The association between smoke-free school policies and adolescents' perceived anti-smoking norms: moderation by school connectedness

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List of abbreviations: smoke-free school policies (SFSPs).

ABSTRACT

Background

Many European schools implement smoke-free school policies (SFSPs). SFSPs may decrease adolescent smoking by causing adolescents to perceive stronger anti-smoking norms, yet there exists no quantitative evidence that indicates for which norms and for whom such effects may occur. This study therefore assessed to what extent adolescents' perceived anti-smoking norms among best friends, teachers, and society at large were associated with SFSPs, and whether these associations were moderated by adolescents' level of school connectedness.

Methods

Survey data were collected in 2016/2017 on 10,653 14-16-year-old adolescents and 315 staff members in 55 schools from seven European cities. Associations of adolescent-perceived SFSPs and staff-reported SFSPs with best friend, teacher and societal anti-smoking norms were estimated in multilevel logistic regression models, adjusted for demographics and school-level smoking prevalence. We tested for interaction between school connectedness and SFSPs.

Results

Adolescent-perceived SFSPs were positively associated with anti-smoking norms by teachers (OR:1.46, 95%CI:1.15–1.85), were negatively associated with anti-smoking norms by best friends (OR:0.81, 95%CI:0.67–0.99), but were not significantly associated with anti-smoking norms by society at large (OR:0.87, 95%CI:0.74–1.02). All interaction tests between adolescent-perceived SFSPs and school connectedness were non-significant. Staff-reported SFSPs were not associated with any norm and showed no significant interaction with school connectedness.

Conclusions

We found that SFSPs are associated with adolescents' perception of more anti-smoking norms by teachers, but less anti-smoking norms by best friends, irrespective of adolescents' level of school connectedness.

IMPLICATIONS

Smoke-free school policies, just as many other tobacco control policies, are assumed to foster adolescents' perception of anti-smoking norms. Still, current evidence does not demonstrate which anti-smoking norms may be influenced by SFSPs and whether this influence is equal for adolescents with different levels of school connectedness. This study suggests that SFSPs foster adolescents' perception of anti-smoking norms by teachers, but may concurrently lead to the perception of less anti-smoking norms by best friends, irrespective of adolescents' school connectedness. SFSPs may therefore need to be complemented with interventions that target anti-smoking norms in adolescent peer groups.

INTRODUCTION

An increasing number of schools in European countries implement smoke-free school policies (SFSPs). SFSPs describe for whom, where and when smoking is prohibited, and what the consequences are for those who violate the smoking rules. However, there still is no conclusive evidence about the impact of SFSPs on adolescent smoking behaviour: previous studies showed positive, no, or even negative associations.[1] Researchers therefore increasingly focus on developing a more refined understanding of the mechanisms through which SFSPs may influence adolescent smoking behaviour, under which conditions these mechanisms may occur, and for whom beneficial or harmful mechanisms may occur.[2-4]

A recent literature review identified individual-level mechanisms through which SFSPs may decrease adolescent smoking behaviour.[5] One of these was that SFSPs may cause adolescents to perceive stronger anti-smoking norms. The occurrence of this mechanism would be most likely when schools implement strong SFSPs.[1,5] Strong SFSPs prohibit smoking everywhere on the school area, for everyone, during all school hours, and are strictly enforced. Strong SFSPs thereby communicate a clear norm that school disapproves smoking in all places that fall within their jurisdiction. Weak SFSPs, in contrast, allow adolescents to smoke in certain areas, apply different rules to younger and older adolescents, or do not consistently connect consequences to rule violations, thereby communicating a more ambiguous smoking norm.

Contemporary literature, however, remains unclear about which types of anti-smoking norms may be influenced by strong SFSPs and whether this influence differs between groups of adolescents. This is an important gap to address, because it develops a more refined understanding about how and for whom SFSPs may be beneficial or harmful.

