

ORIGINAL ARTICLE

## Smoking transmission in-home across three generations

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### Abstract

**Objective:** This paper examines the transmission of smoking in-home across three generations in Spain.

**Methods:** Multilevel logistic regression is used to assess the significance and magnitude of intergenerational transmissions of smoking in-home. We use the survey data “Encuesta Estatal Sobre Uso De Drogas en Estudiantes de Enseñanzas Secundarias (ESTUDES)” corresponding to year 2010. This survey with 32 234 students constitutes a representative survey of Spanish students between 14 and 18 years of age.

**Results:** Estimates reported show a significant association of students’ smoking with mothers’ smoking (OR = 1.41; 95% CI = 1.31–1.51), fathers’ smoking (OR = 1.25; 95% CI = 1.16–1.35) and grandparents’ smoking (OR = 1.30; 95% CI = 1.07–1.57). Our results also suggest that, although mothers’ and parents’ smoking impacts sons’ and daughters’ smoking, grandparents’ smoking significantly increases grandsons’ smoking but does not influence granddaughters’ smoking.

**Conclusions:** Parents and grandparents could reduce adolescents’ smoking by quitting smoking themselves, a decision that would have beneficial effects for parents, grandparents and, indirectly, for adolescents.

### Keywords

Adolescent, family, intergenerational transmission, tobacco consumption

### History

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### Introduction

Despite the fact that the World Health Organization’s Framework Convention on Tobacco Control has persuaded many countries to adopt policies to reduce smoking prevalence in recent years, tobacco continues to be widely consumed in the global population, and among adolescents, in several countries, including Spain. In fact, most smokers begin smoking in adolescence (Calafat et al., 2009; Smith et al., 2007; Yañez et al., 2013; Yu & Williford, 1992), and it is during young adulthood when occasional smokers generally become permanent smokers. In this sense, although most begin smoking with no specific intention of becoming life-long smokers, they are trapped by the addictive nature of tobacco (Prochaska et al., 1992). This addictive nature, especially of nicotine, is more powerful the earlier a person begins smoking (US Department of Health and Human Services, 1994).

Another factor that helps to explain the high prevalence of smoking among adolescents is what the literature has termed the intergenerational transmission of smoking. Strong evidence has been found to support the hypothesis that health-risk behaviours of fathers and mothers influence corresponding health-risk behaviours of their offspring

(Wickrama et al., 1999). This finding could be explained by the Social Learning Theory (Bandura, 1977), which emphasizes the importance of the relationship of individuals within the closer environment, especially that of the family, in the engagement and reinforcement of behaviours. In this way, some adolescents who are exposed to parents’ smoking will be more prone to smoke by emulating their parents, through a process of social learning. In addition, the association between parental smoking and offspring’s smoking could also be due to common genetic influences. To date, several studies have determined a strong link between parents’ smoking and children’s smoking (Duarte et al., 2014b; McGee et al., 2006; Melchior et al., 2010; Paul et al., 2008).

Although it is reasonable to assume that generational links can replicate or extend to more than two generations (for example, grandparents’ smoking can influence grandsons’ smoking), the literature that analyses the transmission of smoking across multiple generations is limited. One important exception is Vandewater et al. (2014), who estimate the three separate logistic regressions for intergenerational transmission of smoking – from grandparents to parents, from parents to children and from grandparents to grandsons, respectively. Our work adds to this limited literature by investigating smoking influences in-home across three generations, using a representative sample of students in Spain, a country with a significant rate of tobacco consumption among adolescents. We use the term “in-home” to denote individuals living under the same roof.

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## Methods

### Sample

We use data from the State Survey on Drug Use among High School Students (“Encuesta Estatal Sobre Uso De Drogas en Estudiantes de Enseñanzas Secundarias, (ESTUDES)”), for the year 2010, carried out by the Spanish Government’s Delegation for the National Plan on Drugs. The survey is based on a multistage stratified sampling procedure. In order to select schools, the sampling frame was stratified per Autonomous Community (17 strata, plus two corresponding to the autonomous cities of Ceuta and Melilla) and institutional ownership (two strata: public and private).

Participants constitute a nationally representative sample of Spanish students aged between 14 and 18 years old. A total of 32 234 students were surveyed. All the information has been obtained directly from the adolescents, who answered the questionnaire anonymously. Parents were not present during the survey sessions, nor were they informed about their children’s responses, in order to reduce under-reporting.

### Dependent variable

The dependent variable in the study is *smoking*, a dichotomous variable which takes value 1 if the individual has smoked cigarettes during the last 30 days, and 0 otherwise.

