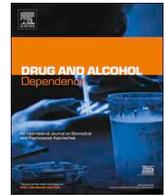




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The association between smoke-free school policies and adolescents' anti-smoking beliefs: Moderation by family smoking norms

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ABSTRACT

Background: Smoke-free school policies (SFSPs) may influence adolescents' smoking through the development of anti-smoking beliefs. We assessed which types of anti-smoking beliefs (health, social and societal) are associated with SFSPs and whether these associations were different for adolescents in smoking permissive versus prohibitive families.

Methods: Survey data was collected in 2016–2017 from 10,980 adolescents between 14–16 years old and 315 staff in 55 schools from seven European cities. We separately measured adolescent-perceived SFSP and staff-reported SFSP at the school-level. Associations between SFSP and anti-smoking health, social and societal beliefs were studied using multi-level logistic regression, adjusting for demographics and school-level smoking prevalence. We tested for interactions between family norms and SFSP, and estimated associations for adolescents in permissive and prohibitive families, respectively.

Results: Adolescent-perceived SFSP was not significantly associated with anti-smoking health (OR:1.08, 95%CI:0.94–1.25), social (OR:0.89, 95%CI:0.75–1.04) and societal beliefs (OR:1.15, 95%CI:0.99–1.33). Staff-reported SFSP were associated with anti-smoking health beliefs (OR:1.12, 95%CI:1.01–1.24), but not with social (OR:0.94, 95%CI:0.83–1.07) or societal beliefs (OR:1.02, 95%CI:0.90–1.14). Most results were comparable between adolescents in smoking prohibitive and permissive families. However, in smoking prohibitive families, adolescent-perceived SFSP were associated with societal beliefs (OR:1.24, 95%CI:1.06–1.46), but not in permissive families (OR:1.06, 95%CI:0.90–1.25). Also, in smoking permissive families, staff-reported SFSP were associated with more pro-smoking social beliefs (OR:0.83, 95%CI:0.72–0.96), but not in prohibitive families (OR:1.05, 95%CI:0.92–1.16). **Conclusions:** We found evidence that SFSP are associated with some anti-smoking beliefs, but more so among adolescents from smoking prohibitive families than from permissive families.

1. Introduction

Adolescent smoking remains a public health concern in European countries (Kuipers et al., 2014; Marcon et al., 2018; Salonna et al., 2017). Smoke-free school policies (SFSPs) set out to prevent adolescent smoking by limiting smoking during school hours by way of specifying who is prohibited to smoke where and when, and what the consequences are for violating the SFSP. Despite their widespread implementation, scientific evidence on the impact of SFSP towards

adolescent smoking behaviour is largely inconsistent: a systematic literature review showed that some studies suggest a favourable impact, but that others show no or even an adverse impact (Galanti et al., 2014). Scientific research may therefore need to shift towards developing a more refined understanding on how (i.e. via which mechanisms) and under what conditions SFSP may impact adolescent smoking behaviour, and for whom this mechanism particularly works.

Building on this perspective, a recently published realist review identified a number of potential mechanisms (Schreuders et al., 2017).

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One such mechanism is that SFSP may stimulate adolescents to develop a range of personal attitudes and opinions that are anti-smoking (i.e. anti-smoking beliefs). This mechanism corresponds with behaviour change theories which postulate that adolescents develop beliefs about smoking through iterative processes of observing, modelling and appraising one's and others' (non-)smoking behaviors as well as by internalizing a school's (non-)smoking values (Kobus, 2003; Markham and Aveyard, 2003). The development of anti-smoking beliefs was argued to be most likely when a school implements strong rather than weak SFSP—that is, when schools prohibit smoking in all school buildings and everywhere on the premises, apply the same rules for adolescents and teachers, and strictly enforce them (Schreuders et al., 2017).

Some empirical studies have assessed the influence of SFSP on anti-smoking beliefs. A quantitative study showed that the perceptions of adolescents on the existence of SFSP are positively associated with negative beliefs about the health and social risks of smoking, which, in turn, may act as mediators for the impact of SFSP on adolescent smoking behavior (Lippman-Kreda and Grube, 2009). Qualitative studies showed that adolescents' perception of partial rules (Baillie et al., 2008; Clark et al., 2002) and weak enforcement (Booth-Butterfield et al., 2000; Gittelsohn et al., 2001; Nilsson and Emmelin, 2010) are linked to the development of unintended beliefs, such as smoking not being so unhealthy as some want them to believe (e.g. teachers, government). These studies, however, provide no refined understanding about which types of beliefs are influenced by SFSP and whether this influence differs between groups of adolescents.

