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Smoking behavior and secondhand smoke exposure among university students in northern Portugal: Relations with knowledge on tobacco use and attitudes toward smoking

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Abstract
Objectives: To assess the prevalence of active smoking and secondhand smoke (SHS) exposure among college students in the north of Portugal, and analyze the relationship between knowledge about tobacco use and attitudes toward smoking.
Materials and methods: This a cross-sectional study with a representative sample of college students ($n = 840$) in one university in Portugal. A validated self-reported questionnaire was administered to a proportional stratified random sample during the academic year of 2018/2019. We evaluated associations between smoking status, SHS exposure, smokers peers, knowledge and attitudes toward smoking and sociodemographic variables.
Results: The results showed that 20.1% of the students surveyed were current smokers (7.3% occasional smokers, 2.9% regular smokers and 9.9% daily smokers). Most current smokers started smoking before the age of 17 (61.4%) and reported never having tried to quit smoking (59.7%). Only 34.4% of students reported (almost) not having been in enclosed spaces with smokers in the past 7 days. Exposure to SHS and having smoker friends contributes to the prevalence of tobacco use. In general, students showed favorable attitudes toward smoking, especially those who are smokers, have smoking friends and are more exposed to SHS. The level of knowledge about tobacco was moderate, with a higher number of correct responses by former smokers.

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Conclusions: These results suggests an urgent need for socio-educational programs for counseling on smoking cessation. In addition, is also strongly recommended that, throughout academic training, students develop personal and social skills for dealing with the tobacco epidemic.

Introduction

Tobacco use remains a serious public health problem as it is a major cause of preventable diseases and death,[1,2] or in other words, the most avoidable cause of death.[3] Furthermore, secondhand smoke (SHS) exposure increases morbidity and mortality from coronary heart disease, lung cancer, respiratory infections, and other illnesses. Despite (inter)national tobacco prevention policies, such as a ban on smoking in public places, increased taxes on tobacco products and social education about the harmful effects of smoking, the recognition of the severe health consequences of smoking has been a slow process.[4] While these types of policy interventions are only indirectly aimed at young adults, they demonstrate the positive effects of smoking bans in public spaces, being associated with reduced smoking progression, reduced consolidation of experimentation with regular smoking and increased smoking cessation among young adults.[5] This is particularly relevant in areas where alcohol is served, given the strong association between tobacco and alcohol consumption in this age group.[6]

Starting smoking early increases the risk of regular smoking, and early adulthood is often associated with increased cigarette smoking and the establishment of regular smoking habits.[7] The academic environment may constitute a context that favors tobacco use,[8] as well as initiation/experimentation[9] through the way it is socially accepted in this context (Nolen-Hoeksema, 2004). Several studies have shown an increase in the number of smokers on academic courses, both in the number of students who began to smoke regularly and in the number of cigarettes smoked daily.[10] For example, Tercyak, Rodriguez and Audrain-McGovern (2007)[11] found that 25% of those who reported never having smoked in high school started smoking a year later.

Given the impact at various levels of tobacco use and the initiation and increase of smoking among young adults, it is important to understand how knowledge and attitudes toward tobacco use relate to smoking behavior, as this understanding will enable the development of health education programs in higher education from a preventive and educational perspective. In scientific literature, several investigations have addressed the relationship between knowledge, attitudes and smoking habits in higher education.[12–14] These studies take into account the fact that university students are in the process of being educated and that in future, they will be agents of change, responsible for promoting healthy lifestyles.[15]

The purpose of this study was to assess the prevalence of active smoking and secondhand smoke exposure among college students in the north of Portugal and analyze the relationship between knowledge about tobacco use and attitudes toward smoking.

Materials and methods

Population and sample

For the 2018/2019 academic year, 5447 students were registered in the 1st and 3rd year of integrated bachelors and masters degrees, with a higher prevalence of girls attending this university. Excluded from the sample were courses related to health sciences, undergraduate or postgraduate masters who did not have classes in the 1st or 3rd year. We excluded courses in the area of health sciences because we considered that the health knowledge of these students could skew the results of the study.