### Covariates

Given that the main objective of this work is to analyse transmission of smoking in-home across three generations, our main interest is on analysing the effects of parents’ and grandparents’ smoking on adolescents. The survey provides information about smoking behaviour only for those who cohabit with the adolescent. We have no information on those parents and grandparents living outside the adolescent’s home. The key explanatory variables are three dichotomous variables indicating if the cohabitant mother, father or grandparents smoke. For the case of cohabitant grandparents, there is no distinction of gender, so if the adolescent declares that grandparents smoke, we only know that at least one grandparent lives with him/her and smokes.

We have also controlled for other socio-economic characteristics that influence smoking behaviours: gender (1 = male, 0 = female), age, immigrant, immigrant mother, immigrant father, living without mother, living without father, living with grandparents, working status of parents (retired or unemployed), university degree of parents, working, adolescent’s disposable income and smoking peer friends (a dichotomous variable indicating whether or not the majority of friends smoke). Table 1 reports a descriptive analysis of all the variables.

### Statistical analysis

In order to take into account the multistage sampling nature of the data (Austin, 2010), a multilevel logistic regression, carried out with Stata software, was used in order to evaluate the association between the independent variables and *Smoking*. We report the Odds Ratio (OR) in order to quantify the effect size. These models capture both mean structure (marginal probability in our case) and dependence

Table 1. Descriptive analysis.

	Percentage or mean (SD)
Smoking (All sample)	27.1%
Smoking (Female)	30.0%
Smoking (Male)	24.1%
Smoking mother	30.6%
Smoking father	29.7%
Smoking grandparents	2.5%
Gender male	48.6%
Age 14 (omitted category)	22.9%
Age 15	30.0%
Age 16	25.3%
Age 17	16.3%
Age 18	5.4%
Immigrant	11.2%
Immigrant mother	15.3%
Immigrant father	13.9%
Live without mother	4.7%
Live without father	16.8%
Live with Grandparents	9.7%
Unemployed mother	5.9%
Retired mother	1.2%
Unemployed father	7.1%
Retired father	3.7%
University mother	22.3%
University father	21.9%
Working	11.5%
Income	24.5€ (49.1)
Peer smoking	31.9%

structure (correlation among responses within the same cluster). More specifically, we have included two random intercepts, one for autonomous regions and one for school type (ownership). The data provided do not enable us to introduce random effects at local levels (school or school districts).

## Results

Table 2 reports the estimates, *via* multilevel logistic regression, of the probability of smoking by the adolescent. In the first column, we present results without including the variables working, income and peer smoking (Model 1); in the second column, we present the results including these three variables (Model 2). The reason for this strategy is to check the significance and robustness of the estimates with and without three explanatory variables that may present some kind of endogeneity. Before considering specific results, it is important to highlight that, in all cases, the likelihood-ratio (LR) test rejects the null hypothesis of a standard logistic regression, in favour of a multilevel model. Consequently, autonomous regions and school types vary in their intercepts with their corresponding estimated standard deviations.

Our main result is that the variables measuring parents and grandparents smoking behaviour in-home appear to be highly significant, even after controlling for such things as physical, socioeconomic and school characteristics, which confirms the existence of a home transmission of smoking in-home among the three generations considered. Moreover, the magnitude is quite significant in quantitative terms. These results are robust across the two estimated models, providing plausibility to

Table 2. Multilevel logistic regression.

Variable	Model 1			Model 2		
	OR	[95% CI]		OR	[95% CI]	
Smoking mother	1.49***	1.39	1.59	1.41***	1.31	1.51
Smoking father	1.34***	1.26	1.43	1.25***	1.16	1.35
Smoking grandparents	1.37***	1.16	1.62	1.30***	1.07	1.57
Gender male	0.70***	0.66	0.74	0.73***	0.68	0.77
Age 15	2.18***	1.99	2.38	1.75***	1.58	1.93
Age 16	3.44***	3.14	3.77	2.28***	2.06	2.52
Age 17	4.38***	3.97	4.82	2.64***	2.37	2.95
Age 18	5.61***	4.92	6.39	2.97***	2.56	3.45
Immigrant	1.08	0.91	1.28	1.07	0.89	1.30
Immigrant mother	0.91	0.79	1.04	0.94	0.81	1.09
Immigrant father	0.80***	0.69	0.92	0.85*	0.73	1.00
Live without mother	1.43***	1.26	1.62	1.26***	1.09	1.46
Live without father	1.41***	1.31	1.52	1.33***	1.22	1.45
Live with grandparents	0.98	0.89	1.09	1.02	0.91	1.14
Unemployed mother	0.97	0.86	1.10	1.03	0.89	1.18
Retired mother	1.20	0.95	1.53	1.20	0.92	1.58
Unemployed father	0.94	0.84	1.05	0.94	0.83	1.07
Retired father	0.96	0.83	1.12	0.98	0.83	1.15
University mother	1.00	0.92	1.08	1.03	0.95	1.13
University father	1.03	0.95	1.11	1.04	0.95	1.13
Working				1.55***	1.42	1.70
Income				1.15***	1.12	1.17
Peer smoking				7.74***	7.26	8.24
Level 2 Std. Dev. for School Type (Std. Error)	0.19 (0.06)***			0.15 (0.06)***		
Level 3 Std. Dev. for AC (Std. Error)	0.22 (0.07)***			0.08 (0.09)***		
LR test versus logistic regression	$\chi^2 = 279.2$	$p$ value < 0.001		$\chi^2 = 59.2$	$p$ value < 0.001	
No. observations	27970			27422		

Analyses are carried out in Stata; OR = Odds Ratio; CI = confidence interval; AC = Autonomous Community; Income is in logarithms.