A distinction could be made between adolescents' perception of anti-smoking norms of best friends, teachers and society at large. Best friend and teacher norms are known to influence

adolescent smoking behaviours[6,7] and such influence of societal norms seems likely as of its strong relation to de-normalization and stigmatisation,[8-10] but studies never systematically assessed the associations of these norms with SFSPs. There do exist some qualitative studies that suggest that SFSPs may associate with adolescents' perception of specific types of anti-smoking norms. First, a qualitative study about adolescents' smoking during school hours described how smokers try to mitigate feelings of shame towards their peers for having to stand at a designated smoking area.[11] Second, qualitative studies linked adolescents' perception of weak SFSPs with the view that teachers do not care about, accept, facilitate or even encourage adolescent smoking.[12-14] Lastly, qualitative studies described (young) adults (ex-)smokers experiencing more societal disapproval and devaluation since the implementation of smoke-free public policies.[9,15] However, these qualitative studies provide no insights about whether SFSPs may more strongly influence some anti-smoking norms than others and included smaller samples selected for specific reasons (e.g. only smokers).

One may also expect SFSPs to associate differently with adolescents' perception of anti-smoking norms for adolescents who show different levels of connectedness to the school. The level of school connectedness may differ considerably between individuals within the same school[16,17] and feeling connected to the school (versus unconnected) has been associated with lower odds of smoking susceptibility and lower risk of smoking initiation.[18-20] Feeling connected to the school was argued to protect adolescents against smoking because of a social bond of attachment and commitment that exists between adolescents and the school, which facilitates adolescents' aligning of their norms, values and behaviors with those held and practiced by the school.[21] Contrariwise, unconnected adolescents tend to attach and commit to anti-school norms, values and behaviors, and thinking and doing the opposite of what school health interventions aim to achieve may be perceived as a marker of status.[22] This may imply

that SFSPs may have no or even adverse effects on the perception of anti-smoking norms among unconnected adolescents.

We used data from 55 schools in seven European cities, allowing for sufficient variation in strength of SFSPs. First, we assessed to what extent the strength of SFSPs is associated with adolescents' perception of anti-smoking norms by best friends, teachers and society at large. Second, we assessed the moderation of the association between SFSPs and smoking norms by adolescents' level of school connectedness.

METHODS

Data

Data was collected in the school year 2016-2017 as part of the SILNE-R project (http://silne-r.ensp.org). Seven European 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.[23] A total of 55 secondary schools were included, six to twelve in each city.

Self-administered paper and pencil questionnaires were completed in the classroom, under surveillance of a teacher or research assistant, by all adolescents within a school in the two grades that mainly enrolled students aged 14-16. 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=1,680). Due to the sampling in specific grades, younger and older adolescents 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 the school connectedness scale (n=166), or any of the outcome variables (n=487). The analysis included a total of 10,653 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 could be in teaching positions, senior management positions, and supportive positions (e.g. janitors, care professionals). The aim was to include at least one staff member in each of these functions, yet the persons within each of the functions were selected conveniently. The majority of respondents were teachers. 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.

Ethical approval

All procedures were in accordance with the ethical standards of the respective institutional and/or national research committees, and with the 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).

Variables

Outcome variables

Adolescents' perception of anti-smoking norms by best friends and teachers were determined by the questions: "How would your [best friends/teachers] react if they thought/knew you were smoking?". For best friends and teachers a separate variable was created in which the four possible answers were dichotomised into strong anti-smoking norm (*they (would) disapprove a lot* (coded 1)), vs. no strong anti-smoking norm *(they (would) approve, they (would) not mind,* or *they (would) disapprove a little* (coded 0)). These questions are based on numerous studies asking adolescents about their perceptions of (dis)approval by significant others.[24]

We dichotomized all outcome variables because the values for teacher anti-smoking norms were not normally distributed. Also, we wanted to focus on strong anti-smoking norms because the meaning of *they (would) not mind* and *they (would) disapprove a little* was relatively close, and we preferred a clearer cut-off point.

