciences and obtaining consent from the students' parents. Prior to completing the questionnaire, the students were given instructions on how to complete it and during data collection, none of the schools' staff members were present. Additionally, the students were asked to answer the questionnaire anonymously and were assured of the confidentiality of their responses.

A pilot study was conducted to assess the reliability and validity of the survey instrument. The pilot study was administered with 58 students. The pilot study provided input about the clarity, length, comprehensiveness and the average time needed to complete the survey, as well as collecting data to estimate the reliability of the survey instrument. The survey tool was revised using the input provided by the pilot study. Test–retest correlation of the measures in 54 students, with 2-week interval, was at least .83.

Table 1. A Summary of Responses to Questions About Substance Use/Abuse.

Items	Boys, n (%)	Girls, n (%)	Total, n (%)	95% Confidence interval
Cigarette smoking				
Never smoker	2,050 (85.2)	1,837 (93.9)	3,889 (89.1)	[88.1, 90.0]
Experimenter	283 (11.8)	108 (5.5)	391 (8.9)	[8.1, 9.8]
Regular smoker	74 (3.1)	12 (0.6)	86 (2.0)	[1.6, 2.4]
Hookah smoking				
Never smoker	1,686 (71.6)	1,746 (89.7)	3,434 (79.8)	[78.6, 81.0]
Experimenter	493 (20.9)	186 (9.6)	679 (15.4)	[14.7, 16.9]
Regular smoker	176 (7.5)	15 (0.8)	191 (4.4)	[3.9, 5.1]
Alcohol use				
No	2,148 (91.1)	1,942 (98.7)	4,092 (94.5)	[93.8, 95.2]
Yes	211 (8.9)	25 (1.3)	236 (5.5)	[4.8, 6.2]
Drug abuse				
No	2,290 (97.0)	1,961 (99.7)	4,253 (98.2)	[97.8, 98.6]
Yes	71 (3.0)	6 (0.3)	77 (1.8)	[1.4, 2.2]

Demographics

The data on age, gender, and living place (urban or rural) were collected. Also, the previous year average score was asked as academic achievement.

Tobacco Use

Eleven items from the Global Youth Tobacco Survey were used to measure tobacco-related behaviors (Global Youth Tobacco Survey Collaborative Group, 2012). Specifically, there were three items related to cigarette smoking in the previous year, the previous 6 months (yes or no), and past 30 days (everyday, sometimes, never); three items related to smoking hookah in the previous year, the previous 6 months (yes or no), and past 30 days (every day, once in 2 days, twice a week, once a week, none); two items related to the presence of cigarette or hookah smoker among family members (yes or no); one item related to the presence of a smoker among close friends (yes or no); and two items related to the history of using alcohol and drug (yes or no). A regular smoker was defined as someone who smoked cigarette (hookah) every day, an experimenter was someone who smoked cigarette (hookah) occasionally, and the participant who had never tried or experimented cigarette (hookah) was considered a nonsmoker.

LCA was employed to determine the subgroups of each class. This analysis is a set of structural equations that are used to find groups or subgroups in multivariate classified data. These subgroups are called latent classes. The LCA is used to identify the latent groups and patterns related to the signs. Similar to factor analysis, the LCA can be used to classify the objects according to the maximum probability of being in a class.

To perform the LCA, two three-level and two dichotomous observable variables (i.e., indicators) were used for assessing risk-taking behaviors as a latent variable. These indicators were cigarette smoking (never smoker, experimenter, regular smoker), hookah smoking (never smoker, experimenter, regular smoker), alcohol use (no, yes), and substance abuse (no, yes). After finalizing the model, age, academic achievement score, gender, living place, presence of a cigarette smoker in the family and among friends, and presence of a hookah smoker in the family were entered as the covariates in the LCA model. *p* Values less than .05 were considered as statistically significant. All the analyses were conducted using the procLCA in SAS 9.2 software.

Results

The participants ranged in age from 13 to 20 years (mean = 15.81 ± 1.13). Fifty-five percent of the sample were male (2,432) and 52.3% (2,312) were from urban areas. The mean academic achievement during the previous year was 17.01 ± 2.31 out of 20.

A summary of substance abuse behaviors is presented in Table 1. The results suggested that hookah smoking was more prevalent than the others. Additionally, it was identified that substance abuse was more prevalent among males than females.

