

Use of waterpipes and other substances in adolescents: Prevalence and potential associations with mental and behavioral well-being, a cross-sectional study

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ABSTRACT

INTRODUCTION This study assess the prevalence and potential determinants (attitudes, behavioral and emotional conditions) associated with waterpipe tobacco smoking (WTS) and cigarette smoking in adolescents in public compulsory secondary schools.

METHODS This was a cross-sectional study conducted in October 2017 in three secondary schools from Seville, Spain, among adolescents aged 12–18 years. We administered an *ad hoc* questionnaire to explore the demographic and clinical characteristics of students; in addition, it included questions on consumption of tobacco (waterpipe and/or cigarette), alcohol (usual consumption and/or drunkenness) and/or cannabis, and attitudes towards waterpipe tobacco smoking. We also administered a validated version of the Strengths and Difficulties Questionnaire (SDQ), which is used to screen children and adolescents with emotional and behavioral problems. An established usage of a substance was defined as weekly or daily use. A multivariate analysis was performed using binary logistic regression methods to determine the probability of established usage.

RESULTS Of the 1135 adolescents, 72.1% lived with at least one smoker; the established usage was 13.4% for waterpipe; 9.2% for cigarettes and 3.2% for dual use. Of those with established usage of waterpipe, 38.2% had established alcohol usage, 12.7% were drunk weekly or daily, and 27.4% used cannabis. Students consolidating the consumption of waterpipes were three times more likely to have established cigarette use than those not having an established usage (OR=3.7; $p=0.0005$). The overall SDQ score increased the likelihood of established usage of both waterpipes and cigarettes ($p=0.0005$).

CONCLUSIONS The probability of established usage of cigarettes (multivariate analysis) is associated with increasing age (course), cohabitation with smokers, established usage of waterpipe, established use of alcohol and a borderline score in the behavioral dimension (SDQ). Addiction to waterpipes among teens is significantly associated with their behavioral and emotional difficulties.

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INTRODUCTION

Since 2005, the World Health Organization and other agencies and experts have been noticing an increased prevalence in waterpipe tobacco smoking^{1,2}, and in the health problems associated with this form of tobacco use³⁻⁵, and on an increased risk of nicotine

addiction in adolescents related to this way of tobacco consumption^{6,7}, known as the ‘gateway theory’.

A recent meta-analysis links the risk of starting the use of waterpipes with the risk of cigarette use⁸, while a waterpipe session exposes the individual to smoke and toxic levels higher than those of

cigarettes^{9,10}.

Globally, there is consensus that waterpipe use is becoming a widespread worldwide problem, especially among young people, and that it poses a new threat in the global fight against smoking and its consequences in terms of morbidity and mortality¹¹.

This form of smoking, especially among young people, is outperforming cigarette use, not only in Middle Eastern countries but also in some Western countries such as the United Kingdom and Spain^{12,13}. The study on lifestyles Health Behavior in School-aged Children (HBSC) 2018, in which 17507 adolescents aged 15–18 years were surveyed from all over Spain (the largest sample on waterpipe use) indicates that 19.1% of adolescents have used waterpipes sometime in their life¹². Longitudinal studies on the use of waterpipes in adolescents in the USA show notable increase and fluctuations¹⁴.

Regarding risk factors for waterpipe tobacco smoking (WTS), Pratiti and Mukherjee³ grouped them into three categories: factors related to the substance (agent), environmental factors, and factors related to the individual (host). While factors related to substance and environment are well established, factors related to the individual are still understudied³, especially those related to adolescent mental health^{15,16} and new forms of nicotine intake (waterpipes and e-cigarettes).

Therefore, and within the framework of a project on the prevention of tobacco use in adolescents, this cross-sectional study was conducted to assess the prevalence and potential determinants (attitudes, behavioral and emotional conditions) associated with tobacco use in waterpipes and cigarettes in adolescents in public secondary schools in the south of Spain.

METHODS

This cross-sectional study was conducted in October 2017 in three secondary schools (IES) selected based on their accessibility and sociodemographic profile (rural populations of the north-western part of Seville province, in the south of Spain). Schools participating in this Project were: IES La Algaba, IES Castilblanco de los Arroyos, and IES de Gerena. All students of first to fourth grade of compulsory secondary education (ESO) and first to second grade of high school (Bach) present on the day of the survey administration were

invited to anonymously and voluntarily participate. The study was approved by the School Board of each participating IES and by the Research Ethics Committee of the Reference Hospitals.

