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Trends in cannabis use among adolescents in Spain 20062018

The aim of this study was to examine trends in cannabis use among Spanish students 2006-2018 by sex, age, and sex and age combined. Data showed a global decrease both in a lifetime and frequent cannabis use between 2006 and 2018 but four-year comparisons revealed more variability within the specific sex-age groups. No change was found in lifetime use between 2014 and 2018 for all groups. The results emphasize the need for ongoing monitoring of trends in cannabis use and the importance of implementing preventive measures to avoid a change in tendency and to work with high-risk groups, especially 17-18-old boys.

Key words: adolescence, cannabis, decrease, monitoring, substance abuse, trends.

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Introduction

Cannabis is the most frequently used illegal substance among adolescents worldwide (European Monitoring Centre for Drugs and Drug Addiction, 2019a; United Nations Office on Drugs and Crime, 2019) and in Spain (Plan Nacional sobre Drogas, 2019). Frequent cannabis use in adolescence has been shown to be related to several adverse outcomes at these ages such as physical (e.g. sleep difficulties, Fischer et al., 2020) and mental health problems (e.g. depression, Gukasyan & Strain, 2020 and anxiety, Hall, 2014), altered brain development (e.g. differences in structure, Lorenzetti et al., 2020 and functioning, Camchong et al., 2017), impaired cognition (e.g. poorer executive control, Cyrus et al., 2021), worse educational outcomes (e.g. poorer academic performance, Volkow et al., 2014), and increased likelihood of car accidents, consuming other substances, and developing dependence (see Fischer et al., 2020; Hall, 2014; and Volkow et al., 2014 for a review).

Research has also found that heavy cannabis use during adolescence is associated with negative consequences for several important life-course outcomes later in adulthood such as poorer educational outcomes (e.g. lower odds of high school completion and lower degree attainment, Silins et al., 2014), cannabis dependence (Silins et al., 2014), use of other illicit drugs (Thrul, et al., 2020), mental health problems (e.g. depression, Gobbi et al., 2019 and psychosis-like behaviors, Ibarra-Lecue et al., 2018), and higher unemployment (Fergusson & Boden, 2008). In addition to this, in some countries cannabis is frequently smoked with tobacco, which has an even greater impact on health (Aldington et al., 2007; Peters, et al., 2012).

Regarding trends in adolescent cannabis use, international reports such as the *Health Behaviour in School-aged Children* study (HBSC) revealed a downward trend between 2006 and 2018 in lifetime use at age 15 (2006: 18%; 2010: 17%; 2014: 15%;

2018: 13%) (Inchley, et al., 2020). However, the *European School Survey Project on Alcohol and other Drugs* (ESPAD) showed stability in the percentage of 15-year-olds who had used cannabis at least once in their lifetime (17% in 2007, 18% in 2011, 17% in 2015, and 16% in 2019). ESPAD data on current cannabis use (once or more in the last 30 days) slightly increased from 2007 (6.4%) to 2011 (7.6%) and remained stable since then (7.2% in 2015 and 7.4% in 2019) (ESPAD Group, 2020). High cross-national differences were present in both reports. The survey *Monitoring the Future* carried out in the USA found ups and downs in a lifetime and current daily use in all age groups between 2006 and 2018, which resulted in overall stability for the whole period (Miech et al., 2020).

In Spain, the Secondary School Students Survey on Drugs (ESTUDES) showed an overall decrease in lifetime cannabis use between 2006 and 2018 in both sexes. However, some fluctuations were found in the intervening years (boys: 38.0% in 2006, 34.9% in 2010, 31.5% in 2014, and 34.5% in 2018; girls: 34.6, 31.1, 26.8, and 31.5%, respectively). The same pattern was detected for frequent use (20 days or more in the last 30 days), i.e., a general decline for the whole period, but with instabilities between the surveys years (boys: 4.2% in 2006, 4.3% in 2010, 2.6% in 2014, and 3.3% in 2018; girls: 2.2, 1.8, 1.0, and 1.4%, respectively) (Plan Nacional sobre Drogas, 2019). Given these examples of inconsistent results and instability, it is essential to perform more comprehensive analyses to determine precisely how adolescent cannabis use has evolved over recent decades in Spain.