Adolescents' perception of anti-smoking norms by society at large was determined by the statement: "Most people think less of a person who smokes". The four possible answers were dichotomised into strong anti-smoking norm (*strongly agree* (coded 1)), vs. no strong anti-smoking norm (*agree, disagree,* or *strongly disagree* (coded 0)). This statement was based on a widely used scale to assess the perceived stigmatisation of people with a mental illness.[10]

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 SFSPs.[25,26] Government legislation in each of the participating cities banned smoking in the school area at the time of data collection. The only exception was Amersfoort (the Netherlands), though most schools in Amersfoort voluntarily prohibited smoking on the premises.

Staff-reported SFSPs 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 staff members within a school was assigned for each, with a minimum of zero (weakest) and maximum of four (strongest).

Adolescents answered four questions about SFSPs. The first question was about the rules on adolescent smoking. (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. The option Don't know received 0 points because it denotes that adolescents cannot benefit from the thought that adolescent smoking is prohibited. Not only the first, but also the second answer received one point, because we used this question for measuring the formal rules adolescents think that apply, irrespective of their actual enforcement. Enforcement was, in turn, measured more adequately by the second 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. The options often and always were treated equally because both indicate a weak enforcement of the rules. The same questions were asked for teacher smoking. (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. The option Don't know received 0 points because it denotes that adolescents cannot benefit from the thought that teacher smoking is prohibited. 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 adolescents 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).

Weekly smoking prevalence among all respondents in the same school was included as a school-level confounder. We did not control for adolescents' own smoking status because this may be influenced by the outcome measure of interest, i.e. their perception of anti-smoking norms, particularly those of best friends.

Individual-level independent variables

School connectedness was determined by five statements based on a validated scale[27]: "I feel close to people at my school", "I feel I am part of my school", "I am happy to be at my school", "I feel the teachers at my school treat me fairly" and "I feel safe in my school". Adolescents could answer *strongly agree*, *agree*, *disagree* or *strongly disagree* to each statement, receiving 1 to 4 points per statement, respectively. A school connectedness score was calculated as the sum of all items, divided by the number of statements an adolescent answered, with higher scores indicating less school connectedness. Adolescents were then

categorized into two groups: connected (1.00–2.00) and unconnected (2.20–4.00), so that those categorized as connected on average responded between *strongly agree* and *agree*.

Age (in years), gender, city, parents' migration background (zero, one, or two parents not from country of residence), parental smoking (zero, one, or two smokers), mother's educational level and father's educational level were measured as possible confounders at the individual level [28]. We did not control for smoking by siblings and friends because these likely are subject to the same SFSPs.[28] Adolescent-reported parental educational level was measured in country-specific categories that were later standardized into low, middle and high education. In most countries, low corresponded with primary school and/or lower level of secondary school, middle corresponded to higher level of secondary school and/or lower level college, and high corresponded to college or university degree.[29]

Statistical analysis

First, anti-smoking norms were described by level of SFSPs implementation divided into tertiles, for adolescent-perceived (1.34–2.29; 2.30–2.90; 2.91–3.70) and staff-reported (1.50–2.85; 2.90–3.40; 3.50–4.00) SFSPs separately.

Second, we tested the associations of continuous variables of adolescent-perceived and staff-reported SFSPs with anti-smoking norms, using multilevel logistic regression models, presenting ORs with 95% CIs. We adjusted the model for age, gender, city, parents' migration background, parental smoking, mother's educational level, father's educational level, school connectedness and school-level adolescent smoking prevalence. Also, a random intercept at the school level was included to account for variation in smoking norms between schools that were not accounted for by the included variables. The analysis thereby controlled for differences between cities with respect to diverse factors such as cultural backgrounds and educational systems.

Third, we derived the association between SFSPs and smoking norms separately for adolescents who feel relatively connected and unconnected to the school, from models that included interaction between school connectedness and adolescent-perceived and, respectively, staff-reported SFSPs. We adjusted for the same variables as in the model described above.

We performed two sensitivity analyses. First, we included SFSPs as tertiles when assessing their association with anti-smoking norms. These associations were similar to those reported for continuous variables of SFSPs. Second, we included school connectedness as tertiles instead of a continuous variable. We found similar interactions for both ways.