Assessment tools

An *ad hoc* 23-item self-administered questionnaire was developed following expert recommendations on how to ask adolescents about waterpipe use¹¹, which includes questions about: essential use, dependence or cessation, exposure (current smokers), expanded use related items and policy/regulation related items. The questionnaire collected information about the student's age and gender, cigarette use in coexistent relatives, frequency of tobacco use (cigarettes and waterpipes) of the student, and the attitudes regarding WTS. It also asked about the use of alcohol and other substances such as cannabis (Annex 1). In addition, Goodman's questionnaire 'The Strengths and Difficulties Questionnaire' (SDQ) (translated into Spanish and validated), used to screen children and adolescents with emotional and behavioural problems was also administered; In addition to a total score, the 25 items provide information on five dimensions: emotional symptoms subscale, conduct problems subscale, hyperactivity/inattention subscale, peer problem subscale, and prosocial behaviour subscale¹⁷⁻²⁰. Questionnaires were handed over and explained by the tutors of the different groups during a normal class (50 min). The teachers in charge of administering the survey had been previously trained by the researchers to solve the possible doubts of the students without giving leading answers.

Sociodemographic variables such as age, course, sex, and cohabitation with smoker relatives and their kinship were analysed. In addition, the use of substances (cigarettes, waterpipe, alcohol, drunk and cannabis) was also assessed: the age of initiation and the frequency of consumption. We defined 'drunk or dizzy from alcohol' as the adolescent's self-perception in response to the question: 'Have you ever been drunk or dizzy from alcohol?' Attitudes and beliefs regarding waterpipe use were also measured. Finally, emotional and behavioural abilities and difficulties were analysed using the SDQ questionnaire. The established usage of cigarettes, waterpipes, alcohol, drunk or dizzy from alcohol and experience with cannabis were used as variables.

Substance use was classified as 'established' if weekly or daily; 'sporadic' ('once in a while'), for cigarettes, and 'unestablished' for monthly or sporadic use of waterpipes, alcohol or drunk or dizzy from alcohol. Cannabis use was classified as 'experienced' or 'not experienced' (having smoked at least once). SDQ questionnaire scores, both global and by dimensions, were expressed as the median and interquartile range (IQR: P25-P75) and subsequently, to improve comparability with other studies, the overall SDQ score was encoded into three categories (cut-off points: normality –from 0 to 15 points-, borderline –from 16 to 19 points- and pathological –from 20 to 40 points-) following the rules of the questionnaire itself²¹.

A descriptive analysis and subsequently a bivariate analysis of data were performed. The chi-square test was used to determine the association between two qualitative variables as determinants of cigarette and waterpipe use. The mean comparisons were made using the Student's t-test, and asymmetric distributions were compared using Mann-Whitney's U test. With variables whose significance was less than 0.15, a binary logistic regression model was used to evaluate the association of explanatory variables with the established usage of cigarettes, which is the greater consumption in adulthood and therefore indicates the risk of later smoking. All tests were bilateral and were considered significant if $p < 0.05$.

Data were analysed using the IBM-SPSS v.22 and EPIDAT 3.1 statistical software.

RESULTS

Subjects disposition and characteristics

The sample size was $n=1135$ students: 876 (77.2%) were ESO (middle school) students and 259 (22.8%) were high school students. The average age (SD) was 14.7 (1.8) years. Of the total, 546 (48.1%) were female students, and 47 (4.1%) did not answer the gender question. The characteristics of these students are shown in Table 1.

Prevalence and use initiation

In terms of the prevalence of substance use, 152 (13.4%) had established waterpipe usage and 104 (9.2%) established cigarette usage. Globally, 230 (20.2%) had established tobacco usage in one form, and 36 (3.2%) had established usage in both. Of those

with established usage of waterpipe, 60 (38.2%) had established use of alcohol, 20 (12.7%) were drunk or dizzy from alcohol on a weekly or daily basis and 43 (27.4%) used cannabis. Similarly, of those with established usage of cigarettes, 51 (46.8%) were established alcohol users, 26 (23.9%) established drunk and 59 (54.1%) used cannabis; all these associations are statistically significant (Table 1). Students with established usage of waterpipes have a threefold greater chance of having established usage of cigarette (OR=3.7; 95% CI: 2.4–5.7, $p=0.0005$).