On the basis of the two dichotomous indicators and the two indicators with three levels, there were 36 possible response patterns. To fit the LCA models with classes ranging from 1 to 7 were attempted. For each LCA model, G2, Akaike information criterion, and Bayesian information criterion were computed (Table 2). According to these model selection indices and interpretability of the results, the authors concluded that a three latent class

Table 2. Comparison of LCA Models With Different Latent Classes.

Number of latent classes	Number of estimated parameters	G2	df	p	AIC	BIC	Maximum log-likelihood
1	6	1546.5	29	<.001	1558.5	1596.9	−5658.0
2	13	181.4	22	<.001	207.4	290.5	−4975.4
3	20	21.6	15	.119	61.6	189.5	−4907.1
4	27	15.1	8	.057	69.1	241.7	−4899.3
5	34	12.5	1	<.001	80.5	297.9	−4894.0
6	41	7.7	−6	—	89.7	351.8	−4888.6
7	Not well identified						

Note. df = degrees of freedom; LCA = latent class analysis; AIC = Akaike information criterion; BIC = Bayesian information criterion.

Table 3. Three Latent Class Model of Substance Abuse Behaviors and Its Covariates Among High School Students.

	Latent class		
	Low risk	Tobacco experimenter	High risk
	0.859	0.095	0.046
Latent class prevalence	Item-response probabilities		
Cigarette smoking			
Never smoker	**0.965**[a]	0.459	0.276
Experimenter	0.033	**0.521**	0.373
Regular smoker	0.002	0.020	0.351
Hookah smoking			
Never smoker	**0.922**	0.000	0.122
Experimenter	0.068	**0.929**	0.237
Regular smoker	0.010	0.071	**0.642**
Alcohol use			
No	**0.988**	**0.821**	0.397
Yes	0.012	0.179	**0.603**
Drug abuse			
No	**0.998**	**0.996**	**0.656**
Yes	0.002	0.004	0.344
Covariates (p value[b])		OR (95% CI)	OR (95% CI)
Age (p < .001)	Reference	1.18 [1.04, 1.32]	1.84 [1.45, 2.32]
Past year average score (p < .001)	Reference	0.97 [0.91, 1.04]	0.85 [0.78, 0.92]
Gender (male) (p < .001)	Reference	3.06 [2.16, 4.35]	19.50 [6.82, 55.75]
Habitat status (urban) (p = .003)	Reference	1.54 [1.19, 2.00]	1.07 [0.71, 1.61]
Cigarette smoker in the family (p < .001)	Reference	1.52 [1.15, 2.01]	1.95 [1.27, 2.98]
Hookah smoker in the family (p < .001)	Reference	9.56 [6.23, 14.67]	21.84 [11.95, 39.91]
Having smoker friend (p < .001)	Reference	5.29 [3.74, 7.48]	9.67 [6.06, 15.42]

Note. OR = odds ratio; CI = confidence interval.
[a]Item-response probabilities >.5 in bold to facilitate interpretation.
[b]Significance of the model with covariate in comparison to the model without covariate, performed by likelihood ratio test. *p* < .5 shows the model with covariate better than the one without covariate.

model was appropriate. The results identified that differences between the expected and observed frequencies of response patterns were not statistically significant (G2 = 21.6, degrees of freedom = 15, *p* = .12).

After finalizing the three-level latent class model, the covariates were entered into the LCA model. The results, as presented in Table 3, included latent class prevalence and item-response probabilities as well as odds ratio of

covariates associated with latent class membership. The probability of membership in each latent class is presented in the first row of Table 3. The rate of students as low risk-takers, tobacco experimenters, and high risk-takers was nearly 86%, 9.5%, and 4.6%, respectively. The conditional probabilities (item-response probabilities) of responses to each substance abuse behavior are listed in the middle part of Table 3. These probabilities form the basis for the interpretation and labeling of the latent classes. The larger conditional probabilities are in bold to highlight the overall pattern. The Latent Class 3, *high risk*, was characterized by a high probability of using all substances, except drug abuse. Individuals in this latent class were likely to report that they had engaged in all the considered substance abuse behaviors, except drug abuse. In contrast, those in the Latent Class 1, *low risk*, were likely to report not being engaged in any of the considered substance abuse behaviors. It was the other latent class that reflected different patterns of substance abuse behaviors. The Latent Class 2, *tobacco experimenter*, had a high probability of reporting two types of substance abuse behavior, namely, smoking and hookah using.