R version 3.4.3 was used for the analyses.

RESULTS

Table 1 presents the characteristics of the study population and the distribution of these characteristics according to adolescent-perceived SFSPs and staff-reported SFSPs. The median age of adolescents was 15 years. There were slightly more girls than boys. The overall weekly smoking prevalence was 10.1%. Smoking prevalence in schools with strong, intermediate and weak adolescent-perceived SFSPs was respectively 6.2%, 9.0%, and 14.0%. For strong, intermediate and weak staff-reported SFSPs, it was respectively 8.4%, 8.1%, and 12.8%. A third of adolescents were categorised as unconnected to their school.

Supplementary file 2 presents the number of schools per tertile of adolescent-perceived and staff-reported SFSPs over the different cities. Finland had the highest percentage of schools with strong adolescent-perceived SFSPs, while those in Italy were perceived as the weakest. Staff-reported SFSPs were strongest in Finland and weakest in the Netherlands. The correlation between adolescent-perceived SFSPs and staff-reported SFSPs was 0.44.

Table 2 presents the distribution of adolescents across the scores for anti-smoking norms by best friends, teachers and society at large, according to adolescent-perceived SFSPs and staff-reported SFSPs. Overall, 25.8% of adolescents perceived anti-smoking norms by best friends, 41.8% by teachers, and 12.6% by society at large. There is a clear pattern of more anti-smoking teacher norms with increases in adolescent-perceived and staff-reported SFSPs. No clear patterns can be distinguished for best friends and society at large.

Table 3 presents associations between adolescent-perceived SFSPs and norms, controlling for school connectedness, socio-demographics, school smoking prevalence, and city. Adolescent-perceived SFSPs was positively associated with anti-smoking norms by teachers (OR: 1.46, 95%CI: 1.15–1.85), negatively with anti-smoking norms by best friends (OR: 0.81, 95%CI: 0.67–0.99), but not significantly with anti-smoking norms by society at large (OR: 0.87, 95%CI: 0.74–1.02). Staff-reported SFSPs, adjusted for the same covariates, was not associated with anti-smoking norms by best friends (OR: 0.97, 95%CI: 0.90–1.05), teachers (OR: 1.03, 95%CI: 0.93–1.14), and society at large (OR: 1.02, 95%CI: 0.96–1.09) (not reported in a table).

Table 3 also presents associations between norms and other covariates. Adolescents aged 14 perceived stronger anti-smoking norms by all three actors than older adolescents. Females perceived stronger anti-smoking norms by best friends and teachers, whereas males perceived stronger anti-smoking norms by society at large. Adolescents whose parents smoke perceived weaker anti-smoking norms by best friends and society at large than those without smoking parents. Parental smoking was not associated with adolescents' perception of anti-smoking norms by teachers. There was no clear trend in the association between mother's/father's educational level and anti-smoking norms. Adolescents in school with a higher smoking prevalence perceived weaker anti-smoking norms by best friends and teachers, but stronger anti-smoking norms by society at large.

Table 4 presents the associations between SFSPs and norms per subgroup of school connectedness. We found positive associations (i.e. more anti-smoking) between adolescent-perceived SFSPs and anti-smoking norms by teachers for both connected (OR: 1.44, 95%CI: 1.12–1.83) and unconnected (OR: 1.52, 95%CI: 1.16–2.00) adolescents. There was a negative association between adolescent-perceived SFSPs and anti-smoking norms by best friends for unconnected adolescents (OR: 0.74, 95%CI: 0.58–0.94), but not for connected adolescents (OR: 0.84, 95%CI: 0.69–1.03). All other associations were statistically non-significant.

Table 5 presents the ORs for interaction between SFSPs and school connectedness. Adolescent-perceived SFSPs showed no significant interaction with school connectedness for the anti-smoking norms by best friends (OR: 0.88, 95%CI: 0.73–1.06), teachers (OR: 1.06, 95%CI: 0.89–1.26), and society at large (OR: 0.93, 95%CI: 0.75–1.16). Staff-reported SFSPs also showed no significant interaction with the school connectedness for anti-smoking norms by best friends (OR: 0.98, 95%CI: 0.91–1.06), teachers (OR: 1.02, 95%CI: 0.95–1.09), and society at large (OR: 0.96, 95%CI: 0.87–1.05).