There is a progression in the age of use initiation in such a way that the average (standard deviation) [95% CI age of use initiation of alcohol is 13.6 (1.6)] (95% CI: 13.5–13.7); of waterpipe, 13.9 (1.7) (95% CI: 1.8–111 4.0), of cigarettes 14.2 (1.7) (95% CI: 14.1–14.3) and cannabis 14.6 (1.7) (95% CI: 14.5–14.7) years ($p=0.0005$). In order to identify the existence of differences in usage distributions per course, a paired comparison of substances was conducted using the Mann-Whitney U test, which highlighted the existence of these significant differences ($p=0.0005$).

Potential determinants on substances use

Family role model (cohabitation with smokers)

From our sample, 818 (72.1%) students lived with at least one smoker. Of these, 120 (14.7%) had established usage of waterpipe and 90 (11.0%) cigarette ($p=0.189$; and $p=0.01$ compared with the established usage of those not living with a smoker, respectively) (Table 1).

A statistically significant association was found among female students living with smokers and the established usage of cigarette [43 (11.1%) established users vs 8 (5.0%) non-established users ($p=0.025$)]. This behaviour was not seen in males.

We have also analysed the differential role of cohabitants, classifying them into the following categories (father, mother, sister, brother, grandfather, grandmother and others). If the mother smokes, the risk of established cigarette use among adolescents increases (OR=1.96; 95% CI: 1.31–2.92, $p=0.0012$), and if it is the sister who smokes, the probability is increased more than threefold (OR=3.73; 95% CI: 1.81–7.67, $p=0.0004$). No statistically significant differences were seen in the rest of the family members.

Cognitive attitudes associated with waterpipe usage
 With regard to cognitive attitudes (beliefs) associated with WTS, it should be noted that there are statistically significant differences between students who had established usage and those who did not. The former showed beliefs and cognitive attitudes consistent (understanding as consistent, favourable attitudes to

consumption) with minor damages (waterpipe and cigarette) (Table 1).

Cognitive-behavioural difficulties and strengths
 Within the analysis of emotional and behavioural variables associated with established usage of waterpipe and cigarette, we found that the overall

Table 1. Demographic, clinical characteristics and attitudes towards waterpipe tobacco smoking of secondary school students from Seville, Spain, October 2017 (N=1135): overall and by the degree of tobacco usage in waterpipe or cigarette

