LEVELS AND PATTERNS OF SUBSTANCE USE AMONG SCHOOL-ATTENDING ADOLESCENTS IN ROSARIO (SANTA FE-ARGENTINA) DURING 2016, 2018 AND 2019

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Running Title: Substance Use among high-school students

LEVELS AND PATTERNS OF SUBSTANCE USE AMONG SCHOOL-ATTENDING ADOLESCENTS IN ROSARIO (SANTA FE-ARGENTINA) DURING 2016, 2018 AND 2019

Abstract

Objectives

Psychoactive substance (PSs) use is a public health problem that affects society in general and particularly adolescents. Therefore, knowing adolescents' levels and patterns of PSs use is essential for developing public health policies.

Methods

During 2016, 2018, and 2019, a total of 1121 students (from Rosario-Argentina) were surveyed to evaluate their levels and patterns of use of alcohol, energy drinks, tobacco, and marijuana, among others.

Results

The results showed a decrease in the age of onset as well as in the risk perception of PS use, especially in 2018 and 2019. The reported reason for first use over the three years was "curiosity", followed by "feeling good". Moreover, the most consumed PSs (in order of preference) were alcohol, followed by energy drinks, tobacco, and marijuana. It was also found that more women reported consuming alcohol compared to men.

Conclusions

Interestingly, in terms of age at first use, it was found that adolescents tried energy drinks first, followed by alcohol, tobacco, and then marijuana. The decrease in the age of onset and the risk perception of the use of a PS and the pattern of use reported by adolescent students suggests the need to implement age-specific public prevention policies.

Keywords: Substance Use, adolescents' behaviors, underage drinking, underage smoking, age of onset.

Introduction

Adolescence is a developmental period that, in Western societies, would span between the ages of 10 and 22 years old (y.o.). It is characterized by functional and structural brain changes among others. The literature shows that risk taking behaviors are heightened in adolescents compare to adults, especially in contexts with straightaway rewards (van Duijvenvoorde et al., 2016). For instance, the use of Psychoactive Substances (PSs) for the first time. Moreover, the use of PSs at early ages is associated with greater risks of problematic use in adulthood (Mooney-Leber & Gould, 2018), as well as with family, peers, or work problems and with a higher risk of psychiatric disorders (Poudel & Gautam, 2017). Briefly, developing alcohol addiction in adults is four times higher if drinking begins before 14 y.o. (Chwedorowicz et al., 2017); also, early use of alcohol and tobacco independently predicts other substance use problems in adulthood (Griffin et al., 2019).

In our country, Argentina, a national survey run in 2014 among high-school students showed that alcohol was the PS most consumed followed by energy drinks (SEDRONAR, 2014). In fact, it seems that the most consumed PS among adolescents worldwide was alcohol, followed by energy drinks. In contrast, tobacco use may be declining (Johnston et al., 2021; Ruiz & Scherr, 2018; SEDRONAR, 2014). Another PS frequently used was marijuana (Johnston et al., 2021; SEDRONAR, 2014), and like the others, early onset was associated with substance use problems in adulthood (Hawke et al., 2020; Rioux et al., 2018). Taking all these together, highlights the relevance of knowing adolescents PS patterns of use to understand the problem and to contribute to the development of public prevention policies. The present article aimed to investigate those patterns of PS use among high-school students from Rosario (Santa Fe -Argentina), between 2016 and 2019, to contribute to the description of the problem since the previous data was from 2014 (SEDRONAR, 2014).

Materials and methods

Sample

Students who answered the questionnaire belonged to schools located in Rosario (Santa Fe - Argentina) and its surrounding areas; and they were part of a university outreach project that run from 2013 to 2019.

Questionnaire description

The questionnaire investigated aspects related to the sample (such as age, school year, gender), as well as the knowledge and risk perception of the problems that a PS can cause, the pattern of use, age of first use, type of PS, etc. (For more information see the Supplementary Information Section). The survey was applied in 2014-2016-2018 and 2019, only the years when the project was funded.

Statistical analysis

The data obtained were processed by the Statistics and Data Processing Area of the Facultad de Ciencias Bioquímicas y Farmacéuticas , Universidad Nacional de Rosario- Argentina (FCByF-UNR-Argentina). For data analysis R Core Team (R Foundation for Statistical Computing, 2019) and a significance level of $p<0.05$ were used.

Ethical considerations

Both the questionnaire and the informed consent were approved by the Ethics Committee of our institution (FCByF-UNR-Argentina) (Act No. 420/2013). The informed consent was signed by parents because the students were underage.