The minimum sample size needed for this study was 592 students (margin of error = 5%, confidence level = 99%, and response distribution = 50%). For this purpose, a stratified probabilistic sampling of university students was performed according to the academic year and the scientific area of study. The different undergraduate and master's degrees were divided into scientific areas (as defined by the Foundation for Science and Technology): Social and Human Sciences, Judicial and Economic Sciences, Exact and Nature Sciences and Engineering Sciences.

In this cross-sectional study with a representative sample of college students ($n = 840$) in one university in Portugal, data were collected using a validated self-reported questionnaire without biochemical confirmation.

The sample consists of 464 incoming students (55.2%) and 376 final year students (44.8%). The scientific area of studies included, 302 (36.0%) students from the engineering sciences, 270 (32.1%) students from the social and human sciences, 136 (16.2%) students from the exact and natural sciences and 132 (15.7%) students in the area of law and economic sciences. Most of the students surveyed were female (55.4%, $n = 465$), not in an affective relationship (58.3%, $n = 486$), displaced from their usual residence (64.9%, $n = 537$), full-time student (88.8%, $n = 739$) and with a BMI corresponding to a normal weight (73.1%, $n = 599$). The average age of the sample was 20.78 years (SD = 4.221), with a range of 18–54 years, only 3% of students were 30 or older.

Instruments

Currently, there are several scientific instruments to monitor the prevalence of smoking among young adults, as the Youth Risk Behavior Surveillance System (YRBSS),[16]

the Behavioral Risk Factor Surveillance System (BRFSS),[17] the National Survey on Drug Use and Health[18] and the National Youth Tobacco Survey.[19] Nevertheless, the data to be collected by using any of these surveys did not fully meet the objectives of the intended investigation. Therefore, the development of the instruments present in this investigation was carried out in three stages: scale construction (1st stage); content validity (2nd stage); psychometric validity (3rd stage), according to the procedures defined by Bowling (1998).[20]

For the construction of the scale (1st stage) was carried out a systematic review of the literature[14] in order to identify the questions and items commonly used to assess knowledge, attitudes and smoking habits in higher education. Based on this review, an analytical matrix was created for each of the dimensions to be analyzed, and those with the same semantic similarities were eliminated.

For the content validity (2nd stage) we invited 10 PhD researchers from several Portuguese universities with recognized work in the area of Health Education in Higher Education and the feedback from 5 of the invited investigators and all proposed semantic changes were considered. Similarly, the instrument was applied to 12 university students, using the method ''thinking aloud''[20,21] to identify items that might be confusing, excluding less relevant or redundant items, and verify that pre-coded response options were sufficient. In order to obtain greater objectivity, the following scale was used as the criterion of clarity evaluation for each item: 1 - confused; 2 - unclear; 3 - clear. After suggested redrafting, the preliminary version of the questionnaire survey was presented to a sample of 32 students, not included in the final sample.

The questionnaire included sociodemographic variables (sex, age, scientific area of study, academic year, weight and height (to calculate BMI), have a affective relationship, professional situation e current residence) and specific questions related:

- Smoking status (''Do you currently smoke?'' Possible answers: I currently smoke daily (at least 1 cigarette per day); I currently smoke regularly (at least one cigarette a week, but not every day); I currently smoke occasionally (less than one cigarette per week); I don't smoke now, but I used to smoke daily (at least 1 cigarette a day); I don't smoke now, but I used to smoke occasionally (at least 1 cigarette per week); I never smoked. And for current smokers: ''How many cigarettes do you smoke per week? Or per day?''); first experience of smoking (''How old were you when you started smoking?''); cessation attempts (''Have you ever tried to quit smoking?'')
- Smoker peers (''How many of your friends smoke regularly?'';
- Secondhand smoke (SHS) exposure (''Throughout the week, how long are you in enclosed spaces with smokers?'');
- Tobacco use knowledge (TUK): 6-item scale with answer options - True, False, Don't Know (1. ''Smokers are more likely to get lung cancer than non-smokers''; 2. ''Smokers feel tired more easily than non-smokers''; 3. ''The heart of a smoker works harder because carbon monoxide stops the blood from carrying oxygen''; 4. ''The nicotine present in cigarettes lowers blood pressure''; 5. ''The nicotine present in cigarettes is a nervous system stimulant''; 6. ''Smokers are more likely to develop osteoporosis than non-smokers'');
- Attitudes toward smoking use (AtS): 3-items scale on a 5-point likert scale (1 – strongly disagree, 5 – fully agree) (1. ''Smoking helps one relax and reduces stress''; 2. ''Smoking helps one to think''; 3. ''Smoking helps control body weight'').