Our first research question relates to the specific types of beliefs that SFSP may influence. Scientific studies traditionally focus on adolescents' beliefs about health (e.g. developing lung cancer) and social (e.g. looking cool) risks and benefits of smoking when underpinning the influence of beliefs on smoking intentions and initiation (Cremers et al., 2015; Song et al., 2009). More recently, interest has increased in beliefs that relate to the benefits and risks of smoking for the chance to participate in society, such as opportunities for employment, starting a family, renting a house, or getting health insurance. These, which we refer to here as "societal beliefs," have not yet been linked to smoking initiation, but were shown to be an adequate proxy measure of a smokers experience of discrimination (Stuber et al., 2008, 2009). SFSP may more strongly influence some types of beliefs than others, though to-date no studies exist that have addressed this question.

Our second research question relates to the potential moderating influence of family smoking norms on the association between SFSP and adolescents' anti-smoking beliefs. Scientific studies show that the family and school environments are two key institutes influencing adolescents' smoking beliefs (Sabiston et al., 2009; Wiium and Wold, 2006), yet little is known about how incongruences between these spheres influence such beliefs. Based on the theory of productive socialization in adolescence (Hurrelmann, 2014), we put forward two possible scenarios. On the one hand, SFSP could lead to stronger increases in anti-smoking beliefs among adolescents in smoking permissive families (primary socialization from childhood onwards), because these adolescents need to align their personal beliefs to the school sphere (secondary socialization since enrolment in school). On the other hand, SFSP could lead to weaker increases in anti-smoking beliefs among adolescents in permissive families because they experience more resistance when internalizing SFSP during secondary socialization than adolescents in prohibitive families. Generating evidence about whether SFSP may be effective for adolescents in permissive families is important to understand how SFSP could help adolescents who have a relatively high a priori chance to start smoking (Avenevoli and Merikangas, 2003; Tyas and Pederson, 1998; Zaborskis and Sirvyte, 2015).

In this study, we used data from 55 schools in seven European cities, allowing for sufficient variation in SFSP strength, to answer the two research questions. First, what are the associations of SFSP with adolescents' anti-smoking health, social and societal beliefs? Second, to

what extent are these associations stronger for adolescents in families with permissive smoking norms than for those in families with prohibitive smoking norms?

2. Materials and methods

2.1. Data

Data was collected over the course of 2016–2017 as part of the SILNE-R project (<http://silne-r.ensp.org>). Seven cities were chosen in seven European countries: Namur (Belgium), Tampere (Finland), Hannover (Germany), Dublin (Ireland), Latina (Italy), Amersfoort (the Netherlands) and Coimbra (Portugal). These cities were chosen as they reflect the respective national averages in terms of demography, unemployment rate, income, and proportion of migrants (Lorant et al., 2015). A total of 55 secondary schools were included, six to twelve in each city.

Self-administered paper and pencil questionnaires were completed by all adolescents in the classroom, under the surveillance of a teacher or research assistant, at a school in the two grades that enrol students of 14–16 years of age. The total adolescent population consisted of 13,061 adolescents. The participation rate was 79.9%.

Adolescents were excluded from the analysis if they were aged 12, 13, 17, 18 or 19 years ($n = 1680$). We collected data at two grades which enrol mostly adolescents at the age of 14–16. Younger and older adolescents in these grades likely are non-representative of their respective age groups. For instance, older adolescents could be the more problematic and difficult subset of older adolescents who have to repeat a grade. Another reason for exclusion was that these age groups were unevenly distributed over the cities, most likely due to differences in country's educational systems.

Adolescents were also excluded if they had missing information on any of the following: gender ($n = 15$); smoking status ($n = 60$); two or more statements on injunctive family smoking norms ($n = 39$); six statements on descriptive family smoking norms ($n = 160$); three or more statements on health beliefs ($n = 63$); or two or more statements on social ($n = 21$) or societal beliefs ($n = 43$). The analysis included a total of 10,980 adolescents across the 55 schools.