Results

Sample description

A total of 1121 students answered the questionnaire (women: 46.6%, men: 48.4%, and 5% preferred to not express their gender). Regarding the participants' age distribution in 2016 and 2018, more than half of them were between 15 and 16 y.o., while in 2019 more than half of them were 14 y.o. or younger (Figure S1). The data analysis of the age distribution revealed that they were significantly different over the 3 years (Kruskal Wallis test, p value < 0.001). The results presented here were analyzed taking this limitation into account. It is important to note that the age distribution was influenced by the organization of the outreach project that aimed to prevent the use of PS. In 2019, after reviewing previous years' experience, the group decided to focus efforts on the youngest students.

Knowledge and risk perception of the problem

To evaluate the risk perception of the problems that PSs use may produce, a list of 16 PSs was presented to individually respond if they were capable to produce addiction (results were displayed in Table S1). The results revealed that the affirmative responses showed a decrease over the years, suggesting that the risk perception tend to decrease through the years. For example it was found that in 2019 the affirmative responses decreased for cocaine, tobacco and alcohol compared to 2016 (Figure S2).

Ever use in a lifetime

Students' responses regarding their PSs use at least once in a lifetime (EUIAL: Ever Use In A Lifetime) showed that over the 3 years, more than 80% of the students expressed having tried at least one of the 16 PS surveyed, reaching the maximum number of responses in 2018. This general EUIAL values appeared to be strongly influenced by alcohol use, followed by energy drinks and to a lesser extent by tobacco and marijuana (Figure S3).

Reasons for the first use

Most of the students who had used some PS chose curiosity and feeling good as the reasons for their first use. Where curiosity was the reason chosen in the first place and feeling good in second place. It is important to mention that some of the students chose more than one reason, but the questionnaire did not have the option of ordering them (Table S2).

Age of onset

In addition, the age at first use was surveyed. Table 1 showed the average age for the first PSs used as well as the results for each one of the 4 most used (according to Figure S3). Also, the median age of onset was calculated (Figures S4 and S5). Altogether, the results revealed that over the 3 years energy drinks were the first PS tried by adolescents. Then, they tried alcohol and/or tobacco. Whereas they used marijuana later in life as it had the highest median and average age of onset.

Pattern of use by age group

EUIAL

Figure 1 showed the EUIAL of the four PS most used, grouped according to the students' ages. Over the 3 years the PS most used was alcohol, interestingly it was significantly higher in the group of 15-16 y.o. in 2016, while in 2018 the use was similar between 15-16 y.o. and 17 and older (>17 y.o.). Surprisingly in 2019 the responses were similar regardless the age. Therefore, the use of alcohol increased from 2016 to 2019.

Regarding the use of marijuana, it was clear that the first use happened mostly in the group >17 y.o.. Moreover, the percentage that expressed using marijuana for the first time at >17 y.o. was significantly different from the other groups in each year; while in 2019 this group also had the highest percentage of responses .

Regarding the first use of tobacco, the pattern changed over the years. Briefly, in 2016 around 30% of the students expressed having smoked tobacco regardless the age group. Instead, in 2018 and 2019 the group of >17 y.o. showed a higher percentage of responses than the other groups.

Finally, the energy drinks' age of onset mostly happened in students younger than 17 y.o. in 2016. However, in 2018 the pattern changed, in the group >17 y.o. the percentage of responses increased while it decreased in the <14 y.o.. Interestingly, in 2019 the responses in the youngest group were similar to 2016 and, in the oldest were between 2016 and 2018.

Recent use

Recent use gathered the responses regarding the use of a specific PS during the past year (Figure 2). Alcohol is the most used in the past year regardless age groups. Specifically, the 15-16 y.o. group showed the highest percentage of responses in 2016, which also turned out to be significantly different from the rest of the age groups. On the other hand, in the older age group, recent use increased between 2016 and 2019. Interestingly, among younger students (<14y.o.), a higher number of responses was found in 2016 and then steadily decreased until 2019; becoming the age group with the lowest recent use during 2019.

Regarding marijuana use in 2018 and 2019, responses were significantly higher in the age group >17 y.o.. It also seems that the use in the last year is almost exclusive in the older students over the three years.

Responses on tobacco use in the past year increased over the years. Interestingly, the differences between the age groups increased over time, since among the youngest the responses decreased, while among the older ones the responses increased between 2016 and 2019.

