



Original article

Influence of microenvironmental factors on tobacco consumption among Spanish youth

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ABSTRACT

Introduction: The onset of tobacco use is occurring at increasingly younger ages. Numerous studies have identified risk and protective factors associated with smoking in adolescents, with family factors being among the most influential. Likewise, the group of friends and the role of teachers as role models also exert a notable influence on the onset of consumption.

Objective: To analyze the influence of social and family role models on tobacco consumption in adolescents, considering these factors as elements of the microenvironment.

Method: A retrospective cohort study was conducted at three points (2011, 2016 and 2019). The sample, incidental in nature, consisted of 3928 Spanish students aged 12–14 years, enrolled in Compulsory Secondary Education in 54 educational centers. Data collection was performed by means of a self-administered questionnaire designed ad hoc, with adequate internal consistency (Cronbach's alpha). Previously, a health education and prevention program developed by the Spanish Association Against Cancer (Asociación Española Contra el Cáncer) was applied. Both the intervention and data collection complied with the established ethical principles. Statistical analysis included descriptive techniques, bivariate and multivariate analyses and binary logistic regression models.

Results: The influence of family and social models on tobacco use varied between cohorts. The paternal figure showed an influence of 1.3 % in 2011, .7 % in 2016, and 0.8 % in 2019; the maternal figure of 2.2 %, 1.5 % and 0.3 %, respectively. Siblings had an influence of 4.3 % in 2011, 1.6 % in 2016 and 0.5 % in 2019. The influence of the best friend was 23.2 % in 2011, 18.7 % in 2016 and 1.7 % in 2019. The figure of the teacher was relevant in 2011 (0.9 %) and 2019 (0.4 %). Regarding multivariate predictive models, in 2011 older age explained 10.5 % of consumption. In 2016, older age, peer pressure and less family communication explained 20.4 %. In 2019, younger age, more available money and peer pressure explained 2.4 % of consumption.

Conclusions: The results reinforce the importance of social and family patterns as risk factors in the early stages of adolescent smoking. The multicausal nature of smoking in this vital stage justifies the design of preventive interventions aimed at modifying risk factors and promoting protective factors.

1. Introduction

This study aims to analyze the influence of social and family patterns on tobacco use among school adolescents. For this purpose, three temporal cohorts (2011, 2016 and 2019) are examined to identify possible changes in consumption patterns and associated factors over time.

This work is based on Bronfenbrenner's Ecological Systems Theory, which states that the development of the individual is mediated by multiple environmental systems. This allows the analysis of tobacco consumption in adolescents considering the influence of the microsystem (family, friends, school) and the mesosystem, which includes the relationships between these environments¹ As well as the Theory of

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Human Development in Global Contexts by Super and Harkness through the concept of "developmental niche", which adds a cultural perspective to this ecological approach. This theory highlights how family beliefs, parenting practices and daily routines influence adolescent behavior, including the adoption or rejection of behaviors such as tobacco use. In this way, it is understood that development is closely linked to the cultural context in which each person is inserted.²

The general hypothesis guiding this research is that *adolescent smoking is significantly associated with various microenvironmental factors*, such as the presence of close role models (family, friends, teachers), perceived peer pressure, type of family communication and level of economic control. It is also considered that the importance of these relationships will vary according to time, showing the changes in social and family contexts over the three cohorts analyzed.

Despite the research available in this field, most previous studies are based on single cross-sectional data or individual factors. This study adopts a comparative and longitudinal perspective in the Spanish context, incorporating three clearly differentiated cohorts and focusing on microenvironmental variables. The aim is to provide useful evidence for the design of more effective and contextualized prevention strategies in social, educational and family settings.

It is estimated that there are more than one billion smokers in the world, of which more than 150 million are adolescents.³ One out of every ten adolescents use tobacco and three out of every five young people who try tobacco will become addicted smokers in adulthood.⁴ The onset of tobacco use is occurring at increasingly younger ages⁵ specifically between 13 and 15 years of age⁶⁻⁸. Throughout adolescence, the frequency and quantity of tobacco consumption increases until it reaches its peak at around 25 years of age. Currently, it begins to decrease, probably due to the assumption of the roles and responsibilities of adulthood.^{6,7,9-11}

Data from the Health Behaviour in School-aged Children (HBSC) study (2018) with almost 50 participating Western countries and a Spanish sample of 40,495 adolescents between 11 and 18 years of age, it is noted that 15 % of 15-year-old adolescents have smoked in the last 30 days.¹² In Spain the situation is not very different; in the survey on drug use in Secondary Education in Spain (ESTUDES)¹³ tobacco appears as the second most consumed psychoactive substance among students aged 14–18 years. In addition, 38.2 % smoked tobacco, the first contact with tobacco occurred at 14.1 years of age and they acquired the habit of daily consumption at 14.7 years of age.

A distinction has been made between experimental tobacco use (understood as occasional experimentation without continuity over time) and habitual use, which involves regular repetition of the behavior and a pattern of use. According to the literature, consumption goes from experimental to habitual or regular when the young person smokes on a weekly or daily basis for a sustained period, generally between 6 and 12 months after the first contact.^{14,15} From this point on, the risk of developing nicotine dependence increases, especially if consumption begins before the age of 15 years. Although adolescence is a stage characterized by curiosity and experimentation, it is continued use that represents a danger to health and development. Therefore, current studies point to the importance of detecting not only the prevalence of use, but also patterns of use, since habitual use is closely linked to the development of addiction.^{14,16}

Despite extensive research on the risk and protective factors associated with tobacco use among young people, there are still limitations to the role of social and family patterns in the initiation and maintenance of tobacco use. Recent research in Turkey has identified several socio-demographic and economic factors that influence tobacco and alcohol use, highlighting the complexity of these behaviors and the need for multifaceted preventive strategies.¹⁷

Numerous authors have tried to clarify the risk and protective factors in youth tobacco use. For González and Berge¹⁸ the *risk factors* are mainly low self-esteem, lack of sporting activity, high attendance at parties, having friends who smoke (especially their best friend), parents

and/or relatives who smoke and live permanently with them. *Protective factors* include participation in sports, good, friends who do not smoke (especially their best friend), non-smoking parents, and having a good knowledge of the harm smoking causes to health.