With regards to sex and age, there is wide agreement that boys and older adolescents show higher cannabis use (ESPAD Group, 2020; Inchley, etal., 2020; Miech et al., 2020; Plan Nacional sobre Drogas, 2019). However, there is little sex- and age-specific data on trends in adolescent cannabis use, especially in Spain. International

and national surveys are intended to show an overview of trends but lack specific statistical analyses. The present research goes a step further and takes an in-depth look at how both lifetime and frequent cannabis use has changed in each of the specific groups over time. These analyses will provide information about the real evolution of cannabis use in each group and will enable us to determine which groups are at high risk and therefore, are most in need of intervention. Only in this way can political decisions be taken which are adjusted to the reality of the data. Hence, the aim of this study is to analyze trends in cannabis use (both lifetime and frequent use) between 2006 and 2018 by sex, age, and sex and age combined.

Methods

Study design

This research is based on the *Health Behaviour in School-aged Children* (HBSC) study. The HBSC study is a WHO collaborative cross-national study conducted every four years to research adolescent health, health-related behaviors, and social contexts in a growing number of countries in Europe and North America, providing key information for the design of evidence-based health promotion policies. Data collection was carried out through a school-based survey using self-reported questionnaires administered in the classroom, in accordance with the study's international protocol (Roberts et al., 2007). The total study sample comprised 44,784 students aged 15-18 (51% girls) coming from four different waves of the HBSC study conducted in Spain (2005/06, 2009/10, 2013/14, and 2017/18). Participants were selected following multistage random cluster sampling stratified by age, geographical area, habitat, and school type. The sample units were classrooms, chosen at random from the census provided by the Ministry of Education. Sampling weights by age, geographical area, and school type

were included to correct imbalances in the sample and to adjust the data to the population parameters. The sample was representative of students of these ages in Spain. All procedures were in accordance with the 1964 Helsinki declaration and its later amendments or comparable ethical standards, and with the ethical standards of the Coordinating Ethics Committee of Biomedical Research of Andalusia. Further information about the study can be found elsewhere (Roberts et al., 2007).

Measures

The measures used in this study were survey year (2006/2010/2014/2018), sex (girls/boys), age (15-16/17-18), and cannabis use, both lifetime and frequent consumption. Lifetime use was assessed with the question 'Have you ever taken cannabis (hashish or marijuana) in your lifetime?' and frequent use with 'Have you ever taken cannabis (hashish or marijuana) in the last 30 days?'. The response categories for both questions in 2006 and 2010 were: 'never', '1-2 times'; '3-5 times'; '6-9 times'; '10-19 times'; '20-39 times'; '40 times or more'. In 2014, the international coordinating center of the HBSC study agreed to change the response categories to: 'never', '1-2 days; '3-5 days; '6-9 days; '10-19 days; '20-29 days; '30 days or more'. Lifetime use responses were coded as 0 (never) and 1 (at least once in lifetime).

Following the European Monitoring Centre for Drugs and Drug Addiction definition, frequent use was categorized as 0 (<20 times/days in the last 30 days) and 1 (20 times/days or more in the last 30 days) (European Monitoring Centre for Drugs and Drug Addiction, 2013).

Analyses

Poisson regression models with robust variance were performed and Prevalence Ratios (PR) and 95% confidence intervals (95% CI) were calculated using STATA (Espelt, et

al., 2019). First, Poisson regression equations were performed to show the differences by sex, age, and sex and age combined in each of the survey years (2006, 2010, 2014, and 2018). Secondly, trend analyses were carried out both for the entire period 2006-2018, as well as for the four-year intervals. For the latter, 2006 was the reference for the comparison 2006-2010, 2010 for 2010-2014, and finally, 2014 for 2014-2018. Both trend analyses included the variables sex, age, and sex and age combined to observe similarities and differences in patterns of cannabis use for girls and boys, for the 15-16 and 17-18 age groups, and for the specific sex-age groups (girls at age 15-16, boys at age 15-16, girls at age 17-18, boys at age 17-18).

Results

Sample data are shown in Table 1.