Procedure and statistical analysis

All the students who attended the selected courses were personally invited to participate. At the end of each randomly selected class, the objectives of this study were presented and after informed consent, students filled out the paper-pencil questionnaire, in the classroom context. The response rate was 96.2% (95% CI 94.8–97.6), 33 questionnaires were excluded as not answered or incorrectly filled out. So we invited 873 university students to participate in this study.

All ethical research procedures with humans referred to by Christensen et al. (2015)[22] were fulfilled and the study was approved by the University Ethics Committee.

Data were analyzed using the IBM SPSS Statistics for Windows, version 25.0 (IBM Corp., Armonk, NY, USA). For statistical analysis, we analyzed frequencies and contingency tables, performed Pearson's correlation, Chi-square test, independent *t*-test, and one-way variance (ANOVA) and Hochberg's GT2 multiple comparison procedures. A p value < 0.05 was considered as significant.

Multinomial regression model was developed including only variables with a significant bivariate association with smoking status. The nominal indicator of 'non smoker' was assigned as the reference category and all covariates were entered into the model simultaneously. Variables found not to contribute to the prediction of the dependent variable were excluded from the final model. A significance level of 0.05 was considered.

Tobacco use patterns were analyzed according to the classification: No-smoker (who never smoked – ''I never smoked''); Former smoker (who have smoked weekly – ''I don't smoke now, but I used to smoke occasionally (at least 1 cigarette per week)'' and daily – ''I don't smoke, but I used to smoke daily (at least 1 cigarette a day)'') and Current smoker (occasional smokers – ''I currently smoke occasionally (less than one cigarette per week)'', regular smokers – ''I currently smoke regularly (at least one cigarette a week, but not every day)'' and daily smokers – ''I currently smoke daily (at least 1 cigarette per day)'').

To the scale about knowledge the number of correct responses was added to give an overall knowledge score, and means calculated. This means that the higher the scale value, the higher the level of knowledge.

The attitude scale was subjected to Cronbach's alpha analysis in order to analyze its reliability,[20] and a good reliability index was obtained ($\alpha = .770$). In addition, inter-item correlations ranging from .674 to .387. Reading the results of this scale shows, the higher the average of the scale, the more negative the attitudes of university students toward tobacco consumption.

Table 1 Frequencies and Chi Square test for sociodemographic variables and smoking-related characteristics. Bold: statistical significance