Current use

Current use, gathered the responses regarding the use of a PS in the last month (Figure 3). In 2016 and 2018, alcohol was the PS most use in the last month; while in 2019, even though

alcohol was the most used for >15 y.o.; in the < 14 y.o. the current use of alcohol was similar to energy drinks. Also in 2019, the alcohol's current use in the oldest students was significantly different from the other age groups. Regarding marijuana use, the responses in the >17y.o. were significantly higher than the other groups for each year. Moreover, in 2019 the use of marijuana in the last month in this particular age group reached the highest level found.

Responses on current tobacco use showed a similar level in all 3 age groups in 2016 and 2018. However, in 2019 responses in the >17 y.o. were significantly different from the other 2 groups, where students of <14 y.o. presented the lowest level throughout the years.

Interestingly, in 2019, the responses on current use of alcohol, tobacco and marijuana in >17 y.o. group were significantly different from the other groups. Finally, there were similar levels of current energy drink use among students <17 y.o. over the 3 years.

Patterns of use analyzed by gender

When the different patterns of alcohol use were analyzed by student gender, it was found that in 2018 and 2019, the percentage of women who reported having used alcohol is significantly higher than men. Interestingly, 2018 had the highest level of responses across all patterns for both genders.

Discussion

The results presented here correspond to a survey carried out on 1121 high school students from Rosario (Santa Fe-Argentina) in 2016, 2018 and 2019. Among the most important findings were that more than 80% of the students expressed having used any of the 16 PS surveyed at least once in their lives. Four PS were the most chosen (in order of preference): alcohol, energy drinks, tobacco and marijuana.

Age of onset

The results shown here suggest that the age of the first use is decreasing over the years. Previous reports of our group already showed this trend (Biolatto et al., 2020). In addition, the average

age for the first use of alcohol, tobacco and marijuana decreased between 2019 and 2016 (Table 1). The average age of onset found in a national survey held by in 2014 (SEDRONAR, 2014) were similar to our results in 2016; and there are no more recent national data on this point. It is interesting to note that adolescents around the world are using PSs at younger ages [(Biolatto et al., 2020; Comisión Interamericana para el Control del Abuso de Drogas (CICAD)-Secretaría de Seguridad Multidimensional (SSM) -Organización de los Estados Americanos (OEA), 2019; Johnston et al., 2021; Miech et al., 2019; Secretaria de Gobierno de Salud & Ministerio de Salud y Desarrollo Social de la Nacion, 2018; SEDRONAR, 2014)].

Risk Perception

Students' knowledge about the possibility of PS-producing addiction was used to estimate the risk perception that PS use entails. Between 2016 and 2019, there was a slight decrease in identifying alcohol as addictive, suggesting a decrease in risk perception of alcohol use. Similar results were found in La Plata (Argentina) in 2019 where one out of two adolescents specifically reported that alcohol was not risky (Martello, 2019).

Patterns of use of alcohol, energy drinks, tobacco and marijuana

The results presented here showed that 8 out of 10 high-school students in Rosario expressed having use some PSs at least once in their lifetime. In fact, alcohol was the one that contributed the most to the highest percentage of PS use found. Although, alcohol and tobacco use are usually illegal for adolescents, the literature shows that are the most used among them worldwide (Comisión Interamericana para el Control del Abuso de Drogas (CICAD)-Secretaría de Seguridad Multidimensional (SSM)- Organización de los Estados Americanos (OEA), 2019; Holligan et al., 2019; Johnston et al., 2021).

Alcohol

Over the years, the age group that showed the higher use of alcohol was changing. In 2016, the higher use of alcohol happened among the 15-16 y.o.. In 2018, 15-16 y.o. and >17 y.o. showed similar levels, except for the current use where the group of >17 y.o. displayed the highest level of use. In 2019, the EUIAL was similar in the three age groups, however the group of <14 y.o. showed lower levels of recent and current use compared to the others. In contrast the group of >17 y.o. had the highest current use. Our results were confirmed by other studies run in Argentina such as National School Health Survey 2018 (NHSH-2018-Argentina) for current use (Secretaria de Gobierno de Salud & Ministerio de Salud y Desarrollo Social de la Nacion, 2018) and Martello (2019) for EUIAL(Martello, 2019). From the comparison between the different patterns of use, it is possible to suggest that most of the younger students used alcohol only once at least in 2019.

Surprisingly we found that women used significantly more alcohol than men in 2018 and 2019. None of the previous studies in Argentina (Martello, 2019; Secretaria de Gobierno de Salud & Ministerio de Salud y Desarrollo Social de la Nacion, 2018; SEDRONAR, 2014) found this gender difference in alcohol use.