Table 1. Sample data by sex (girls/boys), age (15-16/17-18), and survey year (2006, 2010, 2014, and 2018)

Age	*Sex*	*Survey year*				*Total*
		2006 (n)	*2010 (n)*	*2014 (n)*	*2018 (n)*	
15-16	*Girls*	2231	1341	3082	3619	10273
	Boys	2032	1225	2949	3655	9861
17-18	*Girls*	3115	857	3800	4903	12675
	Boys	2356	886	3909	4824	11975
Total		9734	4309	13740	17001	44784

Results on lifetime cannabis use are shown in Table 2 and Figure 1. In all survey years, boys were more likely than girls to have ever consumed cannabis. The only exceptions were 2006 (for the two age groups) and 2010 (in 15-16 year-olds), in which no sex differences were detected. At age 15-16, the magnitude of the differences

between boys and girls increased from 2.5 percentage points higher in girls in 2006 to 4.5 higher in boys in 2018. At age 17-18, sex differences rose between 2006 (2 percentage points) and 2010 (8.4 percentage points) and remained around 6 percentage points in 2014 and 2018 (higher in boys in all years). According to age, 17-18 year-olds showed higher lifetime use than 15-16 year-olds in all survey years with stable differences between the two groups of around 15 percentage points.

Regarding trends, an overall reduction from 42.6% in 2006 to 30.2% in 2018 (PR = .71; IC95% = .68 - .74) was found for the whole sample. Likewise, data showed significant decreases in four-year comparisons 2006-2010 (42.6-37.7%), 2010-2014 (37.7-33.4%), and 2014-2018 (33.4-30.2%). Analyses of the specific sex-age groups showed significant reductions between 2006 and 2018 in all groups. Higher declines were observed in both groups of girls (16 percentage points) while boys aged 15-16 diminished their lifetime use in 9 percentage points and boys at age 17-18 in 11 percentage points. However, downward trends were not continuous. Stability was found between 2006 and 2010 in both groups of boys, between 2010 and 2014 in 17-18 year-olds girls, and in the most recent period 2014-2018 in all groups.

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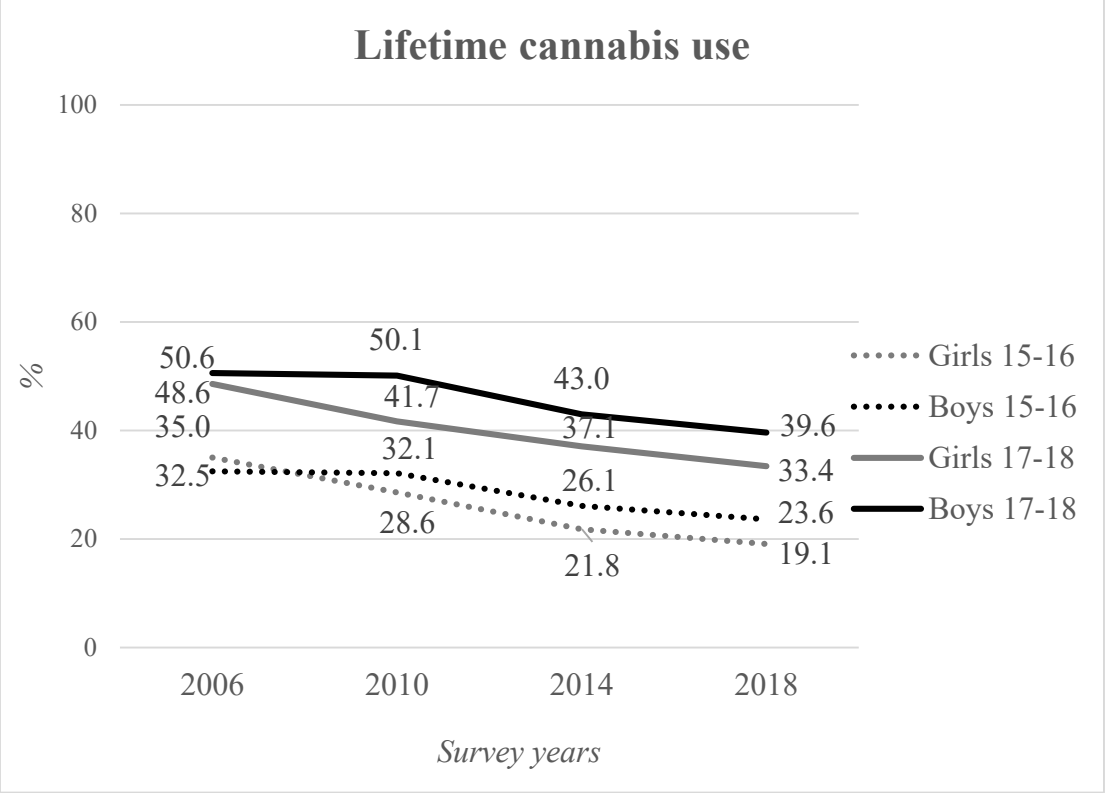
Table 2. *Lifetime cannabis use: percentages (%) and prevalence ratios (PR) (95%CI) in each survey year (2006, 2010, 2014, and 2018) and prevalence ratios (95%CI) in the global (2006 vs. 2018) and partial comparisons (2006 vs. 2010, 2010 vs. 2014 and 2014 vs. 2018).*