Self-administered paper and pencil questionnaires were also distributed among staff members ($N = 315$) of the same schools. Staff members included janitors, teachers and those in management positions. Staff in one Finnish low-socioeconomic status school did not provide data, and therefore, the Finnish researchers that collected the data in this school filled out the form indicating the school rules.

2.2. Ethical approval

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards. Ethical approval was obtained separately for each of the cities to comply with the national standards (Supplementary file 1).

2.3. Variables

2.3.1. Outcome variables

The adolescent survey included adapted scales, from Song et al. (2009), measuring anti-smoking health and social beliefs. The health belief scale consisted of four statements on health risks of smoking: smoking increases my chances of (i) getting lung cancer, (ii) having less ability to exercise, (iii) having chronic trouble breathing, and (iv) getting facial wrinkles (Cronbach's $\alpha = 0.77$). The social belief scale consisted of three statements on social benefits of smoking: smoking increases my chances of (i) looking cool, (ii) becoming popular, and (iii) looking grown-up (Cronbach's $\alpha = 0.80$).

The adolescent survey included two statements to measure anti-smoking societal beliefs. These statements were adapted from [Stuber et al. \(2008\)](#) to make them more relevant to the experiences of adolescents. The two statements read: most people (i) would not hire a smoker to babysit their children, and (ii) would be reluctant to date someone who smokes (Spearman-Brown coefficient of 0.46).

All responses to statements were on a 4-point Likert scale and individual mean scores were created for each health, social and societal belief scale. Scores for health and societal beliefs were reverted so that higher scores indicated stronger anti-smoking beliefs.

2.3.2. School-level independent variables

The strength of SFSPs were measured independently from both staff and adolescent perspectives, as staff reports may represent the existing rules that staff members are aware of, and the perspective of adolescent may reflect the actual implementation of SFSP ([Kuipers et al., 2016](#); [Lovato et al., 2006](#); [Sabiston et al., 2009](#)).

Staff-reported SFSP measured the smoking rules that, according to staff members, apply to adolescents and staff members during school hours. Individual staff members answered eight relevant questions. Six questions measured whether the smoking policy applied for (a) adolescents and/or (b) staff members at, respectively, three places: (i) in the school building, (ii) on the school premises, parking lots and sport fields, and (iii) during events organized by school that take place outside the school area. Each item was worth 0.5 point if answered *Yes*. Two questions asked whether there is a smoking room or area for (a) adolescents and/or (b) staff members, worth 0.5 point each when answered *No*. An aggregated mean score, calculated by summing the means of all respondents within a school was assigned for each, with a minimum of zero (weakest) and maximum of four (strongest).

Adolescents answered four questions about policy implementation. (i) "Are adolescents allowed to smoke on the school premises?" Answer options were: *No, adolescents are not allowed to smoke and this is strictly enforced*; *No, adolescents are not allowed to smoke, but this rule is not strictly enforced*; *Yes, adolescents are allowed to smoke in certain areas*, *Yes, adolescents are allowed to smoke anywhere on the school premises* and *Don't know*, receiving 1, 1, 0.5, 0 and 0 points, respectively. Not only the first, but also the second answer received one point, because enforcement was measured more adequately by the following question: (ii) "How often do you see adolescents smoking on school premises?" Possible answers were: *never, sometimes, often, and always*, receiving 1, 0.5, 0 and 0 points per statement, respectively. (iii) "Are teachers allowed to smoke on the school premises?" Response options were: *No, teachers are not allowed to smoke*; *Yes, teachers are allowed to smoke in certain areas*; *Yes, teachers are allowed to smoke anywhere on the school premises* and *Don't know*, receiving 1, 0.5, 0 and 0 points, respectively. And (iv) "How often do you see teachers smoking on school premises?", with the same response options as for the second question. We first calculated an aggregated mean score per question and per school, excluding the individuals with missing values from each calculation (i.e. no exclusion from the sample), by summing and averaging the scores for all respondents within a school. Then, for each school an overall score was calculated by the sum of the abovementioned aggregate scores, varying between 0 (weakest) and 4 (strongest).

Prevalence of weekly smoking among all respondents in the same school was included as a school-level confounder.