Energy drinks

Energy drinks represented the second PS most used as well as the first one tried by adolescents, over the 3 years. In terms of each year's responses among the age groups, the level of use had an interesting change. Briefly, the EUIAL of the group of >17 y.o. in 2016 had the lowest responses compared to the other ages. Then, in 2019, the higher EUIAL was for the group of <14 y.o.. Another interesting point was that in 2019 the level of responses among those groups became similar. The differences between the levels of responses in the patterns of use suggested that the EUIAL did not happen during the last month or year.

Tobacco

From our results, 2 to 3 out of ten high-school students in Rosario expressed using tobacco at least once, setting it in the third place of PS most used over the years. While the first use happened at similar ages to alcohol and later than energy drinks.

Over the years the older students were the ones that expressed using tobacco at higher levels. Interestingly, in 2019 the EUIAL among the oldest student was the highest while among the youngest students reached a lowest level. Both previous national surveys, in 2014 (SEDRONAR, 2014) and in 2018 (Secretaria de Gobierno de Salud & Ministerio de Salud y Desarrollo Social de la Nacion, 2018) confirmed our results. In contrast a general population study released by CICAD showed a decrease in the use of tobacco (Comisión Interamericana para el Control del Abuso de Drogas (CICAD)- Secretaría de Seguridad Multidimensional (SSM)- Organización de los Estados Americanos (OEA), 2019). However, that decrease was not that clear among adolescents. At least, in 2019 where the youngest students showed the lowest responses but the oldest students had the highest responses.

Marijuana

Over the years marijuana represented the fourth PS most used in our sample, and also the one with the highest average age of onset. Clearly, the group of >17 y.o. expressed the higher levels of use that were significantly different from the others groups in each year regardless the patterns of use (EUIAL, current, and recent use). Also, in 2019 the results suggested that the first use was during the last year and mostly during the last month, whereas in the previous years was not as clear. These results were supported by NSHS (Secretaria de Gobierno de Salud & Ministerio de Salud y Desarrollo Social de la Nación, 2018). Previous studies in Argentina were showing an alarming trend of increasing use of marijuana in adolescents (SEDRONAR, 2014). Similarly, in Latin America the use of marijuana during the last year (current use) in the general population has increased in the last decade in Chile, Argentina, Uruguay and Costa Rica

(Comisión Interamericana para el Control del Abuso de Drogas (CICAD)- Secretaría de Seguridad Multidimensional (SSM) -Organización de los Estados Americanos (OEA), 2019).

Limitations

Before assessing the implications of this study, it is important to take into account its limitations. First, surveys are prone to recall bias, as subjects must remember their past experiences. Second, although the answers were completely confidential, students may have chosen not to give honest responses for fear of possible repercussions (i.e., the principal telling their parents). Last but not least, the fact that the composition of the sample was influenced by the organization of the outreach project is one of our major limitations.

Conclusions

In summary, we have found that, in Rosario (Santa Fe, Argentina) between 2016 and 2019, 8 out of 10 high-school students expressed having used some PS in their lifetime. Among the PS used were: alcohol, energy drinks, tobacco, and marijuana. The first two were used by 6-8 while the others were used by 2-3, out of 10 students. Also, it was found that students' first used energy drinks, then alcohol, and later on tobacco and/or marijuana. This sequence of use gave rise to certain observations that might be influenced by the sample composition. For instance, the fact that EUIAL of tobacco and marijuana were lower in 2019 compared to 2016 and 2018 which could be the result of a sample mostly composed by <14y.o. In addition, this different sample composition over the years might be responsible for an overrepresentation of the responses of >17 y.o. in 2019. On the other hand, these differences in the sample composition may become a strength of the study since it emphasized the relevance of applying specific prevention strategies according to students' age. Another important finding was a significantly more women expressed having used alcohol than men, in 2018 and 2019. Since the evidence showed that women are more susceptible to the effects of alcohol (Nolen-Hoeksema, 2004);

this might be another point to take into account in the designing of public policies. Moreover, considering that alcohol use is illegal for minors, it is possible that prevention strategies should also be directed to adults who provide/sell the alcohol.

It is important to remember that our results come from attending-school adolescents and revealed that age was an important factor regarding patterns of PS use. As well as that the age of onset was decreasing. Given that, individuals' previous history has a relevant role in the effect of a PS as well as in the transition from use to abuse; it is possible that adolescents and children who for different reasons do not attend school would consume other substances or at different ages. Highlighting the relevance of knowing the target population when developing prevention policies/strategies.

Finally, considering that our results were in line with other Argentinean studies others, it could be suggested that they could be useful not only for national but also for the region campaigns.