	SURVEY YEAR				GLOBAL AND PARTIAL COMPARISONS [PR (95% CI)]			
	2006	2010	2014	2018	2006-2018	2006-2010	2010-2014	2014-2018
Total (%)	42.6	37.7	33.4	30.2	.71 (.68-.74)***	.89 (.84-.94)***	.89 (.83-.95)***	.91 (.85-.96)**
Sex								
Girls (%)	42.9	34.7	30.6	27.5	.64 (.60-.69)***	.81 (.75-.88)***	.88 (.80-.97)*	.90 (.83-.98)*
Boys (%)	42.2	41.0	36.3	33.0	.78 (.73-.84)***	.97 (.90-1.05)	.89 (.81-.97)**	.91 (.84-.98)*
PR (95% CI)	.98 (.92-1.05)	1.18 (1.08-1.29)***	1.19 (1.08-1.31)**	1.20 (1.13-1.28)***				
Age								
15-16 (%)	33.8	30.2	23.9	21.3	.63 (.58-.69)***	.90 (.81-.98)*	.79 (.71-.87)***	.89 (.81-.98)*
17-18 (%)	49.5	45.9	40.1	36.4	.74 (.70-.78)***	.93 (.87-.99)*	.87 (.80-.95)**	.91 (.85-.98)**
PR (95% CI)	1.46 (1.36-1.58)***	1.52 (1.39-1.66)***	1.68 (1.53-1.85)***	1.71 (1.60-1.82)***				
Sex-age								
Girls 15-16 (%)	35.0	28.6	21.8	19.1	.55 (.49-.62)***	.82 (.72-.93)**	.76 (.66-.88)***	.88 (.77-1.01)
Boys 15-16 (%)	32.5	32.1	26.1	23.6	.73 (.65-.82)***	.99 (.86-1.13)	.82 (.71-.94)**	.90 (.79-1.02)
PR (95% CI)	.93 (.82-1.05)	1.12 (.97-1.29)	1.20 (1.03-1.40)*	1.23 (1.11-1.37)***				
Girls 17-18 (%)	48.6	41.7	37.1	33.4	.69 (.64-.74)***	.86 (.78-.95)**	.89 (.78-1.01)	.90 (.81-1.00)
Boys 17-18 (%)	50.6	50.1	43.0	39.6	.78 0.73-.84)***	.99 (.90-1.09)	.86 (.77-.96)**	.92 (.84-1.01)
PR (95% CI)	1.04 (.96-1.13)	1.20 (1.07-1.34)**	1.16 (1.02-1.31)*	1.19 (1.10-1.28)***				

*p < .05; ** p < .01; *** p < .001

Figure 1. *Trend in lifetime cannabis use between 2006 and 2018 in each of the specific sex-age groups.*