Variables	Total	Waterpipe usage			Cigarette usage		
		Not established (978; 86.2%)	Established* (157; 13.8%)	p	Not established (1026; 90.4%)	Established* (109; 9.6%)	p
Age (years), mean (IQR)	14.5 (13.2–16.3)	14.3 (13.1–16.0)	16.0 (14.5–17.0)	<0.001	14.4 (13.1–16.1)	16.0 (14.8–16.9)	0.0005
Sex, n (%) ^a				0.148			0.806
Female	546 (50.2)	478 (51.1)	68 (44.7)		495 (50.3)	51 (49.0)	
Male	542 (49.8)	458 (48.9)	84 (55.3)		489 (49.7)	53 (51.0)	
School grade (Br, age) ^b , n (%)				0.0005			0.0005
1st ESO (8th year, 12–13)	244 (21.5)	235 (24.0)	9 (5.7)		240 (23.4)	4 (3.7)	
2nd ESO (9th year, 13–14)	248 (21.9)	225 (23.0)	23 (14.6)		231 (22.5)	17 (15.6)	
3rd ESO (10th year, 14–15)	206 (18.1)	183 (18.7)	23 (14.6)		181 (17.6)	25 (22.9)	
4th ESO (11th year, 15–16)	178 (15.7)	140 (14.3)	38 (24.2)		152 (14.8)	26 (23.9)	
1st Bachiller (12th year, 16–17)	147 (13.0)	114 (11.7)	33 (21.0)		125 (12.2)	22 (20.2)	
2nd Bachiller (13th year, 17–18)	112 (9.9)	81 (8.3)	31 (19.7)		97 (9.5)	15 (13.8)	
Cohabitation with smokers, n (%)	818 (72.1)	698 (85.3)	120 (14.7)	0.189	728 (89.0)	90 (11.0)	0.01
SDQ score, mean (IQR)							
Emotional symptoms	3.0 (1.0–4.0)	2.0 (1.0–4.0)	3.0 (2.0–5.0)	0.04	3.0 (1.0–4.0)	3.0 (1.0–4.0)	0.62
Behavioral problems	2.0 (1.0–3.0)	2.0 (0.0–3.0)	2.0 (1.0–4.0)	0.0005	2.0 (0.0–3.0)	3.0 (1.0–4.0)	0.0005
Hyperactivity	4.0 (2.0–5.0)	4.0 (2.0–6.0)	5.0 (3.0–6.0)	0.005	4.0 (2.0–6.0)	5.0 (4.0–7.0)	0.0005
Peer problems	1.0 (0.0–2.0)	1.0 (0.0–2.0)	1.0 (1.0–2.0)	0.02	1.0 (0.0–2.0)	1.0 (1.0–2.0)	0.05
Prosocial behavior	8.0 (7.0–9.0)	9.0 (7.0–9.0)	8.0 (7.0–10.0)	0.42	9.0 (7.0–10.0)	8.0 (7.0–9.0)	0.017
Total of difficulties	10.0 (6.0–14.0)	10.0 (6.0–14.0)	12.0 (8.0–15.0)	0.0005	10.0 (6.0–14.0)	12.0 (10.0–16.0)	0.0005
Established use of alcohol, n (%)	156 (13.7)	96 (9.8)	60 (38.2)	0.0005	105 (10.2)	51 (46.8)	0.0005
Drunk or dizzy from alcohol, n (%)	50 (4.4)	30 (3.1)	20 (12.7)	0.0005	24 (2.3)	26 (23.9)	0.0005
THC usage, n (%)	117 (10.3)	74 (7.6)	43 (27.4)	0.0005	58 (5.7)	59 (54.1)	0.0005
Cognitive attitudes, n (%)							
Damage by WP ≥ cigarette	243 (21.4)	220 (22.5)	23 (14.7)	0.0005	213 (20.8)	30 (27.5)	0.0005
Water filters toxic substances	430 (37.9)	363 (37.1)	67 (42.7)	0.014	369 (36.0)	61 (56.0)	0.0005
WP affects passive smokers	609 (53.7)	545 (55.7)	64 (40.8)	0.0005	559 (54.5)	50 (45.9)	0.002
WP transmits infections	872 (76.8)	749 (76.6)	123 (78.3)	0.307	786 (76.6)	86 (78.9)	0.075
Package contains information	284 (25.0)	564 (57.7)	69 (43.9)	0.0005	235 (22.9)	49 (45.0)	0.0005
WP creates addiction	633 (55.8)	564 (57.7)	69 (43.9)	0.0005	581 (56.6)	52 (47.7)	0.0005
WP leads to cigarette use	740 (65.2)	678 (69.3)	62 (39.5)	0.0005	666 (64.9)	74 (67.9)	0.573

* Established usage: waterpipe or cigarette use once or more times a week. a 147 (4.1%) students did not answer the question about sex. IQR: interquartile range (P25–P75).

b School grade: Expressed in the Spanish system, and in brackets the British equivalent (Br) and the age at which it is studied. ESO: mandatory secondary education. SDQ: The Strengths and Difficulties Questionnaire. THC: tetrahydrocannabinol (cannabis). WP: waterpipe.

score obtained in the SDQ questionnaire was positively associated with the established usage of both, waterpipe and cigarette ($p=0.0005$ for both associations). When analysing the five dimensions of this questionnaire separately we found that the established use of waterpipe was positively and statistically significantly associated with emotional symptoms, behavioural problems, hyperactivity and peer problems. This same analysis for cigarette use revealed that this habit was positively and statistically significantly associated with behavioural problems, hyperactivity and difficulties related to prosocial behaviour. The analysis of the relationship between

the established usage of waterpipe and cigarette and the SDQ questionnaire score by ranges is shown in Table 2.