\* $p$  value < 0.10.

\*\* $p$  value < 0.05.

\*\*\* $p$  value < 0.01.

the estimates, given that the significance of coefficients is similar. Given that the full model (Model 2) provides lower intergenerational effects, we focus on this model, bearing in mind that these effects can be considered as conservative effects. The odds that an adolescent becomes a smoker increases around 41% (OR = 1.41; 95% CI = 1.31–1.51) if he/she lives with a smoker mother, around 25% (OR = 1.25; 95% CI = 1.16–1.35) if he/she lives with a smoker father and around 30% (OR = 1.30; 95% CI = 1.07–1.57) if he/she lives with at least one smoker grandparent. In this regard, as shown in other studies, the influence of the mother is clearly the most relevant, while the influence of a grandparent is comparable (slightly higher) to the influence exerted by the father.

Results for the gender variable indicate that males tend to have a lower probability of smoking, with an OR equal to 0.73 (95% CI = 0.68–0.77). An interesting exercise involves comparing whether results vary by gender. Table 3 reports estimates for males and females separately, and some interesting variations come to light. Females are more sensitive to both mother and father smoking (OR = 1.47; 95% CI = 1.33–1.62 and OR = 1.30; 95% CI = 1.17–1.44, respectively) than males (OR = 1.34; 95% CI = 1.20–1.49 and OR = 1.20; 95% CI = 1.08–1.34, respectively). In contrast, while females appear to not be influenced by grandparent smoking, males are greatly influenced with OR equal to 1.63 (95% CI = 1.25–2.13). A common pattern found for both boys and girls is that mother smoking has a greater impact than father smoking.

## Discussion

Although there is strong evidence to suggest that parental smoking behaviour is an important predictor of smoking among adolescents (Duarte et al., 2014a,b; McGee et al., 2006; Melchior et al., 2010; Paul et al., 2008), the intergenerational transfer of smoking across three generations has been barely investigated. One notable exception is Vandewater et al. (2014), who found, in three separate regressions, that the intergenerational transmission of smoking occurred from grandparents to parents, and from parents to children, but not from grandparents to grandsons (which appeared to be significant only at the 10% level). Our work adds to this sparse literature, investigating home intergenerational influences on smoking across three generations, using a nationally representative sample of Spanish students aged 14–18.

Regarding our main focus, the intergenerational transfer of smoking, our results are conclusive: cohabitant grandparents' and parents' smoking increases the probability that adolescents begin to smoke. Thus, home fathers' smoking and mothers' smoking appear as important predictors of their children's smoking. These results are in line with prior research. This association could be due to the fact that adolescents of parent smokers are more prone to emulate them through a process of social learning. Similarly, parents who smoke can be more permissive with children smoking, and, at the same time, children could be less obedient when the parents do not observe the

Table 3. Multilevel logistic regression by gender.

Variable	Female			Male		
	OR	[95% CI]		OR	[95% CI]	
Smoking mother	1.47***	1.33	1.62	1.34***	1.20	1.49
Smoking father	1.30***	1.17	1.44	1.20***	1.08	1.34
Smoking grandparents	1.04	0.79	1.36	1.63***	1.25	2.13
Age 15	1.88***	1.66	2.14	1.59***	1.36	1.85
Age 16	2.46***	2.15	2.81	2.05***	1.76	2.38
Age 17	2.82***	2.44	3.27	2.39***	2.03	2.81
Age 18	3.08***	2.50	3.79	2.77***	2.24	3.42
Immigrant	0.90	0.70	1.15	1.36**	1.02	1.81
Immigrant mother	0.97	0.80	1.19	0.89	0.70	1.12
Immigrant father	0.95	0.76	1.18	0.75**	0.59	0.95
Live without mother	1.17	0.95	1.43	1.35***	1.10	1.67
Live without father	1.43***	1.28	1.60	1.21***	1.06	1.38
Live with grandparents	0.95	0.82	1.11	1.08	0.92	1.26
Unemployed mother	1.01	0.84	1.21	1.01	0.82	1.25
Retired mother	1.53**	1.06	2.19	0.89	0.58	1.35
Unemployed father	0.90	0.76	1.06	1.02	0.84	1.23
Retired father	1.00	0.80	1.25	0.96	0.75	1.22
University mother	0.98	0.87	1.11	1.11*	0.98	1.27
University father	0.98	0.87	1.11	1.11	0.98	1.26
Working	1.35***	1.18	1.55	1.74***	1.54	1.97
Income	1.11***	1.07	1.14	1.19***	1.15	1.23
Peer smoking	7.88***	7.23	8.58	7.70***	7.01	8.46
Level 2 Std. Dev. for School Type (Std. Error)	0.22 (0.07)***			0.00 (0.06)**		
Level 3 Std. Dev. for AC (Std. Error)	0.07 (0.18)***			0.11 (0.03)**		
LR test versus logistic regression	$\chi^2 = 57.4$			$\chi^2 = 8.57$		
No. observations	27970			27422		