2.3.3. Individual-level independent variables

Family smoking norms were measured by three questions that covered the social psychological concepts of injunctive and descriptive norms ([Rivis and Sheeran, 2003](#)). Two statements measured the injunctive smoking norm: (i) "How would your parents react if they thought/knew you were smoking?", with response options: *they (would) approve*; *they (would) not mind*; *they (would) disapprove a little*; and *they (would) disapprove a lot*, receiving 0, 0, 1 and 2 points, respectively; and (ii) "Is smoking permitted in the home (where you live in all or most of the time)?", with response options: *no one is permitted to smoke in my home*;

smoking is permitted only in certain areas of my home; *smoking is permitted freely in my home*; and *I don't know*, receiving 2, 1, 0 and 0 points, respectively. In the instance where individuals had one missing value, the amount of points of the other injunctive norm statement was doubled.

The descriptive norm question was: "Does any member of your family smoke cigarettes?" Adolescents ticked all boxes that apply for their *(step)father*, *(step)mother*, *(step)brother*, *(step)sister*, and were categorized into three groups: 0, 1, or 2 or more smoking family members, receiving 4, 2 and 0 points respectively.

The injunctive and descriptive norms were combined into an overall family smoking norms score that ranged from 0 to 8 and was dichotomised by using a median split (0–6 and 7–8), representing individuals with relatively permissive and prohibitive family smoking norms, respectively.

Age (in years), gender (male vs female), city, parents' migration background (0, 1, or 2 parents not from country of residence), mother's educational level and father's educational level (low, middle, high or unknown) were measured as potential confounders ([Aveyard et al., 2004](#)). The education level of parents was assigned country-specific categories that were later standardized into low-, middle- and high-education. In most countries, low-education corresponded with primary school and/or lower level of secondary school, middle-education corresponded to higher level of secondary school and/or lower level college, and high-education corresponded to college, university entrance diploma or university degree ([Kuipers et al., 2016](#)).

City was included as a confounder, as there were too few cities to include city as a hierarchical level above the school-level.

2.4. Statistical analysis

First, we described the distribution of individual scores on anti-smoking beliefs. Due the non-normal distributions, we divided individuals into two groups using a median-split, representing relatively pro-smoking versus anti-smoking health (1.00–3.50; 3.67–4.00), social (1.00–3.50; 3.67–4.00) and societal (1.00–2.50; 2.50–4.00) beliefs.

Second, anti-smoking beliefs were described by level of SFSP, for which adolescent-perceived (1.34–2.27; 2.30–2.90; 2.91–3.70) and staff-reported (1.50–2.85; 2.90–3.40; 3.50–4.00) SFSP were divided into tertiles. This division in tertiles was done only for descriptive purposes and assessing sensitivity. The main regression models thus included continuous SFSP variables (assuming linear relationship).

Third, we tested the association of anti-smoking beliefs with, respectively, adolescent-perceived and staff-reported SFSP, using multi-level logistic regression models, and we presented the results as ORs with 95% CIs. The ORs therefore, represent the relative odds of anti-smoking beliefs for adolescents in schools with a one point higher score in SFSP. A random intercept at the school-level was included to account for variation in levels of anti-smoking beliefs between schools that were not accounted for by the included variables. We adjusted the model for age, gender, city, migration background, mother's and father's educational level, family smoking norms and school smoking prevalence.

Fourth, we tested whether the association between SFSP and anti-smoking beliefs varied by family smoking norms, by testing the interaction between family smoking norms and adolescents perceived and staff-reported SFSP. Additionally, from this interaction model we derived the association between SFSP and anti-smoking beliefs separately for smoking permissive and smoking prohibitive families.

R version 3.4.3 was used for the analysis.

3. Results

[Table 1](#) presents the characteristics of the sample (N = 10,980) and the distribution of these characteristics according to adolescent perceived SFSP and staff reported SFSP. The median age of adolescents was 15 years. There were slightly more girls than boys. In schools with strong adolescent-perceived SFSP, 22.6% of adolescents had smoking

Table 1
Sample characteristics and school smoking prevalence, stratified by adolescent-perceived and staff-reported SFSP.