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Disclosure of interest

The authors have no conflict of interest associated with the material presented in this paper.

Data availability

The participants of this study did not give written consent for their data to be shared publicly, so due to the sensitive nature of the research supporting data is not available.

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Legends

Table 1. **General age of onset as well as for each of the 4 PS most chosen.** Data are expressed as the average age ± standard deviation. (y.o. = years old). The survey had a question where a list of 16 PSs was given with a space to answer at which age it was first used. This question was after the one that asked if they tried any PS at least once in their lifetime. Among those students who expressed having used more than one PS, the lowest reported age was taken to calculate the average age of onset for the first PS or the general age(1).

Figure 1: **Ever Use in a Life time for each PS discriminated by age.** The figure shows the percentage of students who expressed having use at least once in their lifetime (Ever Use In A Lifetime=EUIAL) each of the four PS most chosen, discriminated by age groups. * Significantly different from the other age groups $p<0.05$, Fisher's exact test.

Figure 2: **Recent use for each PS discriminated by age.** The figure gathers the responses on the use during the past year of each of the 4 PS most chosen, discriminated by age groups. * Significantly different for the other age group* $p<0.05$, Fisher's exact test.

Figure 3: **Current use for each PS discriminated by age.** The figure gathers the responses on the use during the past month of each of the 4 PS most chosen, discriminated by age groups. * Significantly different from the other age groups ($p<0.05$; Fisher's exact test).

Figure 4: **EUIAL, current and recent use of alcohol discriminated by female and male.** The bars represent the percentage of students who express to have tried alcohol organized by gender. * Significantly different ($p<0.05$; Fisher's exact test)

Table 1

PSs	2016 (y.o.)	2018 (y.o.)	2019 (y.o.)
The first PSs (1)	12.70 ± 1.6	12.78±1.78	12.08±1.87
Energy drinks	12,34 ±2,14	12,88 ± 1,79	12,33 ± 1,74
Alcohol	13,11 ± 1,42	13,27 ± 1,55	12,62 ± 1,63
Tobacco	13,66 ± 1,12	13,56 ± 1,86	13,05 ± 1,91
Marijuana	14,37 ± 1,48	14,70 ± 1,69	13,99 ± 1,67