The odds ratio indices of membership in each class, compared with the first class and associated with the independent variables, are listed in the last part of Table 3. For example, as can be seen, for 1-year increase in the age of students, the risk of membership also increased in Classes 2 ($OR = 1.18$) and 3 ($OR = 1.84$) compared with Class 1. Similarly, being male, compared with female, increased the risk of membership in Classes 2 and 3, compared with Class 1 by 3.06 and 19.5 times, respectively.

Discussion

The study was conducted to estimate tobacco use and to categorize high school students as either low or high in taking the risk of tobacco use initiation. The use of hookah had the highest prevalence, which may be due to a commonly held mistaken belief that smoking a hookah is less harmful than any other method of smoking, such as cigarettes (Akl et al., 2013; Aljarrah, Ababneh, & Al-Delaimy, 2009). Another reason might be that smoking a hookah is not forbidden by religious orders. There are other studies that have reported the growing use of hookah (Sutfin et al., 2011; Zielińska-Danch, Czogała, Adamczyk, & Danch, 2011). Traditionally, hookah use has been common among Iranian families, men and grandmothers in particular, and currently there are many coffee shops that provide it. This phenomenon has also gained popularity in Western countries.

Next was the alcohol use, which is forbidden in Iran due to legal, cultural, and religious reasons; as a result, it is less prevalent than smoking. There are studies which report that smoking is more prevalent among students than the use of alcohol. However, in comparison with drug use, the use of alcohol is more prevalent (Faggiano, Richardson, Bohrn, Galanti, & EU-Dap Study Group, 2007; Mohanan et al., 2014).

Findings of the current study identified that the use of cigarette, hookah, alcohol, and drug was higher among the males compared with the females, which is in line with the results of several published works (Agarwal, Nischal, Agarwal, Verma, & Dhanasekaran, 2013; Dida, Kassa, Sirak, Zerga, & Dessalegn, 2014; Mohammadpoorasl, Ghahramanloo, Allahverdipour, & Augner, 2014; Mohanan et al., 2014; Noonan, 2013; Reda, Moges, Yazew, & Biadgilign, 2012; Sutfin et al., 2011). In Europe, the gap between the prevalence of smoking in males and females has been shrinking due to its decrease in males and increase in females (2013). Gender equality, entering the labor market, freedom in spending money, and being targeted by the smoking industry are identified as the reasons for the growing rate of smoking in women (2013). In many developing countries, adolescents tend to be like their counterparts in Western countries; thus, continued social and behavioral changes are expected. On the other hand, in Islamic countries, females do not have the degree of freedom that males have (e.g., they go out less frequently) and are carefully watched by their parents; thus, they are less likely to smoke and/or drink. Another possible reason for this finding may be that tea/coffee shops in Iran, which, for example, can be used for hookah smoking, are traditionally and exclusively for men.

This study revealed three latent classes of low risk, experience of smoking, and high risk for both genders. Less than 5% of the subjects were in the high-risk group and 9.5% had experienced smoking. All the covariates were correlated with the group membership. Being older, male, city dweller, and having a smoker in the family and/or among friends increased the probability of being classified in the Groups 2 and 3, which has been supported by the studies inside (Mohammadpoorasl, Ghahramanloo, Allahverdipour, & Augner, 2014) and outside Iran (Goncy & Mrug, 2013).

Substance use and abuse rate among students with lower academic achievements was higher compared with others, suggesting an association between these two variables. In other words, poor academic achievement is associated with higher odds of being categorized into the Groups 2 (experience of substance) and 3 (high risk), probably because such students may pay less attention to their educational tasks, or vice versa, that is, poor educational performance may lead to substance use. Previously, a negative effect between substance use and academic performance has been reported (Andrade, 2014; James, Kristjánsson, & Sigfúsdóttir, 2011). A study on the impact

of alcohol on the educational progress of high school students has reported that drinking alcohol has a statistically significant effect on the average score of male students, but not females (Balsa, Giuliano, & French, 2011). Additionally, changes in the academic achievement can be predicted by friends' scholastic characteristics (Mounts & Steinberg, 1995). As indicated earlier, the results of present study identified that the presence of a smoker among family members or close friends is associated with the substance use/abuse, which has been reported in other studies as well (Agarwal et al., 2013; Finan, Schulz, Gordon, & Ohannessian, 2015; Lee, Yun, Lee, & Jee, 2010; Mohanan et al., 2014; Rezaei, Nedjat, Golestan, & Majdzadeh, 2011).