However, difficulties related to prosocial behaviour have only been linked to cigarette use, whereas emotional symptoms were related only to waterpipe use (Table 1). Of the 1135 students who answered the SDQ questionnaire, 62 (5.5%) had an overall score within the pathological range, and 127 (11.2%) were borderline. By dimensions, the pathological range in emotional symptoms was higher in women than in men (4.9% vs 2.6%; $p=0.009$); behavioural problems in women were

Table 2. Distribution of score ranges in the Strengths and Difficulties Questionnaire among secondary school students from Seville, Spain, October 2017 (N=1135) according to gender and the established usage of tobacco in waterpipe or cigarette

Scores	Sex ^a		p	Waterpipe usage			Cigarette usage		
	Female (546; 50.2%) n (%)	Male (542; 49.8%) n (%)		Not established (978; 86.2%) n (%)	Established* (157; 13.8%) n (%)	p	Not established (1026; 90.4%) n (%)	Established* (109; 9.6%) n (%)	p
SDQ total score^b			0.443			0.033			0.0001
Normal (0–15)	459 (84.1)	450 (83.0)		833 (85.2)	125 (79.6)		877 (85.5)	81 (74.3)	
Borderline (16–19)	63 (11.5)	59 (10.9)		100 (10.2)	17 (10.8)		94 (9.2)	23 (21.1)	
Pathological (20–40)	24 (4.4)	33 (6.1)		45 (4.6)	15 (9.6)		55 (5.3)	5 (4.6)	
Emotional symptoms			0.009			0.277			0.321
Normal (0–5)	450 (82.4)	479 (88.4)		842 (86.1)	130 (82.8)		875 (85.3)	97 (89.0)	
Borderline (6)	43 (7.9)	35 (6.5)		65 (6.6)	16 (10.2)		73 (7.1)	8 (7.3)	
Pathological (7–10)	53 (9.7)	28 (5.2)		71 (7.3)	11 (7.0)		78 (7.6)	4 (3.7)	
Behavioral problems			0.005			0.0005			0.0005
Normal (0–3)	489 (89.6)	430 (79.3)		837 (85.6)	114 (72.6)		876 (85.4)	75 (68.8)	
Borderline (4)	38 (7.0)	51 (9.4)		79 (8.1)	18 (11.5)		80 (7.8)	17 (15.6)	
Pathological (5–10)	19 (3.5)	61 (11.3)		62 (6.3)	25 (15.9)		70 (6.8)	17 (15.6)	
Hyperactivity			0.247			0.303			0.008
Normal (0–5)	405 (74.2)	381 (70.3)		753 (77.0)	112 (71.3)		795 (77.5)	70 (64.2)	
Borderline (6)	63 (11.5)	80 (14.8)		106 (10.8)	21 (13.4)		109 (10.6)	18 (16.5)	
Pathological (7–10)	78 (14.3)	81 (14.9)		119 (12.2)	24 (15.3)		122 (11.9)	21 (19.3)	
Peer problems			0.418			0.628			0.147
Normal (0–3)	494 (90.5)	477 (88.0)		877 (89.7)	137 (87.3)		914 (89.1)	100 (91.7)	
Borderline (4–5)	37 (6.8)	47 (8.7)		74 (7.6)	14 (8.9)		79 (7.7)	9 (8.3)	
Pathological (6–10)	15 (2.7)	18 (3.3)		27 (2.8)	6 (3.8)		33 (3.2)	0 (0.0)	
Prosocial behavior			0.005			0.03			0.048
Normal (6–10)	528 (96.7)	493 (91.0)		908 (92.8)	139 (88.5)		952 (92.8)	95 (87.2)	
Borderline (5)	11 (2.0)	28 (5.2)		42 (4.3)	7 (4.5)		43 (4.2)	6 (5.5)	
Pathological (0–4)	7 (1.3)	21 (3.9)		28 (2.9)	11 (7.0)		31 (3.0)	8 (7.3)	

^aEstablished usage: waterpipe or cigarette use once or more times a week. n 147 (4.1%) students did not answer the question about sex. SDQ: The Strengths and Difficulties Questionnaire. ^b Cut-off points are shown in brackets next to each category (for self-administered version, <http://www.sdqinfo.org>).