Although acceptance by the peer group is very important for the adolescent, the influence of parents continues to be very important at this stage of life. Family relationships play a fundamental role in the psychosocial development of adolescents¹⁹ and, consequently, *family factors* are considered one of the most influential factors in the initiation of tobacco use.²⁰⁻²²

Within the family factors, aspects stand out such as: the type of education that young people receive^{23,24} the influence that the family exerts on values, attitudes and beliefs of their children; involvement in the selection of the peer group with which their children relate²⁵ the quality of relationships and the family climate; communication between parents and children and emotional support,²⁶ the type of leisure and shared family free time (understood as activities carried out voluntarily and pleasurably during the time not occupied by school or work obligations; family control over money or in supervising who they go out with and how they have fun.^{15,27,28} Other studies also show that the habit of smoking by either parent is positively associated with smoking by the children.²⁹ Along the same lines, Yamamoto-Kimura et al.³⁰ point out that having parents who smoke and social pressure are influential elements in the onset of smoking among adolescents.³¹

Parenting styles have also been identified as significant predictors of adolescent substance use.³² Protective factors include affection, understanding, good communication, responsiveness to adolescent needs, and behavioral control. In contrast, rejection and perceived criticism are considered risk factors.³³ In the family climate, conflict in the home is also a risk factor. In these cases, family members show little affection and low emotional support.³⁴ This family dynamic can be further reinforced when siblings act as models, either directly, through observation, or indirectly, through the transmission of attitudes and values.^{31,32}

However, beyond the family environment, the group of friends also appears in literature as one of the most influential variables in explaining tobacco consumption. In fact, for some authors, consumption depends entirely on the group of friends, even without other added risk factors.³⁵ Other researchers will go further, indicating that the onset of tobacco use could even be a further factor in the selection of friends in adolescence.³⁶ Having friends who smoke is one of the most consistent predictors of the transition from experimental use to regular consumption.³⁷ Ariza and Nebot³⁸ report a risk 35 times higher for young people with friends who smoke compared to those who do not.

Peer group pressure can be a particularly relevant factor in the initiation of tobacco use.³⁹ Most of the time, consumption is done with the peer group, as a social act and sharing in a group^{14,40} and to experience new experiences^{39,41} based on arousal and disinhibition.⁴²

Just as friends can influence adolescent behavior, teachers also play a key role as role models. In this regard, different studies suggest that^{43,44} teachers should be careful about the non-explicit messages they transmit in relation to their own tobacco use, permissiveness towards smoking in other adults or other students, etc. In a study with university professors at the University of Burgos, Morato et al.⁴⁴ found smoking rates of 10.8 %, 24.3 % of whom were ex-smokers. Some 22.3 % agreed or strongly agreed that the negative effects of smoking are being exaggerated and 22.8 % that smoking is a right that should not be limited. For their part, the university students in this study, future professors, had higher than average smoking rates, with prevalences of 39.3 % and an average consumption of 9.75 cigarettes/day.

In Spain, tobacco use among adolescents continues to be a public health challenge. Despite legislative advances in smoking prevention and control, smoking initiation rates at early ages continue to be of concern. Adolescence is a critical stage in the habits that are consolidated, and early contact with tobacco can lead to habitual use and subsequent dependence. In terms of prevention, Spain has developed

various evidence-based strategies, especially in the educational setting, such as school intervention programs, awareness campaigns or community projects. However, their implementation has been uneven and, in some, unsystematic and lacking in scientific rigor, making it difficult to evaluate their impact. For all these reasons, it is essential to continue analyzing the factors that influence the initiation and maintenance of drug use to design more effective interventions adapted to the national context.

The present study aimed to estimate the association between adolescent smoking and these microenvironmental factors, also including variables such as perceived pressure, family communication and economic control.⁴⁵ For this purpose, data from three cross-sectional studies conducted in Compulsory Secondary Education centers in Spain, corresponding to the years 2011, 2016, and 2019, were analyzed.

2. Methods

2.1. Study design and participants

A retrospective cohort study⁴⁶ was conducted at three points: 2011, 2016 and 2019. We used a convenience sample composed of 3928 Spanish students, aged between 12 and 14 years, enrolled in 1st, 2nd and 4th year of Compulsory Secondary Education (ESO) in a total of 54 educational centers in the city of Burgos and its province (19 centers in 2011; 11 in 2016; and 24 in 2019).

As a criterion for inclusion, it was established that the educational centers had to be affiliated with one of the health education programs of the Spanish Association Against Cancer (AECC) taught in secondary education, and that student participation was voluntary.

The distribution by year was as follows.

- In 2011, 846 students (448 females and 398 males), aged 12–17 years ($M = 14.1$; $SD = 2.01$) participated.
- In 2016, the sample consisted of 679 students (335 females and 344 males), aged 12–17 years ($M = 13.5$; $SD = 1.6$).
- In 2019, data were collected from 2403 students (1180 females and 1223 males), also aged 12–17 years ($M = 14.08$; $SD = 2.3$).

As shown in Table 1, the sample was gender balanced. In addition, the majority of the students came from urban environments and attended public or state-funded charter schools. Table 2 shows the tobacco use data.

Table 1
Sociodemographic characteristics of the sample (n = 3.928).