	Total pop. (%) ¹	Adolescent-perceived SFSP			Staff-reported SFSP		
		Weak (%) ²	Inter- mediate (%) ²	Strong (%) ²	Weak (%) ²	Inter- mediate (%) ²	Strong (%) ²
Total (N)	10,980	4122	3961	2897	4423	2632	3925
Family smoking norms							
Permissive	50.6	38.8	38.6	22.6	39.9	25.2	34.9
Prohibitive	49.4	36.2	33.5	30.3	40.7	22.7	36.6
Age							
14	32.1	34.5	34.3	31.1	41.8	26.9	31.3
15	45.5	39.8	33.5	26.8	39.9	23.6	36.5
16	22.4	37.3	43.8	18.8	38.8	20.5	40.7
Gender							
Female	51.2	38.5	32.2	29.2	35.9	25.3	38.8
Male	48.8	36.5	40.1	23.4	44.9	22.6	32.5
City							
Namur	13.8	0.0	74.5	25.5	56.0	24.7	19.3
Tampere	15.0	0.0	29.1	70.9	0.0	13.3	86.7
Hannover	10.2	6.7	56.3	37.0	18.6	65.6	15.9
Dublin	15.9	6.6	48.7	44.7	29.3	29.2	41.5
Latina	16.3	100.0	0.0	0.0	75.4	3.9	20.7
Amersfoort	15.7	81.6	18.4	0.0	81.6	18.4	0.0
Coimbra	13.2	50.9	38.7	10.4	7.1	28.6	64.3
Migration background							
None	76.4	40.3	34.1	25.6	41.3	21.8	36.9
One parent	12.3	30.5	39.5	30.0	39.4	26.0	34.6
Two parents	11.3	26.4	45.6	28.0	34.2	36.3	29.5
Mother education level							
Low	13.3	56.8	35.1	8.1	41.8	26.6	31.6
Middle	32.5	39.9	37.2	22.9	39.7	22.9	37.4
High	39.2	33.2	33.4	33.4	43.0	22.5	34.5
Unknown	15.1	26.8	41.4	31.8	33.2	27.8	39.0
Father education level							
Low	17.3	52.3	37.3	10.4	40.6	24.5	34.9
Middle	29.4	40.4	36.2	23.4	40.0	22.5	37.5
High	35.2	33.9	31.5	34.6	44.8	22.1	33.1
Unknown	18.2	25.9	43.6	30.5	31.8	29.4	38.8
Smoking prevalence (%)	10.2	13.8	9.2	6.4	12.9	8.1	8.5

¹ Percentage in columns.

² Percentage in rows.

permissive families and 33.5% had prohibitive parents. In schools with strong staff-reported SFSP, 34.9% had smoking permissive families and 36.6% with prohibitive families. The overall weekly smoking prevalence was 10.2%. Smoking prevalence was respectively 6.4% and 13.8% in schools with strong and weak adolescent-perceived SFSP, and respectively 8.5% and 12.9% in schools with strong and weak staff-reported SFSP.

Supplementary file 2 presents the number of schools per tertile of adolescent-perceived and staff-reported SFSP over the different cities. Tampere (Finland) had the highest percentage of schools with strong SFSP, while the weakest SFSP were most common in Latina (Italy) and Amersfoort (the Netherlands). The correlation between adolescent-perceived and staff-reported SFSP was 0.44.

Table 2 presents the distribution of adolescents across anti-smoking health, social and societal belief scores, by adolescent-perceived and staff-reported SFSP. The descriptive data show a clear pattern of more anti-smoking health beliefs with increasing SFSP strength, and more anti-smoking societal beliefs with increasing adolescent-perceived SFSP. No clear patterns can be distinguished for social beliefs.

Table 3 presents the associations of adolescent-perceived SFSP with anti-smoking beliefs, controlling for all confounders. There were no significant associations between adolescent-perceived SFSP and health (OR: 1.08, 95%CI: 0.94–1.25), social (OR: 0.89, 95%CI: 0.75–1.04) and societal beliefs (OR: 1.15, 95%CI: 0.99–1.33). Prohibitive family smoking norms associated substantially with higher odds of anti-smoking health (OR: 1.63, 95%CI: 1.50–1.77), social (OR: 1.24, 95%CI: 1.15–1.35) and societal (OR: 1.75, 95%CI: 1.61–1.90) beliefs. Results for staff-reported SFSP, using the same covariates, were not reported in a table, but associated with anti-smoking health beliefs (OR: 1.12,

95%CI: 1.01–1.24), but not with social (OR: 0.94, 95%CI: 0.83–1.07) or societal (OR: 1.02, 95%CI: 0.90–1.14) beliefs.