Results on frequent cannabis use (20 times/days or more in the last 30 days) are shown in Table 3 and Figure 2. Similar to lifetime use, boys were more likely than girls to regularly use cannabis in all survey years, with the exceptions of 15-16 year-olds in 2006 and 17-18 year-olds in 2014, in which no sex differences were found. At age 15-16, the magnitude of the differences increased from 0.6 percentage points higher in girls in 2006 to 3.3 higher in boys in 2010 and decreased in 2014 (2.8) and 2018 (1.5). At age 17-18, sex differences were higher in 2006 (3.6 percentage points) and remained around 2.5 percentage points thereafter (higher in boys in all years). Likewise, frequent cannabis use was higher in the 17-18 year-old group in all survey years. Age differences remained stable at around 2 percentage points except in 2010 (3 percentage points).

Trend analyses showed that the proportion of adolescents who consumed 20 times/days or more in the last 30 days decreased from 4.5% in 2006 to 2.7% in 2018 (PR = .60; IC95% = .50 - .73). This reduction mainly occurred in the last period 2014-2018, decreasing from 4.0 to 2.7%, while no significant differences were found in the previous comparisons (2006-2010 and 2010-2014). Trend analyses in specific sex-age groups showed that frequent use declined significantly in three of the four groups between 2006 and 2018. However, no significant change was found in 15-16 year-old boys for the entire period. More variability was found when focusing on each group separately. Thus, a higher reduction was observed in 15-16 year-old girls (from 3.6% in 2006 to 0.7% in 2018) but a period of stability was detected between 2010 and 2014. In 17-18 year-old girls, frequent cannabis use decreased from 3.8% in 2006 to 2.2% in 2018, however in this group the reduction was only significant in the last comparison (2014-2018). Boys at age 17-18 showed a slight but continuous decline (7.4% in 2006, 7.1% in 2010, 5.9% in 2014, and 4.9% in 2018) that resulted in a significant total decrease. The only group that did not show a significant overall reduction between 2006 (3.0%) and 2018 (2.2%) was 15-16 year-old boys, however a decrease was observed in recent years 2014-2018 (from 4.3% to 2.2%).

Table 3. *Frequent cannabis use: percentages (%) and prevalence ratios (PR) (95%CI) in each survey year (2006, 2010, 2014, and 2018) and prevalence ratios (95%CI) in the global (2006 vs. 2018) and partial comparisons (2006 vs. 2010, 2010 vs. 2014 and 2014 vs. 2018).*

	SURVEY YEAR				GLOBAL AND PARTIAL COMPARISONS [PR (95% CI)]			
	2006	2010	2014	2018	2006-2018	2006-2010	2010-2014	2014-2018
Total (%)	4.5	4.3	4.0	2.7	.60 (.50-.73)***	.97 (.78-1.20)	.93 (.72-1.19)	.67 (.54-.84)**
Sex								
Girls (%)	3.7	2.8	2.8	1.6	.43 (.31-.60)***	.76 (.53-1.09)	.99 (.64-1.53)	.58 (.38-.87)**
Boys (%)	5.4	5.9	5.2	3.8	.71 (.56-.89)**	1.11 (.85-1.44)	.88 (.65-1.19)	.73 (.55-.95)*
PR (95% CI)	1.44 (1.07-1.93)*	2.11 (1.51-2.96)***	1.89 (1.25-2.85)**	2.36 (1.80-3.10)***				
Age								
15-16 (%)	3.3	2.8	2.8	1.5	.44 (.31-.63)***	.85 (.57-1.26)	1.00 (.68-1.48)	.52 (.36-.74)***
17-18 (%)	5.4	5.8	4.8	3.5	.66 (.53-.82)***	1.09 (.84-1.42)	.83 (.60-1.14)	.73 (.55-.98)*
PR (95% CI)	1.62 (1.16-2.24)**	2.07 (1.47-2.92)***	1.71 (1.18-2.47)**	2.43 (1.86-3.16)***				
Sex-age								
Girls 15-16 (%)	3.6	1.3	1.5	0.7	.21 (.12-.37)***	.35 (.17-.71)**	1.19 (.59-2.37)	.50 (.28-.88)*
Boys 15-16 (%)	3.0	4.6	4.3	2.2	.74 (.47-1.16)	1.54 (.95-2.48)	.93 (.59-1.49)	.52 (.33-.79)**
PR (95% CI)	.83 (.48-1.44)	3.63 (1.91-6.90)***	2.86 (1.68-4.86)***	2.97 (1.84-4.78)***				
Girls 17-18 (%)	3.8	4.6	3.7	2.2	.58 (.40-.85)**	1.20 (.78-1.85)	.82 (.48-1.41)	.59 (.36-.98)*
Boys 17-18 (%)	7.4	7.1	5.9	4.9	.66 (.51-.87)**	.96 (.68-1.34)	.83 (.56-1.24)	.84 (.59-1.18)
PR (95% CI)	1.95 (1.39-2.73)***	1.55 (1.01-2.39)*	1.57 (0.94-2.64)	2.22 (1.62-3.05)***				