Variable	2011 (n = 846)	2016 (n = 679)	2019 (n = 2.403)
Sex			
Woman	448 (53.0 %)	335 (49.3 %)	1.180 (49.1 %)
Man	398 (47.0 %)	344 (50.7 %)	1.223 (50.9 %)
Type of educational institution			
Public	210 (24.8 %)	362 (53.3 %)	1.424 (59.3 %)
Arranged ^a	636 (75.2 %)	317 (46.7 %)	979 (40.7 %)
Rural school	155 (18.3 %)	0 (0.0 %)	246 (10.2 %)
Urban school	691 (81.7 %)	679 (100.0 %)	2.157 (89.8 %)
Mean age (years)	14.4	13.5	14.08
Academic year			
1ST ESO	470 (55.6 %)	470 (69.2 %)	1.075 (44.7 %)
2ND ESO	28 (3.3 %)	0 (0.0 %)	331 (13.8 %)
3RD ESO	0 (0.0 %)	5 (0.7 %)	129 (5.4 %)
4 TH ESO	323 (38.2 %)	204 (30.0 %)	745 (31.0 %)
1st Baccalaureate	0 (0.0 %)	0 (0.0 %)	35 (1.5 %)
2nd Baccalaureate	0 (0.0 %)	0 (0.0 %)	3 (1.1 %)
Vocational Training	0 (0.0 %)	0 (0.0 %)	34 (1.4 %)

^a Arranged: Private school with public fundin

Table 2
Tobacco use data (n = 3.928).

Variable	2011 (n = 846) (%)	2016 (n = 679) (%)	2019 (n = 2403) (%)
Initiation of tobacco use			
Never tried it	288 (34.0)	138 (20.3)	33 (4.8)
No, but I have tried it	520 (61.5)	423 (62.3)	1.698 (70.7)
Occasionally	178 (21.2)	108 (15.9)	413 (17.2)
Daily	147 (17.4)	88 (13.0)	165 (6.9)
I have not smoked for months	–	59 (8.7)	675 (5.3)
Average age of onset (years)	12.9	13.4	13.42
Weekly tobacco consumption	n = 133	n = 40	n = 29
40 or more cigarettes	17 (12.8)	8 (20.0)	5 (17.2)
20 cigarettes	9 (6.8)	5 (12.5)	2 (6.9)
10/20 cigarettes	26 (19.5)	20 (50.0)	2 (6.9)
5/10 cigarettes	81 (60.9)	7 (17.5)	20 (69.0)
Have you bought tobacco for yourself?	n = 288	n = 134	n = 116
Yes	103 (35.8)	65 (48.5)	25 (21.6)
No	185 (64.2)	69 (51.5)	91 (78.4)

2.2. Instruments

2.2.1. Evaluation instruments

Data collection was performed by means of a self-administered questionnaire designed ad hoc, called the *AECC Questionnaire of Attitudes and Behavior towards Tobacco for Compulsory Secondary School Students*. The instrument consisted of 43 items distributed in two blocks: a first block with 6 sociodemographic items (age, school, grade, gender, weight and height) and a second block with 37 items on lifestyle habits, organized into three dimensions: substance use (tobacco, alcohol, cannabis and electronic devices), healthy eating and emotional state. All items were categorical, with between 2 and 6 response options.

The design of the questionnaire was based on variables relevant to the study of adolescent smoking, following the recommendations of the World Health Organization.^{47,48} To ensure content validity, it was reviewed by five expert judges from the socio-health and socio-educational fields, who evaluated the relevance and clarity of the items. The final version incorporated their suggestions. The internal consistency of the questionnaire was acceptable, with Cronbach's alpha coefficients of .620 (2011), .604 (2016) and .721 (2019).

The variables collected were classified according to their level of measurement, as follows:

Nominal variables (categorical): gender (male/female), educational institution (public/charter), location of school (urban/rural), and consumption models (e.g., smoker father, mother, peers).

Dichotomous variables: tobacco use (yes/no), discussion of the prevention program at home (yes/no), perceived pressure to smoke (yes/no), family control over spending (yes/no).

Ordinal variables: academic grade (1st ESO to 2nd Baccalaureate), weekly allowance categories (€0–5, €5–10, €10–20, >€20), frequency of tobacco use (never, tried once, occasional, daily, ex-smoker).

Interval variables: not present, as no scales with equal intervals but no true zero were used.

Ratio variables (continuous quantitative): age, weight, height, number of cigarettes consumed per week.

This classification guided the selection of appropriate statistical analyses and is now explicitly stated in the Instruments section to improve clarity for readers.

2.2.2. Intervention program

The study was carried out within the framework of the "Programa de prevención de tabaquismo en la escuela", a health education and cancer

prevention program that has been taught in schools in the province of Burgos (Spain) since 1996. The central purpose of this program is to prevent young people from starting to smoke, with the aim of reducing morbidity and mortality rates due to cancer in the province of Burgos. Among its specific objectives are to contribute to delaying the age of initiation of tobacco use; to increase protective factors against tobacco use and personal skills for its rejection; to facilitate the identification of school groups as vulnerable to the tobacco industry; and to encourage the participation of the entire school community in school's prevention interventions, promoting healthy and active schools. This program consists of three 1-h modules, carried out in three different days, developed from a dynamic and participatory perspective through the use of audiovisuals and role-playing games: a) Informative session on the reality and risks of smoking, including the management of addictive beliefs; b) Management of peer pressure as a factor that modulates and conditions behavior, with emphasis on emotional intelligence; c) Stimulation of critical thinking in the face of advertising and the tobacco industry.

2.3. Procedure

Interested schools applied for participation in the "Smoking prevention program at school" through the municipal educational offer or by direct application to the Spanish Association Against Cancer (AECC). Once the program was granted, it was implemented in the centers by the smoking cessation specialist of the AECC (Provincial Board of Burgos).