Figure 1

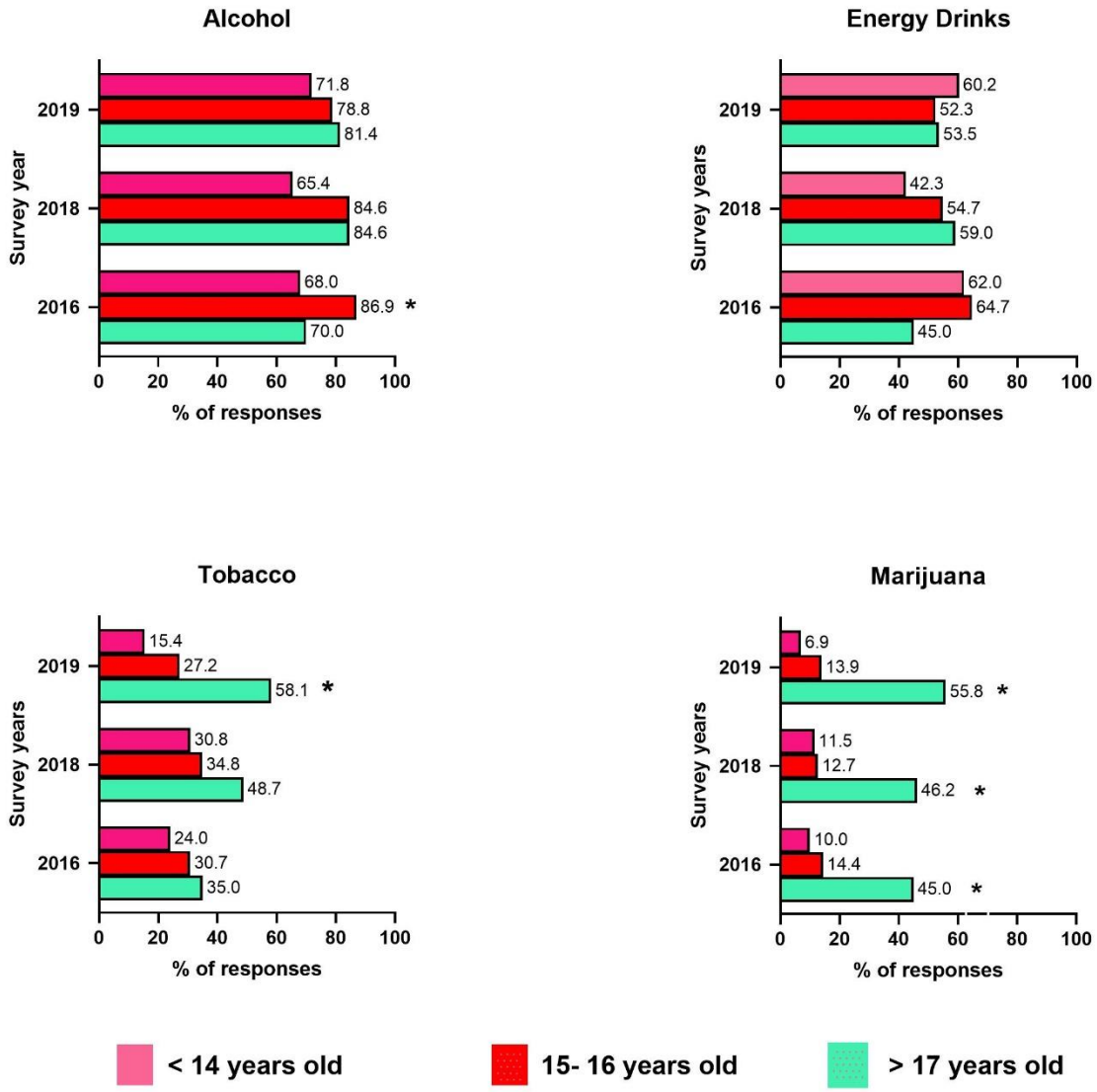

Alcohol
Survey year
2019
2018
2016
71.8
78.8
81.4
65.4
84.6
84.6
68.0
86.9 *
70.0
0 20 40 60 80 100
% of responses
Energy Drinks
Survey years
2019
2018
2016
60.2
52.3
53.5
42.3
54.7
59.0
62.0
64.7
45.0
0 20 40 60 80 100
% of responses
Tobacco
Survey years
2019
2018
2016
15.4
27.2
58.1 *
30.8
34.8
48.7
24.0
30.7
35.0
0 20 40 60 80 100
% of responses
Marijuana
Survey years
2019
2018
2016
6.9
13.9
55.8 *
11.5
12.7
46.2 *
10.0
14.4
45.0 *
0 20 40 60 80 100
% of responses
< 14 years old
15- 16 years old
> 17 years old