Table 3. Distributions of other habits such as alcohol use, drunk and cannabis use based on their degree of consolidation and the Strengths and Difficulties Questionnaire dimensions (SDQ scores) among secondary school students from Seville, Spain, October 2017 (N=1135)

Difficulties	Global		Alcohol		Drunk or dizzy from alcohol			THC		
	Mean (IQR)	Not established (979; 86.3%) Mean (IQR)	Established* (156; 13.7%) Mean (IQR)	p	Not established (1085; 956%) Mean (IQR)	Established* (50; 4.4%) Mean (IQR)	p	No (1018; 89.7%) Mean (IQR)	Yes (117; 10.3%) Mean (IQR)	p
Emotional symptoms	3.0 (1.0-4.0)	3.0 (1.0-4.0)	3.0 (1.5-4.0)	0.278	3.0 (1.0-4.0)	3.0 (2.0-4.0)	0.457	3.0 (1.0-4.0)	2.0 (1.0-5.0)	0.896
Behavioral problems	2.0 (1.0-3.0)	1.0 (0.0-3.0)	2.0 (1.0-4.0)	0.0005	2.0 (1.0-3.0)	3.0 (1.0-5.0)	0.0005	2.0 (0.0-3.0)	3.0 (1.0-4.0)	0.0005
Hyperactivity	4.0 (2.0-5.0)	4.0 (2.0-5.0)	5.0 (3.0-6.0)	0.002	4.0 (2.0-5.0)	5.0 (3.0-6.0)	0.049	4.0 (2.0-5.0)	4.0 (3.0-6.0)	0.002
Peer problems	1.0 (0.0-2.0)	1.0 (0.0-2.0)	1.0 (0.5-2.0)	0.301	1.0 (0.0-2.0)	2.0 (1.0-3.0)	0.038	1.0 (0.0-2.0)	2.0 (1.0-3.0)	0.0005
Prosocial behavior	8.0 (7.0-9.0)	9.0 (7.0-9.0)	8.0 (7.0-9.0)	0.02	8.0 (7.0-9.0)	8.0 (6.0-9.0)	0.033	9.0 (7.0-9.0)	8.0 (7.0-9.0)	0.0005
Total of difficulties	10.0 (6.0-14.0)	9.0 (6.0-13.0)	12.0 (7.5-15.0)	0.0005	9.0 (6.0-14.0)	12.5 (9.0-16.0)	0.001	9.0 (6.0-13.0)	12.0 (9.0-15.0)	0.0005

* Established usage: alcohol use or drunk or dizzy from alcohol once or more times a week. THC: use of cannabis. SDQ: The Strengths and Difficulties Questionnaire. IQR: interquartile range (P25-P75).

Table 4. Multivariate model (binary logistic regression) of variables associated to the established usage of cigarettes among secondary school students from Seville, Spain, October 2017 (N=1135)

Variables	OR	95% CI		Sig.
		Lower	Upper	
Age (years)	1.624	1.080	2.441	0.020
Sex (Ref. female)	0.470	0.258	0.856	0.014
Established usage of waterpipe	1.270	0.678	2.380	0.455
Established usage of alcohol	2.125	1.102	4.098	0.024
Established drunk or dizzy from alcohol (≥1 time/week)	2.930	1.113	7.715	0.030
Experimentation with cannabis	10.754	4.852	23.833	0.000
Beliefs consistent with tobacco usage	1.166	0.462	2.940	0.745
SDQ emotional symptoms	0.925	0.806	1.062	0.268
SDQ behavioral problems	1.028	0.858	1.230	0.767
SDQ hyperactivity	1.263	1.096	1.456	0.001
SDQ peer problems	0.858	0.697	1.058	0.152
SDQ prosocial behavior	0.988	0.830	1.175	0.889
Age of initiating cigarette use	0.665	0.547	0.808	0.000
Age of initiating waterpipe use	0.828	0.663	1.035	0.098
Age of initiating alcohol use	0.994	0.800	1.234	0.956
Age of initiating cannabis use	1.329	0.912	1.935	0.138
Number of smoking cohabitants (0-6)	1.643	1.260	2.140	0.000

lower than in men (1.8% vs 5.6%; p=0.005); and difficulties in prosocial behaviour was lower in women than in men (0.6% vs 1.9%; p=0.005). The distribution of score ranges in the SDQ by gender is shown in Table 2).