The intervention was aimed at students in the 1st and 2nd years of Compulsory Secondary Education (ESO), between 12 and 14 years of age, and a second intervention within the "Youth for Health" program from the 4th year of ESO, adapting the contents to the needs of the center, the available resources and the psychosocial changes of the age group.

At the end of the last session of the program, data were collected by means of the anonymous completion, in paper format, of the "Questionnaire of attitudes towards smoking for ESO students". This instrument was administered by the teachers in charge of the center during tutoring time. These teachers were previously trained to adequately inform the students on how to complete the questionnaire, without inducing their answers. The estimated time needed to complete the questionnaire was approximately 20–25 min.

Regarding ethical aspects, all the participating centers had the necessary authorizations to carry out the program. Parents or legal guardians were previously informed at the initial course meeting about the activities developed, including the questionnaire. The administration of the instrument was managed by the guidance department or the head of studies, guaranteeing the anonymous, voluntary and confidential nature of student participation.

The final sample analyzed consisted of 3,928 students: 846 in 2011, 679 in 2016 and 2,403 in 2019. Although all the students present participated in the prevention program, only those who correctly completed the questionnaire at the end of the intervention were included in the study. Those instruments that were incomplete or had obvious inconsistencies were discarded, so that only correctly completed questionnaires were considered valid. The estimated rate of discarded questionnaires was less than 10 % in the three cohorts, which guarantees a high level of effective participation and adequate representativeness of the sample.

2.4. Data analysis

Data was analyzed using IBM SPSS Statistics, version 25. First, a descriptive analysis of the qualitative variables was conducted through frequency and percentage tables. For quantitative variables, normality was assessed using Q-Q probability plots, skewness and kurtosis indices, and the Kolmogorov–Smirnov goodness-of-fit test.

When the assumptions of normality and homogeneity of variance

(tested using Levene's test) were met, continuous variables were analyzed using independent-sample t-tests (for two groups) and one-way ANOVA (for comparisons across three or more groups). When these assumptions were not met, non-parametric equivalents were used: the Mann–Whitney *U* test and the Kruskal–Wallis test.

Associations between categorical variables were examined using the chi-squared (χ^2) test, considering standardized residuals of ± 2 or more as indicators of statistical significance.

The internal reliability of the questionnaire was assessed using Cronbach's alpha coefficient. Values above .60 were considered acceptable, and those above .80, high.

Following the descriptive and bivariate analyses, univariate binary logistic regression analyses were conducted to estimate the predictive power of various family and social factors on tobacco use (smoking vs. non-smoking). Then, multivariate logistic regression models were built for each cohort, including age, gender, peer pressure, weekly disposable income, and family communication (whether the prevention program was discussed at home) as predictors.

A significance level of $p < .05$ was used for all inferential analyses, with values below .01 considered highly significant. A linear relationship between the continuous independent variables and the logit of the dependent variable was assumed, following standard methodological criteria for logistic regression models, particularly in exploratory studies with a limited number of continuous predictors. Future research is encouraged to empirically assess this assumption using appropriate diagnostic tools. Key assumptions required for the application of logistic regression—such as the absence of multicollinearity, independence of residuals, and an adequate sample size per predictor—were also considered. These conditions are widely recognized as essential for ensuring the validity and reliability of logistic regression analyses, as highlighted by.⁴⁹

No violations of these assumptions were identified, and the models were deemed methodologically appropriate for analysis and interpretation.

3. Results

3.1. Tobacco use data

Students who reported ever trying tobacco presented ages between 6 and 18 years in 2011 ($M = 12.9$; $SD = 2.02$), between 8 and 17 years in 2016 ($M = 13.43$; $SD = 1.98$), and between 8 and 15 years in 2019 ($M = 13.42$; $SD = 2.04$). The mean age of onset remained relatively stable across the three cohorts at around 13 years.

A clear downward trend in the prevalence of consumption was identified, it should be noted that these data refer exclusively to the consumption of traditional tobacco (combustible cigarettes): in 2011, 34.0 % of the student body had smoked, compared to 20.3 % in 2016 and 4.8 % in 2019. In parallel, the percentage of those who had never tried tobacco increased progressively.

Among the students who stated that they had ever smoked, the different types of consumption were analyzed.

- "I've tried it, but I don't smoke" increased from 61.5 % (2011) to 70.7 % (2019).
- "I smoke occasionally" showed a decline between 2011 (21.2 %) and 2016 (15.9 %), with a slight rebound in 2019 (17.2 %).
- "I smoke daily" decreased steadily: 17.4 % in 2011, 13.0 % in 2016 and 6.9 % in 2019.
- Ex-smokers (less than six months without smoking) went from 8.7 % in 2016 to 5.2 % in 2019.

In terms of weekly cigarette consumption, the majority of smokers consumed between 5 and 10 cigarettes per week: 60.9 % in 2011 and 69 % in 2019. In 2016, in contrast, a notable increase in average consumption was observed, with 50 % smoking between 10 and 20

cigarettes per week. The percentage of students consuming more than 40 cigarettes per week was higher in 2016 (20 %) compared to 2011 (12.8 %) and 2019 (17.2 %).

Regarding the direct purchase of tobacco, an increase was found in 2016 (48.5 %), followed by a decrease in 2019 (21.6 %). At no time did the percentage exceed 50 %.

These results reflect a positive evolution in terms of prevention, with a generalized decrease in tobacco use in the adolescent population between 2011 and 2019, both in prevalence and intensity.

3.2. Microenvironmental factors. Consumption models

As can be seen in Table 3, the results show statistically significant differences between cohorts in terms of the presence of smoking close models, with higher exposure observed in 2011 compared to 2016 and 2019.