Figure 2

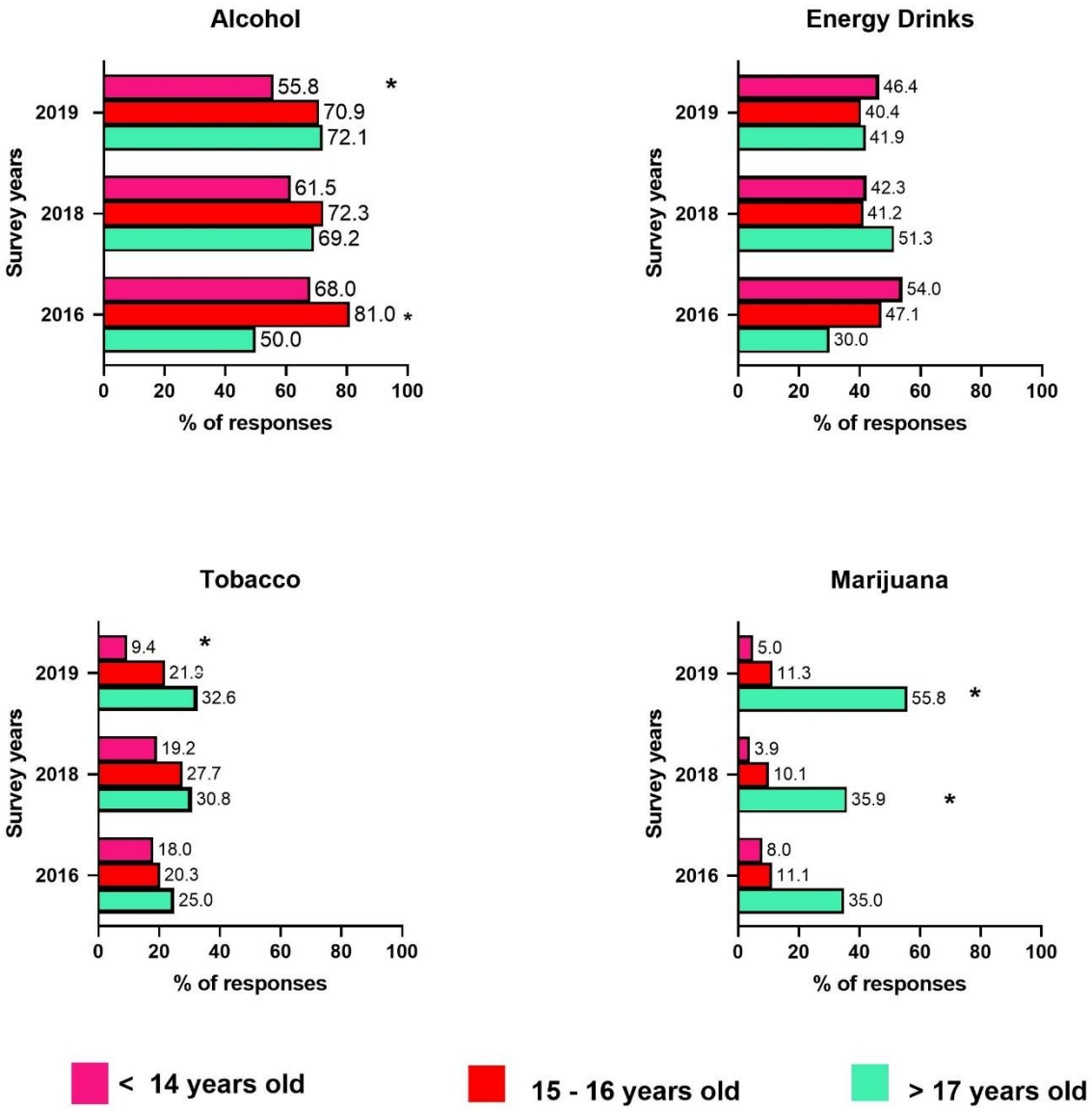

Alcohol
Survey years
2019
2018
2016
55.8
70.9
72.1
61.5
72.3
69.2
68.0
81.0
50.0
*
*
0
20
40
60
80
100
% of responses
Energy Drinks
46.4
40.4
41.9
42.3
41.2
51.3
54.0
47.1
30.0
Tobacco
9.4
21.9
32.6
19.2
27.7
30.8
18.0
20.3
25.0
Marijuana
5.0
11.3
55.8
3.9
10.1
35.9
8.0
11.1
35.0
< 14 years old
15 - 16 years old
> 17 years old