*p < .05; ** p < .01; *** p < .001

Figure 2. *Trend in frequent cannabis use between 2006 and 2018 in each of the specific sex-age groups.*

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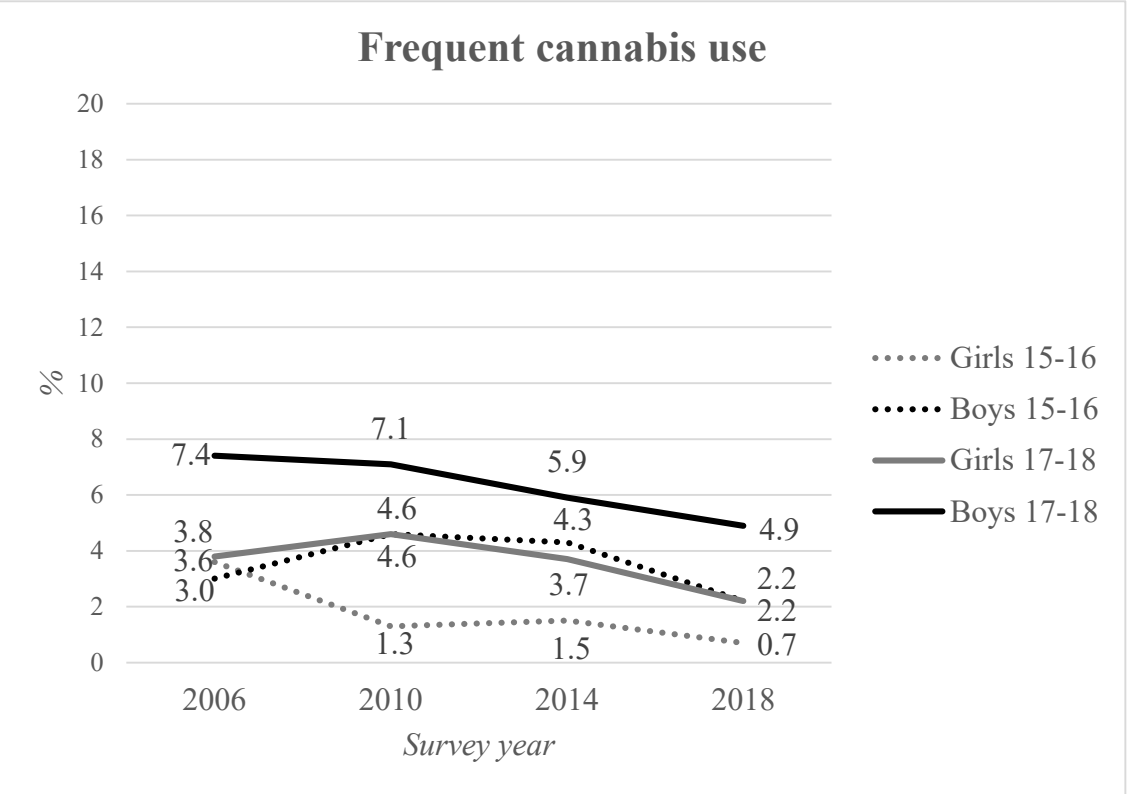

Discussion

The present study examines trends in cannabis use among 15-18 year-old Spanish students between 2006 and 2018. Results showed and overall decrease in both lifetime and frequent use, consistent with the Secondary School Students Survey on Drugs (ESTUDES) (Plan Nacional sobre Drogas, 2019). General reductions in adolescent cannabis use have also been found in other countries such as Australia (Guerin & White, 2020), New Zeeland (Clark et al., 2013), Canada (Leos-Toro, et al., 2019), Czech Republic (Kazmer et al., 2017), and Lithuania (Asgeirsdottir, et al., 2020).