In 2011, 33.5 % of students reported that their father smoked, compared to 28.1 % in 2016 and 28.3 % in 2019 ($\chi^2(2) = 8.627$; $p = .013$). The same trend was observed with respect to mothers who smoked: 31.0 % in 2011, 24.9 % in 2016, and 24.5 % in 2019 ($\chi^2(2) = 14.071$; $p = .001$). The presence of sibling smokers also decreased, from 12.6 % in 2011 to 7.2 % in 2016, with a slight increase in 2019 to 9.3 % ($\chi^2(2) = 13.596$; $p = .001$).

In the social domain, a lower proportion of students with best friends who smoked was detected in 2016 (6.5 %) versus 2011 (11.2 %) and 2019 (9.7 %) ($\chi^2(2) = 10.277$; $p = .006$). Similarly, the presence of smoking teachers was higher in 2011 (49.3 %) than in 2016 and 2019 (both at 43.8 %) ($\chi^2(2) = 13.778$; $p = .001$). Finally, adolescents who indicated having friends or peers who smoked went from 54.7 % in 2011 to 40.9 % in 2016, increasing again to 47.5 % in 2019 ($\chi^2(2) = 29.108$; $p < .001$).

Overall, the most frequent consumption models in the three cohorts were, in order of prevalence: friends or peers, teachers, fathers, mothers, siblings and best friends, with 2011 being the year with the highest exposure in all cases.

A univariate logistic regression analysis was performed to evaluate the predictive capacity of the different family and social models on smoking or non-smoking behavior in adolescents in each of the three cohorts (Table 4).

The results show that all the consumption models evaluated had statistically significant associations with tobacco consumption, although with variations in the magnitude of the effect between cohorts. The most influential model was consistently the best smoking friend, explaining 23.2 % of the variance in 2011, 18.7 % in 2016 and 1.7 % in 2019 ($p < .001$ in all).

Smoking friends or partners also showed a relevant influence, with values of $R^2 = 12.8$ % in 2011, 10.8 % in 2016 and .8 % in 2019. The presence of smoking siblings was significant in all three cohorts, although with a progressive decrease in its impact ($R^2 = 4.3$ % in 2011, 1.6 % in 2016, .5 % in 2019).

Regarding the father-smoker model, a significant relationship was observed in all three years, with a greater weight in 2011 ($R^2 = 1.3$ %) and lower in 2019 (.8 %). The smoking mother model was also significant, although with a progressive decrease in its influence ($R^2 = 2.2$ % in

2011, 1.5 % in 2016 and .3 % in 2019). Finally, the influence of smoking teachers was significant only in 2011 and 2019, but with limited explanatory power ($R^2 < 1$ %).

In summary, social role models (especially best friends and peers) exerted a greater influence than family role models in all three cohorts, although this influence decreased markedly in 2019. The overall pattern of impact in order of importance was: 2011: best friend, peers, siblings, mother, father, teachers; 2016: best friend, peers, siblings, mother, father; 2019: best friend, peers, father, siblings, teachers, mother.

3.3. Offering

Among the 519 students who indicated having tried tobacco, substantial differences were identified between cohorts in terms of the social model responsible for the initial offer (Table 5). In 2011, the majority of adolescents (87.8 %) claimed to have received their first cigarette from an uncle or aunt, whereas in the 2016 (83.5 %) and 2019 (74.1 %) cohorts it was the group of friends who played that primary role.

The influence of fathers, mothers, siblings or cousins was marginal in all years (<6 %), as was that of strangers, which remained around 6–8 %.

This shift in the pattern of offering suggests a transition from extended family influence on peer group pressure, reinforcing the central role of friendship in smoking initiation during adolescence in more recent cohorts.

3.4. Perceived pressure for consumption

The majority of adolescents who had tried tobacco claimed not to have felt pressured to smoke or drink. This proportion was 86.1 % in 2011, 75.4 % in 2016, and 79.3 % in 2019, with statistically significant differences observed between cohorts ($\chi^2 = 7.854$; $p = .02$), with less perceived pressure in 2011 (Table 6).

Among nonsmoking adolescents, the perception of pressure was also low: 88.9 % in 2011, 91.3 % in 2016, and 87.4 % in 2019 reported not having felt it. Differences between cohorts also proved significant ($\chi^2 = 6.690$; $p = .035$), with the lowest pressure in 2016.

In all cases, the proportion of adolescents who did perceive pressure to consume was higher among smokers than among nonsmokers, regardless of the year. This pattern reinforces the influence of the social environment as a facilitating factor for consumption, especially in those adolescents who have already started the habit.

3.5. Family communication

Table 7 shows the results obtained for the variable family communication established at mealtimes.

The results show that family communication is significantly higher among non-smoking adolescents compared to smokers, especially in the 2016 and 2019 cohorts (Table 7).

Among student smokers, only a small percentage indicated that during meals they talked at home about how their day had gone 20.2 % of males and 17.8 % of females in 2016; 4.8 % and 4 % respectively in

Table 3
Comparison between smoking patterns in the three cohorts.

	2011 n = 846 (100 %)	2016 n = 679 (100 %)	2019 n = 2,403 (100 %)	Contrast t-test Chi ²	P-value
Father	283 (33.5)	191 (28.1)	680 (28.3)	8.627	.013
Mother	262 (31)	169 (24.9)	589 (24.5)	14.071	.001
Brothers	107 (12.6)	49 (7.2)	224 (9.3)	13.596	.001
Best Friend	95 (11.2)	44 (6.5)	233 (9.7)	10.277	.006
Teachers	417 (49.3)	272 (40.1)	1051 (43.8)	13.778	.001
Friends/Companions	463 (54.7)	278 (40.9)	1142 (47.5)	29.108	.000

Table 4
Univariate analysis for each cohort of consumption pattern factors related to the dependent variable smoking not smoking (2011: n = 288 if smoking; n = 558 not smoking; 2016: n = 138 if smoking, n = 541 not smoking; 2019: n = 116 if smoking, n = 2287 not smoking).