DISCUSSION

Key findings

Adolescent-perceived SFSPs associated with higher odds of perceiving anti-smoking norms by teachers, with lower odds of perceiving anti-smoking norms by best friends, but not significantly with perceiving anti-smoking norms by society at large. Adolescent-perceived SFSPs showed no significant interaction with school connectedness. Staff-reported SFSPs did not associate with any perceived anti-smoking norm.

Limitations

Four limitations should be taken into account when interpreting the findings. Firstly, our main independent variable, SFSPs, was measured at the school-level. Due to the relatively low number of schools (55 in total), the statistical power at the school-level may have been limited. More precise effect estimates would have been reported with a larger number of schools.

Secondly, the survey statements used for the measurement of SFSPs did not include some city-specific nuances. One example is that schools in Tampere prohibit any smoking during the school hours, including smoking outside the school premises. Another example is that schools in Amersfoort apply different rules for different age groups.

Thirdly, we used cross-sectional data, limiting causal inference. SFSPs may lead to anti-smoking norms, but schools may also be more likely to implement SFSPs when the school climate is such that adolescents perceive more anti-smoking norms.

Lastly, the measurement of norms by best friends and teachers related to the underlying construct of disapproval whereas that of society at large related to devaluation. Results for these norms would have been more comparable if we had been able to measure all three norms according to the same underlying construct.

Interpretations of findings

There was a positive association between adolescent-perceived SFSPs and perceived anti-smoking norms by teachers. This association corresponds with existing qualitative evidence[12-14] and could underpin that strong SFSPs may cause adolescents to think that teachers (would) personally disapprove their smoking. An alternative explanation could be that staff's enforcement of SFSPs is better when they strongly disapprove smoking of adolescents.[30]

We found an inverse association between adolescent-perceived SFSPs and perceived anti-smoking norms by best friends. One explanation could be that adolescents oppose the SFSPs, discuss among their friends that the rules are unreasonable, and consequently perceive less disapproval towards smoking by their best friends. Another explanation could be that strong SFSPs increase the likelihood that adolescents discuss the school rules with their best friends, and consequently find out that their best friends do not or would not disapprove their smoking as strongly as they initially thought (i.e. perception of anti-smoking norm becomes more informed). Both explanations correspond with findings that adolescents in the Netherlands generally disapprove smoking, but simultaneously believe it is important to respect other's choice to smoke.[31]

We found no association, or possibly even an inverse association, between adolescent-perceived SFSPs and perceived anti-smoking norm by society at large. This contrasts earlier qualitative studies on the impact of smoke-free bans in hospitality venues, which found that smoke-free policies caused an increase in the perception of smoking as a socially unacceptable behavior and the stigmatization of smokers.[9,15] We put forward two possible explanations for this discrepancy. First, smoke-free bans in hospitality venues commonly involve a national policy that is accompanied by considerable media attention, whereas this study focused on the strength of implementing SFSPs in individual schools. Second, said studies involved experiences of young adult (ex-)smokers with the implementation of smoke-free bans in hospitality venues, while our analysis involved mostly adolescent never-smokers about smoke-free bans in the school context. Never-smokers are not the objects of stigmatization and may therefore respond differently to smoke-free policies.

School connectedness did not moderate the associations between SFSPs and anti-smoking norms. This contradicts our expectation that unconnected adolescents, as compared to connected adolescents, would show a lower increase in perceived anti-smoking norms in

response to SFSPs. The most likely explanation is that school connectedness has such a strong main effect on adolescents' perception of anti-smoking norms by others (see Table 3) that SFSPs do not influence this relationship. Possibly, moderation of school connectedness would have been found for adolescents' aligning of their own norms with those held by the school (e.g. "I (would) disapprove the smoking of teachers"), but unfortunately we only had data about adolescents' perception of disapproval by others.