It should be noted that the reduction in adolescent cannabis use in Spain occurred despite three important facts. First, Spain lacks national public-prevention initiatives specifically focused on adolescent cannabis use. In the 12-year period considered in this study only one program implemented by the National Plan on Drugs was aimed at this specific substance, although it was not exclusively for adolescents, but for the general population *'Drogas. Hay trenes que es mejor no coger'* [Drugs. There are trains that are better not to take]. The rest of the prevention campaigns were either focused on other substances (e.g. tobacco, alcohol, cocaine) or developed by private entities (with the collaboration of the National Plan on Drugs) (Ministerio de Sanidad, Bienestar y Consumo, 2020a, 2020b). Secondly, research showed that the perception of risks associated with cannabis use for both occasional use (measured as the proportion of adolescents who think that using cannabis once a month or less frequently can cause many problems) and regular use (measured as the proportion of adolescents who think that using cannabis once a week or more frequently can cause many problems) remained stable in the last 10 years (around 50-54% for occasional use and around 88-90% for regular use) (Plan Nacional sobre Drogas, 2019).Third, some studies found that more than 75% of young people aged 15-34 agreed to accept the liberalization of cannabis regarding use, sales and production, with varying degrees of regulation (Megías & Rodríguez, 2016).

Interestingly, the downward trend observed in adolescent cannabis use is in-line with results found for tobacco and alcohol both at the national level (Ariza et al., 2014; Leal-López, et al., 2019; Leal-López, et al., en prensa; Plan Nacional sobre Drogas, 2019) as well as at the international level (Goings et al., 2019; Hublet et al., 2015; Inchley et al., 2018; Kraus et al., 2018; Pape, et al., 2018). Multiple individual and contextual factors have been suggested to be related to the general reduction in adolescent alcohol consumption (Institute of Alcohol Studies, 2016; Oldham, et al., 2018; Pape et al., 2018;

Pennay, et al., 2015; Torronen, et al., 2019). Among them, the strongest evidence seems to be in changes in parental practices such as the improvement in alcohol-specific parental attributes (Vashishtha et al., 2019) and in unorganized leisure time with peers such as the decline in the frequency of going out with friends (Chomynova & Kazmer, 2019; De Looze et al., 2019), while the rise of new technologies has not been consistently related to the decline (De Looze et al., 2019; Pape et al., 2018). However, fewer studies focus specifically on cannabis. According to some of them, less time with peers may be one of the factors related to less cannabis consumption among adolescents (De Looze et al., 2019; Kuntsche et al., 2009). Further research is needed to identify the factors that may be associated with the decline in adolescent cannabis use.

Regarding sex differences, decreases in a lifetime and frequent use were found in both boys and girls although boys continue to be more likely than girls to consume cannabis. Moreover, due to a lower reduction among boys, sex differences in lifetime use increased between 2006 and 2018 for both age groups. This higher male consumption is consistent with previous findings (ESPAD Group, 2020; Guxens, et al., 2007; Inchley, et al., 2020; Miech et al., 2020; Plan Nacional sobre Drogas, 2019). According to age and consistent with other studies (Diaz, et al., 2018; Miech et al., 2020; Plan Nacional sobre Drogas, 2019), older adolescents showed higher lifetime and frequent cannabis use. Both age groups showed reductions in the two patterns of use and age differences remained stable across the 12-year period.