Table 4 presents the main effect estimates per subgroup. Three of these were significant. Among adolescents from prohibitive families, but not among those from permissive families, there were positive associations (more anti-smoking) between adolescent-perceived SFSP and societal beliefs (OR: 1.24, 95%CI: 1.06–1.46), and between staff-reported SFSP and health beliefs (OR: 1.14, 95%CI: 1.02–1.29). Among adolescents from permissive families, but not among those from prohibitive families, there was a negative association (less anti-smoking) between staff-reported SFSP and social beliefs (OR: 0.83, 95%CI: 0.72–0.96).

Adolescent-perceived SFSP interacted with family smoking norms for the societal beliefs (OR: 1.17, 95%CI: 1.01–1.34), but not for health (OR: 1.02, 95%CI: 0.88–1.17) and social (OR: 1.10, 95%CI: 0.96–1.25) beliefs. Staff-reported SFSP interacted with family smoking norms for the social (OR: 1.26, 95%CI: 1.13–1.41) and societal (OR: 1.13, 95%CI: 1.00–1.27) beliefs, but not for health (OR: 1.05, 95%CI: 0.93–1.18) beliefs.

Supplementary file 3 presents the associations of adolescent-perceived SFSP or staff-reported SFSP, included as continuous variable or tertiles, with the anti-smoking beliefs. It shows that both measurements of SFSP are not sensitive (i.e. follow same patterns of associations) to whether these are included as a continuous variable or as tertiles.

4. Discussion

4.1. Key findings

For anti-smoking health beliefs, we found an overall association with staff-reported SFSP, but in the subgroup analysis this could only be

Table 2
Individual-level anti-smoking health, social and societal beliefs, stratified by adolescent-perceived and staff-reported SFSP.

	Total (%)	Adolescent-perceived SFSP			Staff-reported SFSP		
		Weak (%)	Inter-mediate (%)	Strong (%)	Weak (%)	Inter-mediate (%)	Strong (%)
Total (N)	10,980	4122	3961	2897	4423	2632	3925
Health beliefs							
Anti-smoking	42.8	35.2	43.5	52.7	35.5	45.9	49.1
Pro-smoking	57.2	64.8	56.5	47.3	64.5	54.1	50.9
Social beliefs							
Anti-smoking	49.9	49.0	51.6	48.9	47.7	52.5	50.6
Pro-smoking	50.1	51.0	48.4	51.1	52.3	47.5	49.4
Societal beliefs							
Anti-smoking	57.7	49.3	58.3	68.7	55.9	57.9	59.4
Pro-smoking	42.3	50.7	41.7	31.3	44.1	42.1	40.6

Note: Percentages in columns.

demonstrated with statistical significance for adolescents in prohibitive families. No associations with anti-smoking health beliefs were found for adolescent-perceived SFSP. For anti-smoking social beliefs, we found no associations with adolescent-perceived SFSP, while the relationship with staff-reported SFSP interacted with the family norms: SFSP was associated with lower odds of anti-smoking (i.e. more pro-smoking) social beliefs among adolescents in smoking permissive families, but not in prohibitive families. For anti-smoking societal beliefs, there was no overall association with staff-reported SFSP, while the relationship with adolescent-perceived SFSP interacted with the family norms: SFSP was associated with more anti-smoking societal beliefs

among adolescents in smoking prohibitive families, but not in permissive families.

4.2. Limitations

Four limitations should be considered when interpreting the findings. First, due to the low number of included schools, statistical power was limited. We would have demonstrated more reliable effect estimates (i.e. more narrow confidence intervals) if the dataset included a larger number of schools.

Second, we should be cautious in drawing causal conclusions about

Table 3
Associations between adolescent-perceived SFSP and the anti-smoking belief outcomes, while controlling for all other covariates.