		Smoking status						Chi Square test	
		No-smoker		Former smoker		Current smoker		χ^2	*p*
		f	%	*f*	%	*f*	%		
SHS exposure	Never or almost never	233	40.7	24	26.1	29	17.3	86.536	**.000**
	Few times	210	36.7	27	29.3	51	30.4		
	Sometimes	102	17.8	24	26.1	49	29.2		
	Most of the time	17	3.0	11	12.0	24	14.3		
	Almost Always or Always	10	1.7	5	6.5	15	8.9		
Smoker peers	None or almost none	107	18.8	8	8.5	11	6.7	114.594	**.000**
	Few	215	37.7	26	27.7	29	17.6		
	Some	211	37.0	34	36.2	70	42.4		
	Most	34	6.0	20	21.3	44	26.7		
	Almost all or all	3	0.5	6	6.4	11	6.7		
Year of frequency	1st year	329	39.2	58	6.9	77	9.2	8.260	**.016**
	3rd year	249	29.6	36	4.3	91	10.8		
Scientific area	Engineering sciences	217	25.8	28	3.3	57	6.8	20.103	**.003**
	Exact and natural sciences	95	11.3	13	1.5	28	3.3		
	Judicial and economic sciences	70	8.3	22	2.6	40	4.8		
	Social and human sciences	196	23.3	31	3.7	43	5.1		
Sex	Male	252	30.0	38	4.5	85	10.1	3.340	.188
	Female	326	38.8	56	6.7	83	9.9		
Age	<20	266	31.7	35	4.2	54	6.4	11.370	**.003**
	>=20	312	37.1	59	7.0	114	13.6		
Affective relationship	Yes	212	25.5	58	7.0	77	9.2	23.206	**.000**
	No	362	43.5	35	4.2	89	10.7		
Current residence	Displaced	182	22.0	31	3.7	78	9.4	12.942	**.002**
	Not displaced	389	47.0	60	7.2	88	10.6		
Professional situation	Full time student	527	63.3	73	8.8	139	16.7	23.984	**.000**
	Worker/Student	44	5.3	21	2.5	28	3.4		
BMI	Low weight	43	5.3	7	0.9	8	1.0	3.122	.538
	Normal weight	412	50.3	68	8.3	119	14.5		
	Overweight	107	13.1	16	2.0	39	4.8		

Results

The results showed that 68.8% of the students surveyed were non-smokers, 11.2% were former smokers and 20.1% were current smokers (7.3% occasional smokers, 2.9% regular smokers and 9.9% daily smokers). Regular and daily smokers consume on average 8.43 ($SD = 6.462$) cigarettes per week and 8.33 ($SD = 4.870$) cigarettes per day, respectively. Most current smokers started smoking aged under 17 (61.4%) and reported never having tried to quit smoking (59.7%). Only 34.4% of students reported (almost) never having been in enclosed spaces with smokers in the previous 7 days.

Tobacco use is positively correlated with smoker peers ($r_{sp} = .329$, $p < 0.01$) and with SHS exposure ($r_{sp} = .295$, $p < 0.01$), so, smokers tend to have more friends who smoke ($\chi^2(8) = 114{,}594$, $p = .000$) and are more exposed to SHS than former smokers and non-smokers ($\chi^2(8) = 86{,}536$, $p = .000$) (Table 1).

Smoking was significantly associated with sociodemographic characteristics such as which academic year, scientific area, age, being in an affective relationship, current residence, and professional situation. This means that there is a higher prevalence of smoking in: graduating students compared to the year first students ($\chi^2(2) = 8.260$, $p = .016$); students of the economics and law compared to the other scientific areas ($\chi^2(6) = 20.103$, $p = .003$); older students compared to the younger ones ($\chi^2(2) = 11.370$, $p = .003$); students who are in a relationship compared to those who are not ($\chi^2(2) = 23{,}206$, $p = .000$); students who moved away from home at the time of entering higher education compared to non-displaced students($\chi^2(2) = 12{,}942$, $p = .002$); student-workers compared to full-time students ($\chi^2(2) = 23{,}984$, $p = .000$) (Table 1). Note that no statistically significant differences were found in tobacco use according to sex or BMI of respondents.

In general, students showed favorable attitudes toward smoking, because the mean score 2.01 (SD = .924) showed that most respondents disagreed or strongly disagreed with the items of AtS. But, there were significant differences based on smoking status, smoker peers, SHS exposure, scientific area, sex and current residence, as shown in Table 2. Not surprisingly, smokers had more negative attitudes than

Table 2 Mean, one-way ANOVA and t-test for smoking characteristics, sociodemographic variables and attitudes toward smoking (AtS).