Models of Consumption	2011					2016					2019				
	F	p	R	r ²	r ² corrected	β	F	p	R	r ²	r ² corrected	β	F	p	R
Father	11.959	.001	.118	.014	.013	β = .118 p = .001	5.751	.017	.092	.008	.007	β = .092 p = .017	20.119	.000	.091
Mother	19.589	.000	.151	.023	.022	β = .151, p = .000	11.058	.001	.127	.016	.015	β = .127 p = .001	7.752	.005	.057
Brothers	39.167	.000	.211	.044	.043	β = .211 p = .000	11.246	.001	.128	.016	.015	β = .128 p = .001	12.313	.000	.071
Best friend	256.875	.000	.483	.233	.232	β = .483, p = .000	157.058	.000	.434	.188	.187	β = .434 p = .000	43.531	.000	.133
Friends	123.849	.000	.358	.128	.127	β = .358 p = .000	881.585	.000	.328	.108	.106	β = .328, p = .000	19.529	.000	.090
Partners	8.576	.003	.100	.010	.009	β = .100, p = .000	.938	.333	.037	.001	.000	β = .037 p = .001	10.331	.001	.065
Teachers															p = .000

Table 5

Comparison of students according to the consumption pattern that offered them a cigarette for the first time in the three cohorts.

	2011 n = 270(%)	2016 n = 133(%)	2019 n = 116(%)
Parent	5(1.9)	2 (1.5)	1(.9)
Brothers	1 (.4)	2(1.5)	6(5.2)
Friends	8 (3)	111(83.5)	86(74.1)
Uncles	237(87.8)	2(1.5)	1(.9)
Cousins	3(1.1)	7(5.3)	4(3.4)
Unknown	16(5.9)	9(6.8)	9(7.8)

Table 6

Pressure felt to smoke or drink by smoking and non-smoking students (n = 3.928).

Condition	2011 n (%)	2016 n (%)	2019 n (%)	Contrast test
SMOKERS	n = 287	n = 138	n = 116	Value p-value
They have not felt pressured	247 (86.1)	104 (75.4)	92 (79.3)	$\chi^2 = 7.854$.020
Yes, they have felt pressured	40 (13.9)	34 (24.6)	24 (20.7)	
NON-SMOKERS	n = 558	n = 541	n = 2287	Value p-value
They have not felt pressured	496 (88.9)	494 (91.3)	1.999 (87.4)	$\chi^2 = 6.690$.035
Yes, they have felt pressured	62 (11.1)	47 (8.7)	288 (12.6)	

2019). In contrast, this type of communication was much more frequent among nonsmokers (about 80 % in 2016 and more than 95 % in 2019). Also, family arguments for any reason during meals were reported by a higher percentage of smokers than nonsmokers, suggesting a more conflictual family climate among the former.

Regarding the contents of the preventive program, a higher percentage of nonsmokers commented at home on what was discussed about smoking: 89.3 % (males) and 87 % (females) in 2011, and more than 90 % in 2019. In contrast, among smokers these percentages were considerably lower in all cohorts.

Correlation analyses showed a negative and significant relationship between family communication and smoking in 2011 (p = .028, r = .075) and 2016 (p < .001, r = .197), indicating that the greater the communication, the lower the likelihood of smoking. This association was not significant in 2019 (p = .632).

Taken together, these data reinforce the protective role of a communicative family environment against the initiation of tobacco use during adolescence.

3.6. Economic control

Table 8 shows the descriptive results found for the variable economic control and its relationship with adolescent smoking.

The results show clear differences between smokers and non-smokers in terms of weekly disposable income. Smokers more reported having higher amounts of money, especially in the 10–20 € and more than 20 € brackets, compared to non-smokers, who were mostly concentrated in the 0–5 € range (**Table 8**).

For example, in 2016, 29.7 % of male smokers and 18.7 % of female smokers between €5 and.

€10 per week, while 81.5 % and 81.9 % of non-smokers, respectively, were in the €0–5 bracket.

The correlations between economic control and tobacco use showed positive and statistically significant associations in the 2011 (p = .000; r = .221) and 2019 (p = .016; r = .054) cohorts, although of weak intensity in both cases. In 2016, no significant relationship was found (p =

Table 7Family communication in smoking and non-smoking students at mealtimes ($n = 3928$).

Group	Year	Genre	TV lit	They talk about the day	They argue over food	They argue for anything	They do not speak	They commented on the program of prevention
SMOKERS	2011	Men	38 (20.8)	56 (20.2)	8 (23.5)	6 (24)	4 (26.7)	30 (10.7)
		Women	35 (17.0)	46 (17.8)	2 (12.5)	7 (28)	8 (50.0)	32 (13.0)
	2016	Men	40 (5.7)	43 (4.8)	11 (6.7)	11 (6.7)		21 (5.2)
		Women	35 (4.5)	40 (4.0)	10 (5.9)	10 (5.9)		42 (15.3)
	2019	Men	44 (5.1)					44 (5.1)
		Women	39 (9.0)					39 (9.0)
NON-SMOKERS	2011	Men	145 (79.2)	222 (79.8)	26 (76.5)	19 (76.0)	11 (73.3)	251 (89.3)
		Women	171 (83.0)	212 (82.2)	14 (87.5)	18 (72.0)	8 (50.0)	215 (87.0)
	2016	Men	666 (94.3)	846 (95.2)	154 (93.3)			741 (94.9)
		Women	741 (95.5)	946 (96.0)	160 (94.1)			897 (91.0)

Table 8

Economic control by families in smoking and non-smoking students.