Staff-reported SFSPs, in contrast to adolescent-perceived SFSPs, was not associated with any of the anti-smoking norms. An explanation for this difference could be that the adolescent perspective takes better account of the actual SFSPs implementation (e.g., enforcement, communication). This explanation, however, contrasts recent findings that staff-reported SFSPs associate more strongly with adolescents' smoking-related beliefs than adolescent-perceived SFSPs.[4] We therefore think it is important to study what both perspectives precisely measure to help understand our findings as well as the findings of previous studies that report on both measurements separately.[25,26,29]

A recent literature review suggested that SFSPs may cause adolescents to perceive stronger anti-smoking norms, which may subsequently decrease adolescent smoking behaviour.[5] However, we found that SFSPs were not clearly associated with adolescents' increased perception of anti-smoking norms, only with increased anti-smoking norms by teachers. We even found potential adverse influences of SFSPs on the perception of anti-smoking norms by best friends, which are known to have a strong influence on risk taking behavior during adolescence.[32,33] It therefore remains uncertain whether SFSPs contribute to decreasing adolescent smoking behavior through increasing adolescents' perception of anti-smoking norms. This should by no means be interpreted as evidence that SFSPs are ineffective in decreasing adolescent smoking behavior, because anti-smoking social norms merely represent one of the potential mechanisms connecting SFSPs and smoking.[5]

Conclusion

Smoke-free school policies associated with adolescents' perception of more anti-smoking by teachers, but concurrently associated with the perception of less anti-smoking norms by best friends. We therefore consider it is important to complement SFSPs with programmes that specifically target anti-smoking norms in adolescent peer groups.

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

	Total pop.	**Adolescent perceived SFSPs**			**Staff reported SFSPs**		
		Weak	**Inter mediate**	**Strong**	**Weak**	**Inter mediate**	**Strong**
	(%)	**(%)**	**(%)**	**(%)**	**(%)**	**(%)**	**(%)**
Total (N)	10653	3949	3854	2850	4260	2569	3824
(%)	100.0	37.1	36.2	26.7	40.0	24.1	35.9
Age							
14	31.9	34.0	34.4	31.6	41.6	27.0	31.3
15	45.6	39.2	33.9	27.0	39.5	23.9	36.6
16	22.5	37.2	43.4	19.4	38.7	20.4	40.9
Gender							
Female	51.2	38.4	32.1	29.5	35.7	25.4	38.8
Male	48.8	35.7	40.4	23.9	44.5	22.7	32.8
City							
Namur	13.6	0.0	73.9	26.1	54.4	25.0	19.5
Tampere	15.1	0.0	29.1	70.9	0.0	13.6	86.4
Hannover	9.9	7.1	55.8	37.1	18.6	65.8	15.6
Dublin	16.6	6.7	48.6	44.6	29.2	29.4	41.4
Latina	15.6	100.0	0.0	0.0	76.2	3.4	20.4
Amersfoort	15.8	81.5	18.5	0.0	81.5	18.5	0.0
Coimbra	13.4	50.6	38.7	10.8	7.2	28.3	64.6
Migration background							
None	76.4	39.8	34.3	25.9	40.9	21.9	37.2
One parent	12.3	30.4	39.2	30.4	39.3	26.0	34.7
Two parents	11.3	25.9	44.4	28.7	34.5	36.8	28.7
Parental smoking							
No smoker	65.7	35.7	34.7	29.6	40.6	22.9	36.5
One smoker	22.3	39.8	37.9	22.3	40.0	25.2	34.8
Two smokers	12.0	39.6	40.7	19.7	36.5	28.7	34.7
Mother education level							
Low	13.1	56.6	35.1	8.3	41.5	27.2	31.3
Middle	32.4	39.2	37.8	23.1	39.3	22.9	37.8
High	39.5	32.7	33.4	33.9	42.6	22.6	34.8
Unknown	15.0	26.9	41.0	32,0	33.4	27.7	38.7
Father education level							
Low	17.2	51.8	37.7	10.6	40.4	24.6	35.0
Middle	29.2	39.7	36.4	23.8	39.6	22.9	37.5
High	35.4	33.6	31.4	35.1	44.4	22.1	33.6
Unknown	18.2	25.8	43.7	30.5	31.6	29.7	38.7
School connectedness							
Connected	66.3	38.4	34.2	27.5	41.1	23.2	35.7
Unconnected	33.7	34.5	40.1	25.4	37.7	26.0	36.3
Smoking prevalence							
%	10.1%	14.0	9.0	6.2	12.8	8.1	8.4