	Odds ratio (95% confidence interval)		
	Health beliefs	Social beliefs	Societal beliefs
Adolescent-perceived SFSP	1.08 (0.94–1.25)	0.89 (0.75–1.04)	1.15 (0.99–1.33)
<i>Covariates</i>			
Family smoking norms			
Permissive	REF	REF	REF
Prohibitive	1.63 (1.50–1.77)*	1.24 (1.15–1.35)*	1.75 (1.61–1.90)*
Age			
14	REF	REF	OR
15	0.93 (0.85–1.03)	1.02 (0.93–1.12)	0.91 (0.83–1.00)
16	0.90 (0.80–1.02)	1.06 (0.94–1.19)	0.87 (0.77–0.99)*
Gender			
Female	REF	REF	REF
Male	0.82 (0.75–0.89)*	0.76 (0.70–0.82)*	1.10 (1.01–1.19)*
City			
Namur	REF	REF	REF
Tampere	2.01 (1.62–2.52)*	0.90 (0.71–1.15)	2.51 (2.01–3.15)*
Hannover	1.72 (1.38–2.16)*	0.99 (0.77–1.27)	1.81 (1.43–2.28)*
Dublin	2.02 (1.62–2.52)*	0.43 (0.33–0.55)*	1.68 (1.34–2.11)*
Latina	0.94 (0.73–1.19)	0.55 (0.41–0.72)*	0.89 (0.69–1.14)
Amersfoort	0.96 (0.74–1.26)	0.69 (0.51–0.93)*	1.54 (1.17–2.01)*
Coimbra	1.75 (1.40–2.19)*	0.97 (0.75–1.25)	0.43 (0.34–0.55)*
Migration background			
None	REF	REF	REF
One parent	1.08 (0.95–1.22)	0.92 (0.82–1.04)	0.95 (0.84–1.08)
Two parents	1.00 (0.88–1.14)	1.05 (0.92–1.19)	1.14 (1.00–1.31)*
Mother education level			
Low	REF	REF	REF
Middle	0.89 (0.78–1.02)	0.97 (0.85–1.11)	1.09 (0.95–1.25)
High	1.00 (0.86–1.16)	0.96 (0.83–1.10)	1.19 (1.03–1.38)*
Unknown	0.82 (0.68–0.98)*	1.07 (0.89–1.27)	0.99 (0.82–1.19)
Father education level			
Low	REF	REF	REF
Middle	1.19 (1.05–1.36)*	0.93 (0.82–1.05)	1.07 (0.94–1.22)
High	1.29 (1.13–1.49)*	0.85 (0.74–0.97)*	1.15 (1.00–1.32)*
Unknown	1.00 (0.84–1.18)	1.00 (0.85–1.18)	1.06 (0.90–1.25)
Smoking prevalence (per 10% increase)	0.92 (0.84–1.01)	1.01 (0.91–1.12)	0.97 (0.89–1.07)

Note: ORs represent the odds more anti-smoking beliefs with a one point increase in the covariate. * Statistical significance at the 0.05 level.

Table 4
Association of adolescent-perceived SFSP and staff-reported SFSP with the smoking belief outcomes, according to family smoking norms.

	Odds ratio (95% confidence interval)			
	Total population	Health beliefs	Social beliefs	Societal beliefs
Adolescent-perceived SFSP	10,980			
Family smoking norms ¹				
Permissive	5552	1.07 (0.92–1.26)	0.84 (0.71–1.01)	1.06 (0.90–1.25)
Prohibitive	5428	1.09 (0.94–1.27)	0.93 (0.78–1.10)	1.24 (1.06–1.46)*
Staff-reported SFSP				
Family smoking norms ¹				
Permissive	5552	1.09 (0.97–1.23)	0.83 (0.72–0.96)*	0.96 (0.84–1.09)
Prohibitive	5428	1.14 (1.02–1.29)*	1.05 (0.92–1.16)	1.08 (0.95–1.24)

Note: Relative difference between adolescents in smoking prohibitive versus permissive families in the odds of a one category increase in the anti-smoking belief score for adolescents in schools with a one point higher SFSP score. Controlling for all covariates as in Table 3. * Statistical significance at the 0.05 level. ¹ The main effect for the different groups was calculated with the same model, by changing the reference group.

the direction of causality because the data is cross-sectional. SFSP may influence adolescents' anti-smoking beliefs, yet schools could also be more likely to implement SFSP when adolescents are more anti-smoking. Another reason to be cautious is the possibility for school-level confounders that were not taken into account, like the possibility that schools with stronger SFSP provide more health education about smoking.

Third, the surveys included generic statements to measure SFSP, consequently neglecting some city-specific nuances. For example, some schools in Tampere prohibit smoking not only inside but also outside the school premises, yet this could not be included in our calculation of SFSP scores.

Fourth, the two items for calculating the societal belief scale were based on a validated scale (Stuber et al., 2008), yet showed only a Spearman-Brown coefficient of 0.46. We chose to keep the scale as the items measure different dimensions of societal beliefs, but the low reliability also implies that the results for societal beliefs should be interpreted with caution.