Delving into other relationships between adolescent strengths and weaknesses and use of substances (SDQ), we saw that the established usage of alcohol, established drunk and established use of cannabis are statistically significantly associated with the overall score of this questionnaire and with the various dimensions of SDQ, with the exception of emotional symptoms (Table 3).

The multivariate analysis showed a profile of adolescent associated with established use of cigarettes defined by the increase in age (defined by the course variable p=0.0019), cohabitation with smokers (p=0.275), established usage of waterpipe (p=0.0036), established drunk (p=0.0005) and borderline score on the behavioural problem dimension in SDQ (p=0.0345) (Table 4).

DISCUSSION

Our study suggests for the first time that adolescents' emotional states and behavioural difficulties are closely related to the established use of WTS and

cigarettes, as well as other toxic habits (alcohol, drunk and cannabis).

The established usage of waterpipes in our environment is higher than that of cigarettes. This highlights the importance of waterpipe use in the estimation of tobacco use in the adolescent population.

Waterpipe use is associated with more positive attitudes towards it. These consistent attitudes are more frequent among adolescents who consolidate this type of consumption.

Among the adolescents studied, the SDQ overall score is significantly associated ($p < 0.05$) with all the toxic habits studied, so that the higher the score, the greater the likelihood of established usage of tobacco (water pipe ($p = 0.033$) or cigarette ($p = 0.0001$)), alcohol ($p = 0.0005$), drunk or dizzy from alcohol ($p = 0.001$) and cannabis ($p = 0.0005$). As expressed in our study results, there are sex-related differences in the SDQ score, particularly regarding emotional symptoms that are significantly more common among women and the difficulties related to behavioural problems and prosocial behaviour that are more common among men. The established usage of waterpipe is related to all dimensions of SDQ, with the highest scores in those students with established use. Concerning the established use of cigarettes, all dimensions, except emotional symptoms, were statistically significantly associated. As for the established use of alcohol, there is a positive association with the highest scores on behavioural and hyperactivity problems and lower scores on prosocial difficulties. In addition, drunk, together with the dimensions described for alcohol, presents a positive association between the consolidation of this habit and the presence of peer problems. Finally, regarding cannabis use, the significant association between all dimensions (except for emotional symptoms) and the use of this substance stands out. Given the results obtained in this study, it would be advisable to screen the emotional and behavioural health of adolescents systematically, not only to treat the emotional problem but to identify those adolescents at increased risk of consolidating toxic habits at an early age.

The established consumers of waterpipe in our study showed more positive attitudes towards

its use than unestablished consumers. Cognitive attitudes of established water pipe users: 1) it is less harmful than cigarettes, 2) water filters all toxics, 3) It does not affect passive smokers, 4) it does not create dependence and 5) it does not lead to cigarette smoking (the notion of bridge substance or gateway)⁸. These beliefs are even more meaningful and clinically relevant when related to established cigarette consumers. Results from previous studies also show that waterpipe smokers believe that this form of tobacco use is less harmful than cigarette use²² and that a positive attitude towards the use of waterpipes is associated with a greater likelihood of starting cigarette use. An important finding of our study is that 75% of respondents seemed unaware of whether waterpipe tobacco packages contained all the information about their potential harm, possibly because, as the authors have already pointed out, users often do not get to see the tobacco package; it is, therefore, important that the health warnings on waterpipe tobacco packages should also be included on the surface of the smoking devices, as otherwise, the user does not get to see these warnings²³. An analysis of regulations from 62 countries shows that most of them do not have specific regulations on WTS and base the control of tobacco use on legislation on the matter²⁴. It seems necessary, therefore, to develop specific regulations on waterpipe tobacco use that cover aspects such as health warnings and consumption devices.