		AtS	ANOVA		Hochberg		
		Mean (SD)	*Z*	*p*			
Smoking status	Non-smoker	1.77 (.826)	85.886	**.000**	1.7653		
	Former smoker	2.21 (.795)				2.2138	
	Current smoker	2.72 (.918)					2.7186
Smoker peers	None or Almost none	1.70 (.768)	15.581	**.000**	1.6960		
	Few	1.90 (.866)			1.9019		
	Some	2.02 (.910)			2.0183		
	Most	2.50 (1.037)				2.4965	
	Almost All or All	2.77 (.925)				2.7667	
SHS exposure	Never or almost never	1.85 (.843)	7.298	**.000**	1.8470		
	Few times	1.98 (.942)			1.9801		
	Sometimes	2.11 (.937)			2.1085	2.1085	
	Most of the time	2.41 (.965)				2.4067	
	Almost Always or Always	2.48 (.973)				2.4839	
Scientific area	Engineering Sciences	2.15 (.903)	6.791	**.000**		2.1488	
	Exact and Natural Sciences	2.04 (.976)			2.0373	2.0373	
	Law and Economic Sciences	2.06 (.924)			2.0615	2.0615	
	Social and Human Sciences	1.81 (.891)			1.8075		
BMI	Low weight	1.91 (.956)	2.465	.086			
	Normal weight	1.98 (.880)					
	Overweight	2.15 (1.048)					
			t-student				
			t	*p*			
Acadmic year	1st year	1.96 (.907)	−1.677	.094			
	3rd year	2.07 (.942)					
Sex	Male	2.17 (.987)	4.478	**.000**			
	Female	1.88 (.849)					
Age	<20	1.94 (.886)	−1.908	.057			
	>=20	2.06 (.949)					
In relationship	Yes	2.02 (.961)	.233	.818			
	No	2.00 (.902)					
Current residence	Displaced	2.11 (.935)	2.516	**.012**			
	Not displaced	1.94 (.908)					
Professional situation	Full time student	2.00 (.919)	−.749	.454			
	Worker/Student	2.08 (.952)					
Total		2.01 (.924)					

those who had never smoked or stopped smoking ($F(2, 824) = 85.886$, $p = .000$). And students who report that most or almost all friends are smokers and are mostly or almost always exposed to SHS exhibit more negative attitudes than students with no, few or some smoker friends ($F(4, 811) = 15.581$, $p = .000$) and are never or rarely exposed to SHS ($F(4, 814) = 7.298$, $p = .000$), respectively.

Engineering sciences respondents showed more negative attitudes, while those in social and human sciences showed the most favorable attitudes ($F(3, 823) = 6.791$, $p = .000$). Girl respondents and students who lived at home had more favorable attitudes than boy respondents ($t(825) = 4.478$, $p = .000$) and students who had moved away from home ($t(813) = 2.516$, $p = .012$), respectively.

There were no significant differences by year of frequency, age, being in a relationship, IBM and professional situation.

Table 3 shows respondents' knowledge of tobacco use. The mean score was 3.11 ± 1.26 (out of 6) correct answers. There were no significant differences in knowledge scores because of smoker peers, SHS exposure, year of frequency, scientific area, age, being in a relationship, current residence or IBM. However, one-way ANOVA showed significant differences between TUK and smoking status. Respondents who had ceased smoking had a significantly higher mean knowledge score than those who still smoked and those who had never smoked ($F(2, 829) = 3.559$, $p = .029$). Furthermore, *t*-test showed significant differences between TUK and sex of respondents and current residence. That is means girls and displaced students had a lower level of knowledge than boys ($t(830) = 2.336$, $p = .020$) and students living at home ($t(822) = -2.334$, $p = .020$), respectively.

For the final model, we kept the variables that had a statistically significant effect on the logit probability of the

Table 3 Mean, one-way ANOVA and *t*-test for smoking characteristics, sociodemographic variables and tobacco use knowledge (TUK).