4.3. Interpretation of results

Our findings showed that SFSP generally associate less frequently with anti-smoking beliefs among adolescents in permissive families, relative to those in prohibitive families. This corresponds with the expectation that, as put forward in the introduction section, adolescents from permissive families experience relatively more resistance when exposed to SFSP due to an incongruence between the family and school spheres. This result warns us that SFSP may be less effective for adolescents who have a relatively high a priori chance to start smoking, therewith possibly contributing to the increasing concentration of smokers among the more disadvantaged groups (Kuipers et al., 2014).

For anti-smoking health beliefs, we found a positive association with staff-reported SFSP. This corresponds with a study that showed a positive association between adolescents' perception that SFSP exist and the perceived harm of smoking, and with qualitative studies that linked weak SFSP to adolescents' thinking that smoking is not so unhealthy (Baillie et al., 2008; Clark et al., 2002; Lipperman-Kreda and Grube, 2009). A likely explanation for our finding could therefore be that strong SFSP ensures there is no room for adolescents to doubt why schools, as a key institute during adolescence, would not prohibit them to smoke.

For anti-smoking social beliefs, we found an inverse association (i.e. more pro-smoking) with staff-reported SFSP, but only among adolescents in smoking permissive families. Previous studies on SFSP similarly showed that some adolescents may, in response to SFSP, think it looks cool to be sanctioned in front of peers and perceive smoking in a peer-group as a means to challenge school authority (Croghan et al., 2003; Turner and Gordon, 2004). Also, studies exploring how the family influences adolescents' smoking showed that the number of smoking

friends is an important mediator (Simons-Morton and Farhat, 2010). The association thus suggests that exposing adolescents from permissive families to SFSP may cause them to believe that smoking is beneficial to gain social status among their peers.

For anti-smoking societal beliefs, we found an interaction between family norms and adolescent-perceived SFSP, and an association between adolescent-perceived SFSP and anti-smoking societal beliefs among adolescents in smoking prohibitive families. This corresponds with prior studies showing that smoke-free policies may contribute to the development of beliefs that could lead to the discrimination of smokers (Chapman and Freeman, 2008; Evans-Polce et al., 2015). However, our findings indicate that it is primarily adolescents with the lowest chance to become smokers (i.e. prohibitive family norms) who are the ones who may develop such beliefs. While anti-smoking societal beliefs likely protect these adolescents even further against the initiation of smoking (Alamar and Glantz, 2006), the literature concurrently warns us that these beliefs may lead to adverse impacts on individuals who are unable to quit smoking (Bell et al., 2010; Frohlich et al., 2012). It could be that SFSP hereby contribute to the social isolation of adolescent smokers in smoker-networks during school hours.

We found that anti-smoking beliefs associated more often with staff-reported SFSP than with adolescent-perceived SFSP. This is interesting because previous studies more often showed that adolescents' perspective associates with the outcome variable than staff's reports (Galanti et al., 2014). Both measurements thus likely represent somewhat different aspects of SFSP implementation in the real-world, yet little is known about what precisely is the unique contribution of each perspective. We consider such exploration a priority for future studies because it helps to interpret findings of prior studies on SFSP that analyze both perspectives separately as well as formulating more specific practical implications (Kuipers et al., 2016; Lovato et al., 2006; Sabiston et al., 2009).

5. Conclusions

We found evidence that SFSP are associated with some anti-smoking beliefs, but more so among adolescents from smoking prohibitive families than from permissive families. A particular concern among the latter group is the potential development of more pro-smoking social beliefs. Therefore, it is important to develop complementary prevention programmes that explicitly focus on helping those adolescents who grow up in smoking permissive families.

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Contributors

MS, MAG, BvdP and AEK conceptualized the study. All authors contributed to data collection. MS wrote the draft research proposal with the help of MAGK, BvdP, and AEK. All authors contributed to refine the research proposal. MS executed the analysis with the help of MAGK. MS wrote the draft manuscripts. All authors commented on these drafts. All authors approved the final manuscript.

Declaration of Competing Interest

The authors declare that they have no conflict of interest.

Appendix A. Supplementary data

Supplementary material related to this article can be found, in the online version, at doi:<https://doi.org/10.1016/j.drugalcdep.2019.06.023>.

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