		2011 n = 835		2016 n = 622		2019 n = 1969	
		Men	Women	Men	Women	Men	Women
		n(%)	n (%)	n(%)	n (%)	n(%)	n (%)
Smokers	€						
	0–5	6(5.8)	4(4.6)	36(18.5)	38(18.1)	20(5)	11(3)
Control of money	5–10	11(7.3)	14(10.2)			12(4.6)	19(6.4)
Weekly cash	10–20	34(18.4)	49(26.8)	33(29.7)	20(18.7)	10(4.6)	11(5.2)
	+20					12(10.6)	10(8.1)
Non-smokers	€						
	0–5	97(94.2)	82(95.4)	159(81.5)	172(81.9)	377(95)	358(97)
Control of money	5–10	140(92.7)	123(89.8)			248(95.4)	278(93.6)
Disposal of weekly money	10–20	151(81.6)	124(73.2)	78(70.3)	86(81.3)	208(95.4)	200(94.8)
	€					82(89.4)	113(91.9)

.066).

These results suggest that greater availability of money is associated with a greater probability of tobacco use, especially at the extremes of the time analyzed, reinforcing the importance of parental control over economic resources at early ages.

3.7. Multivariate predictors of smoking according to cohorts

Multivariate logistic regression analyses were performed for each cohort, including age, sex, peer pressure, economic control (money available) and family communication (having discussed the prevention program at home) as predictor variables.

In the 2011 cohort, only age proved to be a significant predictor of smoking ($\beta = .286$; $p < .001$), explaining 10.5 % of the variance in smoking behavior (corrected $R^2 = .105$). The rest of the variables did not reach statistical significance.

In the 2016 cohort, the model explained 20.4 % of the variance in consumption (R^2 corrected = .204). The predictive factors were older age ($\beta = .389$; $p < .001$), higher pressure of group ($\beta = .106$; $p = .004$), lower family communication ($\beta = -.142$; $p < .001$).

In the 2019 cohort, the model showed a lower explanatory power (R^2 corrected = .024), although significant. Predictors of consumption were younger age ($\beta = -.147$; $p < .001$), greater amount of money available ($\beta = .117$; $p < .001$), greater peer pressure ($\beta = .052$; $p = .023$).

These results indicate that the risk profile for tobacco use varied over time. While in 2011 the influence of age predominated, in 2016 peer pressure and family communication emerged strongly as relevant factors. In 2019, economic access, environmental pressure and earlier onset were the most significant elements associated with consumption.

4. Discussion

Cohort studies in the field of addictions are quite scarce to

date.^{38,50–53} The aim of the present study was to analyze three cohorts of students in compulsory secondary education (2011, 2016, 2019), covering a period of 8 years. And to study the association between tobacco consumption in these adolescents and microenvironmental factors (family and social). Consequently, we analyzed the consumption of the study of tobacco use in relation to socio-demographic data, consumption patterns, perceived pressure and family variables such as family communication and economic control.

We found no gender differences in tobacco consumption, which coincides with the findings of previous studies^{54–58} These studies indicate that, although there are factors that may affect boys and girls differently, in general terms, the differences are minimal.

In relation to age, we obtain those students who have ever tried tobacco are on average 13 years old in the 2011 academic year, 12.9 years old in 2016 and 13.4 in 2019. It is considered that in the world one out of every ten adolescents consume tobacco at ages ranging between 13 and 15 years.^{8,54,59,60} Along the same lines, the Spanish survey on drug use in secondary education shows that the first contact with tobacco occurs at 14.1 years of age.¹³ Therefore, our results are in line with those reported in the literature.

One of the most important risks and at the same time protective factors in the initiation of tobacco use is the family^{61,62} since it is the first socializing element, whose patterns serve as a model for the development of their behavior. In our study, a slight decrease of parents' smoking is observed from 2011 to 2016 to increase again in 2019. This result is reflected in the tobacco consumption data from the National Health Survey of the Observatory Against Cancer.⁶³ In the case of the city of Burgos (Spain), adult smokers aged 25–64 years, in 2011 are at 34 % male and 43 % female, decreasing in 2016 to 27 % and 34 %, respectively. And increasing in 2019 to 29 % for males and 33 % for females.

On the other hand, we found in our study that the models with the greatest influence on tobacco consumption are, in first place, friends; in

second place, the mother; and subsequently, teachers, siblings, best friend and father. These results are similar to those found in previous studies.^{64–68} In the area of *peer relationships*, it has been established that the strongest bonds are those that adolescents forge with their best friends, who are generally peers at the school they attend. The onset of tobacco use can be compared to a rite of passage that marks the transition from childhood to the adult world, a process of maturation and independence that is reinforced with the entry into high school or compulsory secondary education (ESO). In addition, the adolescent interacts within a broad social network in which he or she maintains weaker ties but also have significant relevance.⁶⁹

In the context of *parental smoking*, the presence of one or both parents who smoke increases the risk of adolescents adopting this habit. However, several studies indicate that this influence is more significant when the mother is a smoker^{25,70} especially in research carried out in northern Europe, where a higher incidence of the maternal model than the paternal model has been observed. There are also studies that point to a more marked paternal influence²² or even a similar influence by both parents.⁷¹ Along these lines, research such as Alkan and Demir¹⁷ underline the relevance of the family and social environment not only in the initiation, but also in the maintenance or cessation of tobacco use.

In relation to the offer of tobacco, the majority (87.8 %) of students in our research who tried tobacco for the first time in 2011 did so after the offer of their uncles. In contrast, in the 2016 and 2019 cohorts, the majority of students (83.5 % and 74.1 % respectively) who tried tobacco for the first time did so because of the offer from their friends. It is noteworthy, as reported in the literature, that friends are the most predictive model in the initiation of youth smoking.^{71–75} It is estimated that 90 % of young people have smoked their first cigarette in the presence of other young people. According to Jarvis,⁷⁶ the group of friends exerts a greater influence than parents⁷⁷ and siblings.

On *perceived pressure*, our results showed that there is greater perceived pressure among students who declare themselves smokers than non-smokers. These findings can be compared with the results of⁶⁹ who point out that non-smoking adolescents share the view that their smoking peers so to appear older, confident or to fit in with the group. Whereas adolescent smokers say that they smoke simply because they like it, rejecting the idea of doing it to feel older or better, although they sometimes point out that they smoke to relax.