Despite this encouraging result, more in-depth trend analyses revealed some interesting findings. Firstly, data showed a lesser decrease in lifetime cannabis use in all groups for the last period (2014-2018). This phenomenon has also been detected for tobacco (Leal-López, et al., 2019) and alcohol use (Leal-López, et al., 2019) among adolescents in Spain. Secondly, frequent cannabis use showed different patterns for

each group, with the particularity that there were periods of stability in all of them. Thus, in 15-16 year-old girls there was no change between 2010 and 2014, while in 15-16 year-old boys and 17-18 year-old girls the relevant declines only occurred in recent years. Another important finding to consider is that, despite 17-18 year-old boys showing a global reduction in the 12-year period, their level of frequent cannabis use is more than twice as high as in 15-16 year-old boys and 17-18 year-old girls, respectively, and seven times higher than in 15-16 year-old girls. From an international perspective, Spain showed the second-highest level of cannabis use among 15-year-olds in 2006 (Currie et al., 2008), remaining among the countries with the highest consumption in both 2014 (Inchley et al., 2016) and 2018 (Inchley, et al., 2020).

In the light of the above, it is crucial to reinforce prevention measures to avoid a trend reversal and to reach specific risk groups. This work revealed that the group presently at greatest risk is 17-18 year-old boys, showing both higher lifetime (40%) and frequent use (5%) in 2018. It should be noted that the adolescent brain is not fully developed and experiences rapid growth (de Graaf-Peters, 2006) which seems to make it particularly sensitive to cannabis use (Fuhrmann, et al., 2015). In addition to brain development, other adverse outcomes have been associated with frequent cannabis use during adolescence (Camchong et al., 2017; Cyrus et al., 2020; Fischer et al., 2020; Gukasyan & Strain, 2020; Hall, 2015; Lorenzetti et al., 2020; Volkow et al., 2014) as well as later in adulthood (Fergusson & Boden, 2008; Gobbi et al., 2019; Ibarra-Lecue et al., 2018; Silins et al., 2014; Thrul et al., 2020). Furthermore, in some countries adolescents often consume cannabis mixed with tobacco, which increases the risks of negative outcomes (Aldington et al., 2007; Peters et al., 2012). Another important point to consider is that the potency of both cannabis resin and herb has increased over the last decade and new cannabis products such as edibles, e-liquids, and concentrates have

emerged (European Monitoring Centre for Drugs and Drug Addiction, 2019a). In relation to the latter, new ways of consumption such as vaping have recently experienced an important growth in the USA (Miech, et al., 2019), in some cases (black-market products with vitamin E acetate) causing harmful health effects (US Centers for Disease Control and Prevention, 2020).

In addition, prevention initiatives should not focus solely on providing adolescents with information about the risks of substance use. These actions have proved to be ineffective for reducing consumption and other risk behaviors (Steinberg, 2007). Prevention programs should comply with a set of quality criteria (European Monitoring Centre for Drugs and Drug Addiction, 2019b), such as reinforcing personal and social competences that enable critical thinking and informed decision-making, thereby promoting their positive development. This would help not only to prevent adolescent cannabis use, but also to reduce use-related risks.

This study has some limitations that should be taken into consideration. First, it is a cross-sectional study with self-reported data, which may lead to underestimation due to biases such as nonresponse, under-reporting, recall, and social desirability. However, all the information gathered followed rigorous international protocols aimed at minimizing potential sources of bias (Roberts et al., 2007). Second, the categorization of the dependent variable changed in 2014 (from ‘times’ to ‘days’), as well as its dichotomization, which despite being a method broadly used in research (MacCallum, et al., 2002), leads to some loss of information. Third, it should be noted that in Spain education is only compulsory until the age of 16 and thus the 17-18 year-old age group is not representative of all adolescents at these ages, but only of those who voluntarily remain in the education system. Therefore, consumption levels could be different if the population no longer at school at these ages were to be taken into account. Lastly,

potential age-period-cohort effects were not explored in this paper. To better understand trends, future studies should try to disentangle the three types of time-varying elements.

Despite these limitations, this study has some important strengths. First, the large representative sample of Spanish students aged 15-18 (around 45,000 adolescents). Second, the extended period covered in this study (12 years), including four different surveys years (2006, 2010, 2014, and 2018). Lastly, the specific statistical analyses used to examine trends in adolescent cannabis use in different groups disaggregated by sex, age, and sex and age combined. All these strengths make this work a good resource for better understanding the reality of adolescent cannabis use in Spain in the 21st century.

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