Note: Percentages in rows.

Table 2. Individual-level anti-smoking norms (in %) at the best friend teacher and societal levels, stratified by adolescent perceived SFSPs and staff reported SFSPs

	Total pop.	**Adolescent perceived SFSPs**			**Staff reported SFSPs**		
		Weak	**Interm,**	**Strong**	**Weak**	**Interm.**	**Strong**
Total	100.0	37.1	36.2	26.7	40.0	24.1	35.9
Best friend norms							
No strong anti-smoking	74.2	79.0	69.7	73.6	76.5	68.9	75.3
Strong anti-smoking	25.8	21.0	30.3	26.4	23.5	31.1	24.7
Teacher norms							
No strong anti-smoking	58.2	66.7	58.7	45.5	64.1	57.6	51.9
Strong anti-smoking	41.8	33.3	41.3	54.5	35.9	42.4	48.1
Societal norms							
No strong anti-smoking	87.4	89.2	84.9	88.4	86.7	84.2	90.3
Strong anti-smoking	12.6	10.8	15.1	11.6	13.3	15.8	9.7

Note: Percentages in columns.

Table 3. Associations between adolescent perceived SFSPs and the anti-smoking norm outcomes, while controlling for all covariates.

	Odds ratio (95% confidence interval)		
	Best friend norms	**Teacher norms**	**Societal norms**
Adolescent perceived SFSPs	0.81 (0.67 – 0.99)*	1.46 (1.15 – 1.85)*	0.87 (0.74 – 1.02)
School connectedness			
Connected	REF	REF	REF
Unconnected	0.74 (0.67 – 0.82)*	0.64 (0.58 – 0.71)*	0.86 (0.76 – 0.98)*
Age			
14	REF	REF	REF
15	0.76 (0.68 – 0.85)*	0.82 (0.74 – 0.91)*	1.00 (0.87 – 1.14)
16	0.70 (0.61 – 0.80)*	0.70 (0.61 – 0.80)*	0.76 (0.63 – 0.90)*
Gender			
Female	REF	REF	REF
Male	0.52 (0.47 – 0.58)*	0.90 (0.83 – 0.99)*	1.30 (1.16 – 1.47)*
City			
Namur	REF	REF	REF
Tampere	0.32 (0.24 – 0.43)*	2.91 (2.02 – 4.20)*	0.38 (0.29 – 0.50)*
Hannover	0.43 (0.31 – 0.59)*	1.62 (1.12 – 2.34)*	1.93 (1.51 – 2.47)*
Dublin	0.95 (0.70 – 1.29)	10.01 (6.76 – 14.83)*	0.80 (0.62 – 1.03)
Latina	0.28 (0.20 – 0.40)*	2.63 (1.70 – 4.09)*	0.14 (0.10 – 0.20)*
Amersfoort	0.33 (0.23 – 0.49)*	1.93 (1.22 – 3.08)*	1.08 (0.81 – 1.44)
Coimbra	0.66 (0.48 – 0.89)*	2.29 (1.55 – 3.38)*	0.50 (0.38 – 0.65)*
Migration background			
None	REF	REF	REF
One parent	1.07 (0,93 – 1.22)	0.95 (0.83 – 1.09)	1.01 (0.85 – 1.21)
Two parents	1.32 (1.14 – 1.53)*	0.82 (0.71 – 0.95)*	1.30 (1.09 – 1.54)*
Parental smoking			
No smoker	REF	REF	REF
One smoker	0.76 (0.68 – 0.86)*	1.08 (0.97 – 1.20)	0.80 (0.69 – 0.93)*
Two smokers	0.63 (0.54 – 0.73)*	1.14 (1.00 – 1.31)	0.80 (0.66 – 0.98)*
Mother's education level			
Low	REF	REF	REF
Middle	0.93 (0.79 – 1.10)	0.96 (0.83 – 1.09)	0.96 (0.77 – 1.19)
High	1.01 (0.85 – 1.20)	0.82 (0.71 – 0.95)*	1.02 (0.81 – 1.28)
Unknown	1.05 (0.85 – 1.30)	0.93 (0.76 – 1.14)	1.11 (0.85 – 1.45)
Father's education level			
Low	REF	REF	REF
Middle	1.01 (0.87 – 1.18)	1.00 (0.87 – 1.15)	0.99 (0.81 – 1.22)
High	1.16 (0.99 – 1.36)	1.14 (0.98 – 1.33)	1.06 (0.86 – 1.30)
Unknown	1.10 (0.91 – 1.33)	1.14 (0.96 – 1.37)	0.98 (0.77 – 1.25)
School smoking prevalence (per 10% increase)	0.87 (0.77 – 1.00)*	0.81 (0.70 – 0.95)*	1.16 (1.03 – 1.32)*