In this study, being a city dweller increased the odds of being in Classes 2 (smoker) and 3 (high risk). One possible reason for this finding may be the ease of access to various substances in urban areas compared with rural areas. Another potential reason may be the fact that most people know each other in small places such as villages, which may be considered an obstacle in the use of substances by the adolescents. This observation is a good topic for further research in the field of rural sociology. In the current study, there were no statistically significant differences between the rural and urban areas on the basis of development and social structure. It can be argued that close family relationships and lack of access to various substances may lead to less substance use in rural area. Nevertheless, there are studies which report different patterns of substance abuse in rural areas. An Indian study reported that the use of illegal drugs and alcohol was more prevalent among rural students compared with the urban ones, while smoking was more prevalent among urban students (Agarwal et al., 2013). A study by the Maine Rural Health Research Center reported that a higher probability for rural adolescents, compared with the urban ones, in terms of being involved in drinking alcohol (Gale, Lenardson, Lambert, & Hartley, 2012). Another study, which was conducted on 12- to 17-year-old students in the United States, reported that the rural adolescents were more likely to drink alcohol and to become alcoholic than urban adolescents (Hartley, 2007). It seems that the aforementioned differences are related to sociocultural differences between the rural and urban areas in Iran compared with other countries.

Although all covariates increased the odds of being in Classes 2 and 3, with respect to age, gender, presence of a hookah smoker in the family, and presence of smoker among friends, the odds of being in Class 3 (high risk) was higher. Gender and presence of hookah smoker in the family resulted in a significant difference between the odds of being in Classes 3 or 2, suggesting that the male gender and presence of a hookah smoker in the family are likely to increase the odds of being in Classes 2 and 3

compared with Class 1, but the odds associated with Class 3 was greater than it was in Class 2. In other words, these variables strongly increase the odds of being in the high-risk group. This finding has important implications for families, officials, and policy makers. Generally, male adolescents take greater risks than female adolescents which can be due to nature, physiology, and gender-related social norms of the people in the Iranian society. Cognitive Neuroscience Society (Steinberg, 2008) stated that higher levels of testosterone in girls and boys lead to risk-taking behaviors, more excitement in boys than girls, and long-term risk-taking experiences among girls. The other gender-related factor is the size and role of orbit frontal region of the brain. The larger size of the orbit frontal region is positively associated with higher testosterone levels as well as greater engagement in risk-taking behaviors among boys; however, the direction of the association is negative among females, suggesting that larger orbit frontal region reduces risk-taking behaviors among females. In other words, a mature orbit frontal increases the risk-taking behaviors among boys and decreases them among girls. A study on neurotransferase enzymes has revealed that the molecule that plays an important role in creating fear in dangerous situations is less active in the brains of male adolescents. It has been reported that adolescent boys are less scared of risky situations than children and adults and are mostly resistant to the threat of punishment (Fang, 2014). Furthermore, the results of the present study that the presence of a hookah smoker in the family increases the odds of being in Class 3 can be due to the notion that, after a while, smoking becomes a normal and acceptable act which is not taken seriously by parents.

Limitations

The data collection tool was a self-administered questionnaire; considering the nature of the questions, it could have led to the underreporting of the real behaviors. Although current research studied several variables in relation to high-risk behaviors among the adolescents, there may be other factors that were not addressed. Due to the cross-sectional and nonexperimental nature of the study, no causal inferences may be drawn.

Conclusions

A fair number of students, males in particular, were identified as high risk-takers. Findings of this study could inform the policy makers of public health and education system to pay attention to the interventions and preventive measures that focus on reducing high-risk behaviors among adolescents, in general, and males, in particular. Considering the simultaneous incidence of multiple

high-risk behaviors, interventions must cover multiple aspects of the issue at the same time. To implement such interventions, schools provide a good place for a convenient access to adolescents. Finally, it is recommended to make multidimensional and intersectorial efforts with the participation of such users.

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