Strengths and limitations

In our study, the proportion of students living with smokers was 72.1%, well above 41.4% reported by the survey on drug use in secondary schools in Spain ESTUDES 2018 study²⁵ and even higher than those estimated by this study in 1994 (68.2%), which may be a limitation as the high proportion of parental models might be leading to increased use among adolescents. Consistent with the literature, our data show a relationship between living with regular smokers and the use of waterpipe tobacco and cigarettes. However, a statistically significant association with the established waterpipe usage was not found, but with cigarettes. In a study conducted on a representative sample from 17 Arab countries, it was found that compared to adolescent children of non-smoker parents, the children of parents who

smoked cigarettes and waterpipes were more likely to smoke waterpipes or both²⁶. Similarly, a secondary analysis of the Global Youth Tobacco Survey, which conducts a meta-analysis of data from 25 countries that included questions about waterpipe use, found that smoker parents were among the factors associated with waterpipe use²⁷. This association between tobacco use in parents and the increased risk of waterpipe use among their children may contribute to its use being seen by parents as less harmful. Although cultural differences play a very important role, it is worrying that in a study conducted in Qatar among 180 adult waterpipe smokers, 70% would not mind if their children were to smoke in waterpipes^{28,29}.

The established use of cigarettes associated with cohabitation with family smokers has differed by student's sex. A statistically significant association between the female students who lived with family smokers and the established usage of cigarettes was found. Our study has shown that if the teen's mother or sister smokes, the risk of established use of cigarettes statistically significantly increases^{30,31}.

All this data shows the importance of family attitudes and habits in the use of waterpipe tobacco by adolescents. Therefore, anti-tobacco campaigns should be aimed at both adolescents and adults.

In our sample, 55.1% had used a waterpipe once in their lifetime, a much higher number than that reported in the ESTUDES (47.3%) in other Western countries (40% in London³², 12% in UK³³, 33% in Sweden³⁴).

Controlled by other variables (established waterpipe usage, consistent cognitive attitudes, emotional symptoms, behavioural and peer problems, and difficulties in prosocial behaviour), the likelihood of consolidating cigarette use is determined by age, female sex, established alcohol use and drunk, experimentation with cannabis, hyperactivity, cohabitation with one or more family smokers and early initiation of cigarette use.

Therefore, screening of emotional and behavioural skills and difficulties among adolescents should be established, and preventive activities on substance use should be implemented early in both the students themselves and their families.

One limitation of our study is that it is restricted to teenagers schooled in public schools in the province of Seville, which may reduce the ability to generalize

these results.

Although the cross-sectional design of our study cannot answer that question, some of our data suggest that the use of waterpipes precedes and may be the gateway to cigarette use also in our environment: the age in those with established waterpipes usage is lower than those with established cigarette usage. Globally, both the annotated literature and our results suggest that prevention activities regarding waterpipe use should be implemented to reduce their use and to try to close the gateway to cigarette use^{8,35}.

One aspect to assess in future studies is whether this usage of waterpipes in adolescence is consolidated into adulthood. Although there is no direct data on this, the fact that WTS is associated with nicotine addiction^{7,36,37}, raises the possibility that this dependence could lead to a maintenance of waterpipe usage in the future, or that this nicotine dependence will be replaced by cigarette use, since the latter is more accessible. Prospective studies should be designed to prove the hypothesis of WTS as a gateway to cigarette use in adolescents.

CONCLUSIONS

In conclusion, the results suggest that early use of waterpipe in adolescents poses a risk to the established usage of cigarettes. Similarly, behavioural and emotional difficulties are associated with the established use of tobacco (cigarette and/or waterpipe), alcohol and cannabis.

Smoking prevention programmes should have a more holistic view when addressing addictions as a whole, taking into account, among other factors, adolescents' emotional and behavioural abilities and difficulties, family use and use of other cigarette-associated substances.

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DATA AVAILABILITY

The data supporting this research is available from the authors on reasonable request.

AUTHORS' CONTRIBUTIONS

JMS-L: Conceptualization-Lead, Data curation-Equal, Formal analysis-Equal, Investigation-Equal, Methodology-Equal, Project administration-Equal, Resources-Equal, Software-Equal, Supervision-Lead, Validation-Lead, Visualization-Equal, Writing-original draft-Equal, Writing-review & editing-Equal. FR-V: Conceptualization-Supporting, Data curation-Supporting, Formal analysis-Supporting, Supervision-Equal, Writing-original draft-Equal, Writing-review & editing-Equal. LGL-R: Conceptualization-Equal, Data curation-Lead, Formal analysis-Lead, Investigation-Equal, Methodology-Lead, Project administration-Equal, Resources-Equal, Software-Lead, Supervision-Equal, Validation-Equal, Visualization-Equal, Writing-original draft-Equal, Writing-review & editing-Equal.

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