Note: ORs represent the odds of strong anti-smoking norms (vs. no strong anti-smoking norm) with a one point higher score for the covariate.
* Statistical significance at the 0.05 level.

Table 4. The association of adolescent perceived SFSPs and staff reported SFSPs with anti-smoking norm outcomes, per subgroup of school connectedness.

	Odds ratio (95% confidence interval)			
	Total Population	**Best friend norms**	**Teacher norms**	**Societal norms**
Adolescent perceived SFSPs	10653			
School connectedness[1]				
Connected	7066	0.84 (0.69 – 1.03)	1.44 (1.12 – 1.83)*	0.89 (0.75 – 1.05)
Unconnected	3587	0.74 (0.58 – 0.94)*	1.52 (1.16 – 2.00)*	0.83 (0.66 – 1.04)
Staff reported SFSPs				
School connectedness[1]				
Connected	7066	0.98 (0.90 – 1.06)	1.02 (0.92 – 1.14)	1.04 (0.97 – 1.11)
Unconnected	3587	0.96 (0.87 – 1.06)	1.04 (0.93 – 1.17)	0.99 (0.81 – 1.08)

* Statistical significance at the 0.05 level.

[1] The main effect within the different groups was calculated with the same interaction model, by changing the reference group for school connectedness and reporting the OR for the SFSPs variable.

Table 5. Interaction tests between SFSPs and school connectedness, with the anti-smoking norm outcomes. Student connected to school were coded 0, while unconnected students were coded 1.

	Odds ratio (95% confidence interval)		
	Best friend norms	**Teacher norms**	**Societal norms**
Adolescent perceived SFSPs			
SFSPs[1]	0.84 (0.69 – 1.03)	1.44 (1.12 – 1.83)*	0.89 (0.75 – 1.05)
School connectedness[12]	1.02 (0.63 – 1.65)	0.55 (0.35 – 0.86)*	1.03 (0.58 – 1.81)
SFSPs*connectedness	0.88 (0.73 – 1.06)	1.06 (0.89 – 1.26)	0.93 (0.75 – 1.16)
Staff reported SFSPs			
SFSPs[1]	0.98 (0.90 – 1.06)	1.02 (0.92 – 1.14)	1.04 (0.97 – 1.11)
School connectedness[2]	0.81 (0.50 – 1.31)	0.57 (0.37 – 0.90)*	1.13 (0.64 – 1.98)
SFSPs*connectedness	0.98 (0.91 – 1.06)	1.02 (0.95 – 1.09)	0.96 (0.87 – 1.05)

[1] Estimate for adolescents with school connectedness is 0.
[2] Estimate for SFSPs is 0.
* Statistical significance at the 0.05 level. All covariates were controlled for.