		TUK				
		Mean (SD)	ANOVA		Hochberg	
			Z	*p*		
Smoking status	No-smoker	3.04 (1.303)	3.559	**.029**	3.0384	
	Current smoker	3.20 (1.143)			3.2000	3.2000
	Former smoker	3.38 (1.219)				3.3830
Smoker peers	None or almost none	3.02 (1.362)	1.644	.161		
	Few	3.01 (1.263)				
	Some	3.16 (1.222)				
	Most	3.36 (1.268)				
	Almost all or all	3.15 (.875)				
SHS exposure	Never or almost never	3.04 (1.317)	1.356	.248		
	Seldom	3.18 (1.279)				
	Sometimes	3.00 (1.259)				
	Most of the time	3.31 (.899)				
	Almost always or always	3.35 (1.226)				
Scientific area	Engineering sciences	3.13 (1.224)	.309	.819		
	Exact and natural sciences	3.14 (1.141)				
	Law and economic sciences	3.15 (1.330)				
	Social and human sciences	3.05 (1.333)				
BMI	Low weight	2.93 (1.041)	.706	.494		
	Normal weight	3.14 (1.272)				
	Overweight	3.12 (1.282)				
			t-student			
			t	*p*		
Academic year	1st year	3.15 (1.273)	.982	.326		
	3rd year	3.06 (1.250)				
Sex	Male	3.22 (1.292)	2.336	**.020**		
	Female	3.02 (1.233)				
Age	<20	3.10 (1.213)	−.182	.855		
	>=20	3.12 (1.299)				
In relationship	Yes	3.17 (1.271)	1.165	.244		
	No	3.07 (1.245)				
Current residence	Away from home	3.14 (1.204)	.302	.763		
	Living at home	3.11 (1.280)				
Professional situation	Full time student	3.07 (1.258)	−2.334	**.020**		
	Worker/Student	3.40 (1.278)				
Total		3.11 (1.263)				

smoking status: AtS ($G^2(2) = 101.993$, $p = .000$); Smoker peers ($G^2(8) = 20.492$, $p = .009$); SHS exposure ($G^2(8) = 21.693$, $p = .006$); In relationship ($G^2(2) = 16.247$, $p = .000$); Professional situation ($G^2(2) = 14.410$, $p = .001$). The adjusted model was statistically significant ($G^2(22) = 257.946$, $p = .000$) and correctly predicted the status smoking 72.5% of the time (93.9% for non smokers).

Table 4 summarizes the results of the multinomial logistic regression for smoking status. The model made it possible to predict that: students who were less exposed to SHS were less likely to be smokers compared to non-smokers; students who had fewer smoking friends were less likely to be smokers and ex-smokers compared to non-smokers; being in a relationship compared to not being in a relationship increases the chances of being a former smoker in relation to a non-smoker; being a full-time student compared to student workers reduces the chances of being a former smoker by 67.7% and of being a smoker by 58.4%; students scoring higher on AtS were more likely to be a former smoker or current smoker than non-smoker.

Discussion

This study examined current smoking status, smoking history, cessation attempts and knowledge of tobacco use and attitudes toward smoking among students at one university in Portugal. Our data showed that 1 in 5 uni-

Table 4 Adjusted odds ratios (OR) and 95% confidence intervals (CI) from multinomial logistic regression model predicting former smoker and current smoker.

		Smoking Status			
		Former smoker[a]		Current smoker[a]	
		OR	(95% CI)	OR	(95% CI)
SHS exposure	Never or almost never	.324	(.087–1.210	.223*	(.069–.720)
	Seldom	.371	(.104–1.324)	.289*	(.094–.888)
	Sometimes	.537	(.149–1–928)	.488	(.158–1.504)
	Most of the time	1.304	(.310–5.486)	1.147	(.322–4.085)
	Almost Always or Always				
Smoker peers	None or Almost none	.116*	(.020–.655)	.152*	(.029–.785)
	Few	.125*	(.025–.617)	.118**	(.025–.551)
	Some	.143*	(.030–.688)	.221*	(.049–.995)
	Most	.262	(.052–1.329)	.413	(.089–1.929)
	Almost All or All				
In relationship	Yes	2.707***	(1.653–4.435)	1.388	(.908–2.122)
	No				
Professional situation	Full time student	.323***	(.171–.608)	.416**	(.225–.768)
	Worker/Student				
AtS		1.829***	(1.391–2.405)	3.096***	(2.430–3945)

OR: odds ratio; 95% CI: 95% confidence interval.
[a] Reference category: no-smoker.
* $p < .050$.
** $p < .010$.
*** $p < .001$.