Figure 3

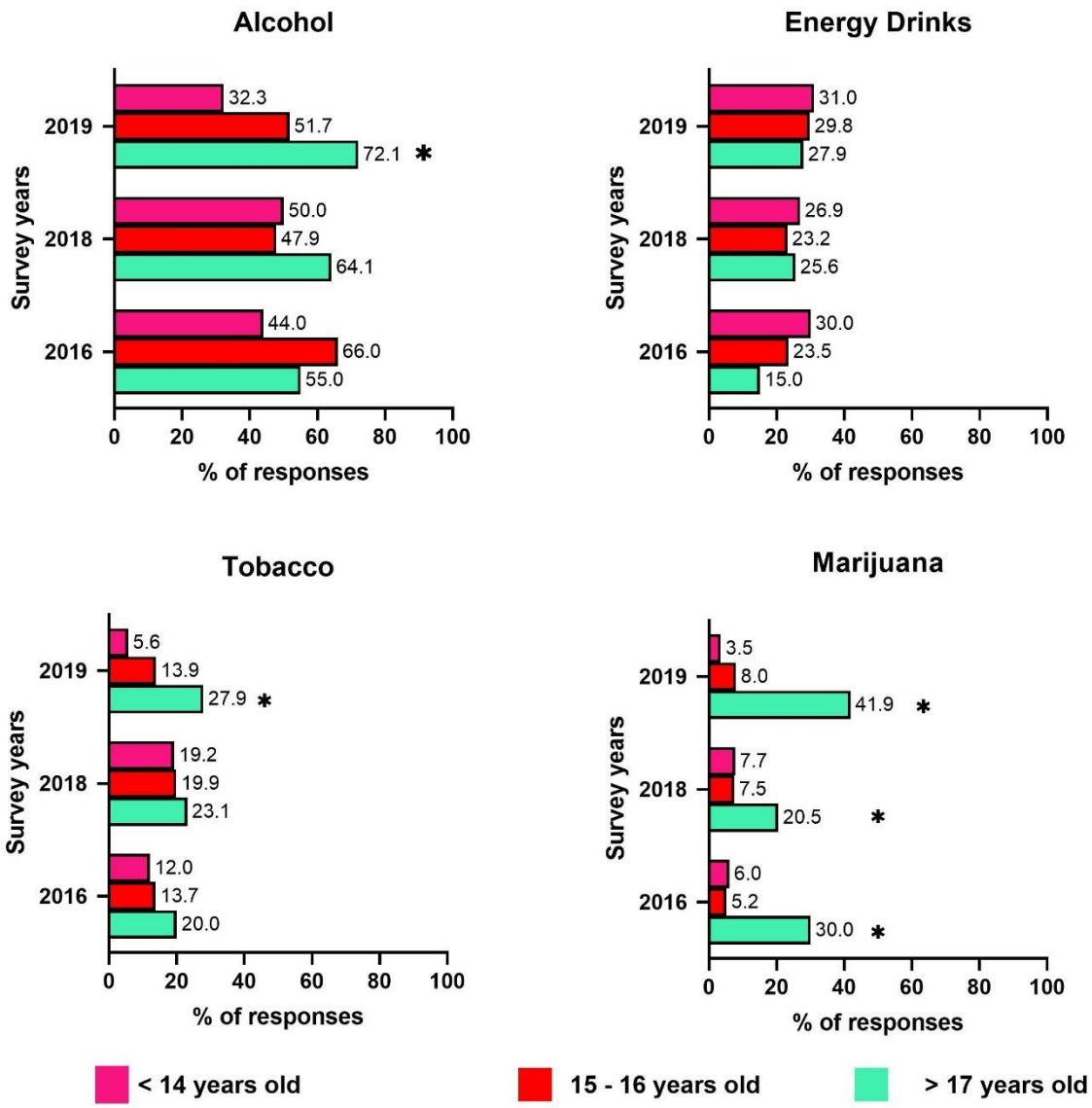
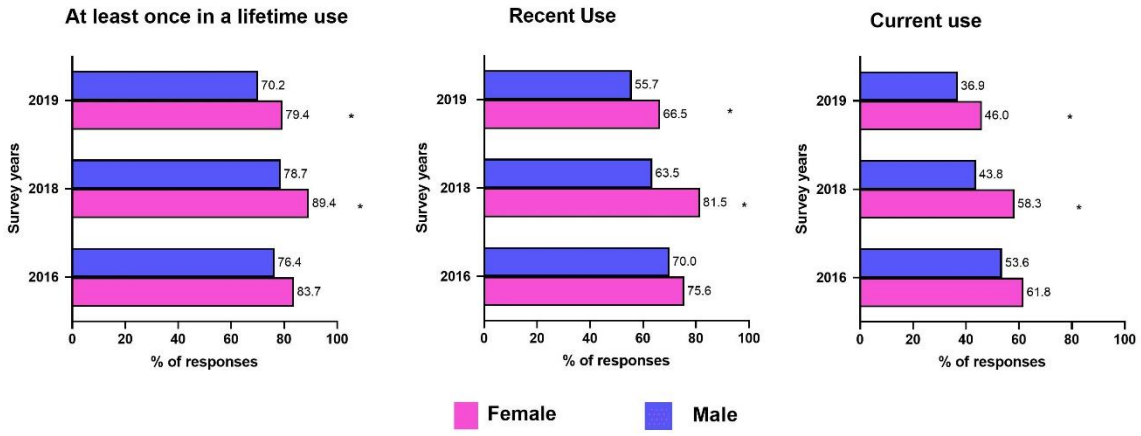

Alcohol
Survey years
2019
2018
2016
32.3
51.7
72.1 *
50.0
47.9
64.1
44.0
66.0
55.0
0 20 40 60 80 100
% of responses
Energy Drinks
Survey years
2019
2018
2016
31.0
29.8
27.9
26.9
23.2
25.6
30.0
23.5
15.0
0 20 40 60 80 100
% of responses
Tobacco
Survey years
2019
2018
2016
5.6
13.9
27.9 *
19.2
19.9
23.1
12.0
13.7
20.0
0 20 40 60 80 100
% of responses
Marijuana
Survey years
2019
2018
2016
3.5
8.0
41.9 *
7.7
7.5
20.5 *
6.0
5.2
30.0 *
0 20 40 60 80 100
% of responses
< 14 years old
15 - 16 years old
> 17 years old

Figure 4


At least once in a lifetime use
Recent Use
Current use
Survey years
2019
2018
2016
70.2
79.4
78.7
89.4
76.4
83.7
55.7
66.5
63.5
81.5
70.0
75.6
36.9
46.0
43.8
58.3
53.6
61.8
0
20
40
60
80
100
% of responses
Female
Male