In relation to *family communication*, greater family communication was found in those adolescents who declared themselves non-smokers compared to smokers. Highlighting the variables: "we talk about how our day went" and "we argue about anything while eating", with clear differences between smokers and non-smokers in the cohorts of 2016 and 2019, without finding differences by gender. Lima-Rodríguez has pointed out that the family acts as a nucleus of socialization that influences the development of self-concept and self-esteem, and that its dysfunction may be related to high levels of stress and lack of social support.⁷⁸ In this regard, with respect to whether they have discussed with their family the topics covered in the tobacco prevention program, students who have not smoked have discussed it in their family environment at higher rates for all three cohorts than students who declare themselves smokers. It appears that talking to a family member about the harmful effects of smoking is a highly protective factor. Similar results were found⁶⁸ where 76.3 % of non-smoking adolescents had spoken to a family member and only .9 % of those who smoked had done so ($p < .001$). These authors emphasize educational aspects (elimination of false beliefs) and family aspects (the family, with its example and advice, is shown to be a very important factor). Some similar conclusions are presented.^{79,80}

If during adolescence the parental style is marked by affection and communication, this family climate will act as a protective factor against drug use.^{81–84} One possible hypothesis is that this protective mechanism would be linked to emotional regulation and control, acting as a buffer against certain risk behaviors.⁸⁵ Along these lines, some studies have found that those children who had affective relationships with their

fathers and mothers during childhood and pre-adolescence are more likely to be more likely to use drugs than those who did not have affective relationships with their fathers and mothers during childhood and pre-adolescence are likely to be more attached to their parents in adolescence, even if there is a decrease in positive interactions between them.^{86–89}

The findings of this study, which emphasize the role of family and social environments in the initiation of tobacco use during adolescence, are consistent with research conducted in other international contexts. In Turkey, Alkan and Abar¹⁷ identified that variables such as age, gender, educational level, marital status, alcohol consumption, exposure to secondhand smoke, and certain healthy lifestyle habits significantly influence tobacco use. In a complementary line of research, the same authors later examined the concurrent use of tobacco and alcohol, revealing that both behaviors share common socioeconomic determinants—including household income, marital status, and education level—which underscores the need for integrated prevention strategies.⁹⁰ Additionally, in a third study, Alkan and Demir found that factors such as household rules regarding tobacco, overall household well-being, social support, and support for stricter tobacco taxation policies significantly affected the duration of tobacco-free periods among individuals attempting to quit.⁹¹

Together, these findings highlight the importance of the social and family context not only in the initiation of tobacco use, but also in its continuation and cessation. Understanding adolescent tobacco use—including both traditional forms and emerging nicotine products—as a socially embedded phenomenon requires the development of prevention strategies that move beyond the individual and target the transformation of the environments where young people grow, interact, and make decisions.

5. Conclusions

This study offers evidence on how the immediate family and social environment influences the first experiences with tobacco during adolescence, in the Spanish context. In a country where the early initiation of tobacco use is still a public health priority, our findings reinforce the idea that intervening on these factors is a key strategy to prevent both experimentation and regular consumption at an early age. Furthermore, considering the multiple causes of the use and abuse of legal substances such as tobacco, it is essential that prevention strategies aim to transform these risk factors and enhance the protective factors surrounding young people.^{92,93}

Tobacco prevention and control policies should focus beyond the adolescent population and reach the entire population. Especially to the role models who are of special relevance in the process of denormalization of smoking in our society, such as parents, siblings and teachers. In fact, for example, a systematic review⁹⁴ found that a family intervention could reduce tobacco use or experimentation by 16 %–32 %.

Likewise, there is a clear need to reduce family vulnerability factors through balanced relationships based on affection, support and consensual levels of supervision and control. Risk prevention in adolescence should include parents trying to clarify appropriate ways of transmitting support, affection, concern and control.

The results obtained in this study should be interpreted considering the limitations related to selection bias. Specifically, this is a convenience sample based on voluntary participation and carried out in compulsory secondary schools with a moderate response rate. Likewise, recall bias must be considered, i.e., self-reported ages at smoking initiation. Finally, as pointed out by⁹⁵ respondents might underestimate their smoking and drinking behaviors due to social desirability.

From these findings, several key recommendations can be derived for the prevention of tobacco use in adolescents. It is important to strengthen family communication, promoting the active participation of parents in the daily lives of young people, since their positive influence is a determining factor in preventing the onset of consumption.

Likewise, adolescents should be taught to resist social and peer pressure by implementing educational programs that help foster a critical sense and help them make healthier decisions, improving their self-efficacy and assertive skills in risk situations. Encouraging participation in recreational and sports activities is also essential, as they not only occupy young people's leisure time, but also reinforce their physical, emotional and social well-being.

In terms of family policies, control over the money handled by young people should be established. Similarly, prevention programs should be integrated in schools, involving the entire educational community, to create an exemplary environment in to promote healthy habits and protect adolescents from the risks associated with consumption.

As for future research, we suggest longitudinal studies to observe the evolution of tobacco consumption over time and how micro-environmental factors change at different stages of adolescents' lives. Furthermore, a focus on the socioeconomic context can provide valuable information on inequalities in prevention and consumption. It would also be relevant to investigate the impact of new technologies and social networks, as these factors are becoming increasingly relevant among young people. In this sense, future research could develop culturally adapted interventions, considering the new social models in adolescents.

In summary, this study contributes significantly to the field of substance use prevention in Spain. The results obtained not only reinforce the importance of factors such as family communication and social control in the prevention of tobacco use but also open new lines of research that could enrich and strengthen efforts in the prevention of tobacco use among adolescents.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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