versity students are smokers but that the prevalence of smoking in this university was lower than identified in other national[23–26] and international studies (Spain[10,27,28]; Greece[29]; Iran[30]; Australia[31]; Jordan[32]; Palestine[33]; Liban[34]; United Kingdom[35]; Italy[36]; Czech Republic[37]; Serbia[38]; Brazil[39]; Saudi Arabian[40]; Belgium[41]; Chile[42]; Poland[43]; Turkey[44]). Similarly, we found a high proportion of students who were former smokers (11.2%), considering that they are young adults and despite the fact that most current smokers (61.4%) started smoking before entering higher education.[10,45] This could be explained because before leaving home, there had been an aspect of parental control which was lost when entering higher education.[46] The prevalence of smoking increased with permanence in higher education, which corroborates scientific literature.[3,32,33,47,48] Consequently, older students included more smokers than younger students (13.6% versus 6.4%) and there were also statistically significant differences depending on the number of cigarettes consumed per day or per week. That is, older smokers smoke, on average, 12.10 (±7.340) cigarettes per week or 8.84 (±4.969) cigarettes per day, while younger smokers smoke, on average, 5.09 (±3.048) cigarettes per week or 5.09 (±2.468) cigarettes per day ($t = -2.909$, $p = .009$ and $t = -2.445$, $p = 0.17$, respectively).

A national study[49] showed that 37.2% of young people aged between 15 and 34 years old had used tobacco in the previous 30 days, meaning this prevalence was higher than verified in this study.

Unlike other national[24,26] and international studies[30,33,42,47,48,50–53] in which male students smoked more than female students, our study did not find any differences in smoking between the sex of respondents. This is consistent with a study conducted in 2004 at the same university.[54]

Most smokers reported never having attempted to quit smoking (59.7%), a very high percentage compared to other studies.[10] This indicates, efforts should be made to understand why students are reluctant to quit smoking.

The prevalence of SHS in closed public spaces is high, due to the fact that more than half of the students (65.6%) had been exposed to SHS in the previous week. Despite prohibitive smoking policies in enclosed public places, college students had a high level of exposure to SHS.[48,55,56] Furthermore, we found that smokers are more exposed to SHS than non-smokers.[57]

Most respondents (52.2%) reported that at least some of their friends were smokers, consistent with the literature, not forgetting that having smoking friends seems to influence tobacco use among university students.[30,38,40,45,50,51,53,58–60]

Regarding attitudes toward tobacco, we found that most students showed favorable attitudes toward smoking[31] but, as in other studies,[31,33] non-smokers demonstrated higher scores on positive attitudes than smokers and former smokers. The influence of smoking friends, exposure to SHS and being enrolled in engineering science courses seems to reduce positive attitudes toward tobacco use.

In terms of knowledge about tobacco use, several studies have shown that smokers have low levels of knowledge,[61] suggesting that increasing knowledge about the effects of smoking would decrease smoking rates during academic

courses.[47] In our study, there was a moderate level of knowledge about tobacco,[30,33,48] higher in students who had already quit smoking.[31,32]

Unlike other research findings, where girls were better informed than boys[31,32,62] or where there were no differences,[30] we found that boys were better informed than girls.[33]

It is also important to highlight the sociodemographic variable ''current residence'', because students who had left their familial home smoked more, knew less about the harmful consequences of smoking and showed more negative attitudes compared to students who had not changed their residence after entering higher education.

Finally, the limitation of this study should be noted. Restricting the study to a single university limits generalizability to the total population of university students in Portugal.

No data were collected concerning the smoking habits of parents/households and, although scientific studies state that children of smoking parents have a greater tendency to be smokers, this type of question did not fit within the scope of our study. One final limitation should be considered. Since the data were collected in 2018–2019, the use of e-cigarettes or ''heat-not-burn'' tobacco products are at least worth mentioning, especially looking at young people.

Conclusions

This study suggests an urgent need for higher education institutions to implement socio-educational programs to discourage tobacco use among university students. In addition, it is also highly recommended that during academic training students develop personal and social skills to deal with the tobacco epidemic.

Conflicts of interest

The authors have no conflicts of interest to declare.

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