Analyses are carried out in Stata; OR = Odds Ratio; CI = confidence interval; AC = Autonomous Community; Income is in logarithms.

\* $p$  value < 0.10.

\*\* $p$  value < 0.05.

\*\*\* $p$  value < 0.01.

strictures against smoking they are trying (again, presumably) to impose upon their children. The influence that mothers exert on their children is stronger than that of fathers, with the latter being similar to the influence of the grandparents.

Analysis by gender suggests that maternal smoking behaviour has a stronger influence than the father's behaviour for both boys and girls. This result may be explained, at least in part, by what some authors called the gender orientation role (Madill & Bailey, 1999; Qualls, 1988). Broadly speaking, we can distinguish between couples with a traditional gender role orientation (characterized by clearly-defined roles within the couple, especially in the case of women: woman–mother, woman–housework, woman–childcare), and couples with a modern gender role orientation, with more shared and flexible roles. In this line, some authors have found maternal socialization to be negatively associated with smoking and drinking among adolescents (Brown & Rinelli, 2010).

Regarding the parental transfer of smoking by gender, we have found that adolescents' smoking (boys and girls) are influenced by both parents' smoking behaviour, with the effect of both parents being stronger on daughters – the results on this specific aspect in the existing literature are not conclusive. On the other hand, Vandewater et al. (2014) conclude that male smoking is influenced by both parents' smoking behaviour, but female smoking is not affected by the smoking behaviour of either parent. However, Ashley et al. (2008) found that fathers' smoking had a stronger influence on sons than on daughters, and that mothers' smoking influenced their daughters, but not their sons. By contrast,

Duarte et al. (2014b), without differentiating by gender, reported that mothers' smoking, but not that of fathers' influenced their children's smoking.

With respect to intergenerational transferences from grandparents to grandsons, we have found significant and positive increments in the probability of smoking for those grandsons who cohabit with smoker grandparents. A similar result is found by Vandewater et al. (2014) although, in that case, it is not significant at conventional levels (only at the 10% level). One argument can justify this difference in significance: the explanatory variable in their work measures only that one of the four grandparents has smoked, without distinguishing whether he/she cohabits with the grandson. Our variable, however, measures whether there are cohabitant grandparents who smoke. It is then plausible to assume that a stronger association will exist for those who cohabit, although this association between grandparents' smoking and grandchildren's smoking is not homogeneous across boys and girls.

## Conclusions

Our analysis provides robust results on the intergenerational transmission of smoking in-home, providing several plausible implications from a policy perspective. First of all, our results indicate that family behaviour can influence students' smoking and, consequently, families cannot leave the heavy lifting in the battle against tobacco to the relevant country authorities and the World Health Organization. Our results suggest that families, as a close environment, have an important and complementary role in reducing smoking

initiation among adolescents. For example, if parents and grandparents quit smoking, or at least smoke without the knowledge of their offspring, this will have beneficial effects – not only for themselves but also for their children. These beneficial effects will not only be in terms of health improvements, but also in terms of economic welfare. With respect to this point Böckerman et al. (2014) have found that, even after controlling for shared environmental and genetic factors in a sample of twins, smoking is negatively associated with lifetime income.

Our results suggest a different level of risk for different groups of adolescents. Even after controlling for several variables, girls are at higher risk of becoming smokers. Consequently, policy-makers should take this into account and include specific information or measures for this subsample. Similarly, students who have a job, have more disposable income, and live without the mother, and those who have more smoker friends, have a greater probability of becoming smokers. Thus, even recognising that smoking is the result of a broad complex of decisions, in which physiological, psychosocial, family and school factors are involved, these target groups should be considered by policy makers in the design of their policies. Finally, anti-smoking campaigns can benefit by including parents as a campaign target. In this regard, Austin & Chen (2003) found that parental guidance decreased alcohol use, both directly and indirectly, by reducing the influences of alcohol advertising.

### Declaration of interest

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