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Intergenerational social mobility, smoking and smokeless tobacco (snus) use among adolescents during 2008–2017



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HIGHLIGHTS

- Youth smoking and snus use are strongly associated with the educational track.
- The risk for tobacco use is elevated in downward-mobile and stable low adolescents.
- Absolute differences in smoking decreased while relative differences increased.
- Absolute and relative differences in snus use increased among boys.

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ABSTRACT

Background: Socioeconomic differences in smoking and other tobacco use are prevalent in adolescents. Less is known about the association between intergenerational social mobility and tobacco use.

Methods: Five waves of national cross-sectional School Health Promotion Study during 2008–2017 in Finland were used, including non-academically and academically oriented adolescents (15–21 years, N = 384,379). The adolescents' educational orientation was compared with the educational track of the parents as a proxy for intergenerational social mobility, which was used as the independent variable in regression models to examine the differences in daily smoking and daily snus use.

Results: Smoking declined in all mobility groups over time, but remained more prevalent among non-academically oriented adolescents among boys and girls. Daily snus use among boys increased over time in all mobility groups. Multiple adjusted models showed that upward mobility and downward mobility are differently associated with tobacco use, the latter increasing the probability of tobacco use compared with the stable high group (boys: smoking: OR = 5.24, 95% CI 5.02–5.46; snus use: OR = 1.57, 95% CI 1.50–1.66). In smoking, absolute socioeconomic differences between the mobility groups decreased over time while relative differences increased. In snus use, both absolute and relative differences increased.

Conclusions: Adolescent smoking and snus use associate strongly with the adolescent's educational track, irrespective of the social mobility class. Non-academically oriented adolescents have an increased risk of tobacco use. The academic and non-academic orientation should already be taken into account in tobacco use prevention in basic education.

1. Introduction

Smoking is a major preventable cause of morbidity and mortality. Smoking causes inequalities in health as those with a lower socioeconomic position (SEP) smoke more than those with a higher SEP (Ruokolainen, Heloma, Jousilahti, et al., 2019). Socioeconomic differences in smoking are already prevalent in adolescence, and while

smoking prevalence has mainly decreased, these differences have persisted or increased (de Looze, ter Bogt, Hublet, et al., 2013; Doku, Koivusilta, Rainio, & Rimpelä, 2010; Kuipers, Nagelhout, Willemsen, & Kunst, 2014). It has been suggested that individual SEP is a stronger predictor of socioeconomic differences in smoking in adolescents than parental SEP (Doku et al., 2010; Kuntz & Lampert, 2013; Paavola, Vartiainen, & Haukkala, 2004). Academic orientation or educational

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track are common measures when examining inequalities in adolescent health (Hagquist, 2007).

In Finland, after nine years of compulsory education, two tracks are available: academically oriented general upper secondary education and work-life oriented vocational education and training. In 2016, 53% of those who finished the comprehensive school continued their studies in general upper secondary school and 42% in vocational education and training (Statistics Finland, 2017). In 2017, 85% of new university graduates had completed general upper secondary education, whereas 9% had completed vocational education (Vipunen, 2018). Studies show large differences in smoking between Finnish academically oriented and non-academically oriented adolescents (Tseveenjav, Pesonen, & Virtanen, 2015). Other European studies confirm this gradient in adolescent smoking (Doku et al., 2010; Kuntz & Lampert, 2013; Øverland, Tjora, Hetland, & Aarø, 2010; Pedersen & von Soest, 2017).

Less is known about the SEP differences in smoking in the context of intergenerational social mobility, especially over time. Intergenerational social mobility refers to a situation where adolescents are on a different educational track than that of their parents. Two studies from Finland imply that upward (downward) mobility is associated with smaller (greater) likelihood of smoking among adolescents (Karvonen, Rimpelä, & Rimpelä, 1999; Paavola et al., 2004). A Swedish study suggests that smoking predicts downward social mobility, whereas not smoking predicts upward mobility (Novak, Ahlgren, & Hammarstrom, 2012). The likelihood of smoking among stable low and downward-mobile adolescents was greater in comparison with the stable high or upward-mobile German adolescents (Kuntz & Lampert, 2013).

In Finland, snus (Swedish type moist snuff) use has increased in recent years (National Institute for Health and Welfare, 2018). Selling snus is prohibited in all EU-countries except Sweden, and as Finland shares a border with Sweden, importing snus to Finland for personal use is relatively common. Only a few studies considering snus use and adolescent SEP have been published. They indicate that differences in snus use according to adolescent SEP seem non-existent or reversed compared with smoking (Mattila, Raisamo, Pihlajamäki, Mantysaari, & Rimpelä, 2012; Øverland et al., 2010; Tseveenjav et al., 2015). One study in Norway examined tobacco use, including snus use, and SEP during 2004–2007 and found no changes in these associations (Øverland et al., 2010). To our knowledge there are no studies about the association of snus use with intergenerational social mobility.

1.1. The research questions

The aim of this study was to examine the association between intergenerational social mobility and tobacco use among adolescents during 2008–2017. Our two research questions are as follows: Have daily smoking and snus use changed among social mobility groups during 2008–2017? Do parental smoking and unemployment, as well as the price of tobacco, explain the differences in smoking and snus use between social mobility groups?

2. Materials and methods

2.1. Participants and procedures

Data came from five waves (2008/2009, 2010/2011, 2013, 2015, 2017) of the national repeated cross-sectional School Health Promotion Study. After excluding missing observations (4%), the overall number of participants was $N = 384,379$ (if not otherwise noted, missing observations were omitted). The data is collected from first and second year students in general upper secondary schools and students in vocational schools (age distribution: 15–21 years old). Before the year 2013, the study was implemented in Southern, Eastern and Northern Finland in even-numbered years and in Western and Central Finland in odd-numbered years. Odd- and even-numbered years were pooled for

national estimates. From 2013 onwards, the study has been carried out nationwide every second year. The survey is conducted as an anonymous and voluntary classroom questionnaire that was available in Finnish, Swedish, English and Russian. The study protocol was accepted by the Institutional Review Board of the National Institute for Health and Welfare.

All Finnish schools providing youth education are invited to participate in the survey. The estimated coverage rate of the survey is based on student enrolment statistics from Statistics Finland. The coverage declined throughout the years for upper secondary school students (74% during 2008–2009, 55% in 2017). The lower coverage in 2015–2017 is mostly due to technical problems in the electronic questionnaire, introduced to the survey in 2015. The technical problems occurred randomly and the corresponding research team has estimated that the data was not skewed and comparability to earlier study waves was obtained on the national level (personal communication). Distributions of the demographic variables (gender, age, maternal/paternal education) 2013 onward supports this (not shown). For vocational schools, the coverage cannot be reliably estimated due to inexact student enrolment statistics.

2.2. Variables

2.2.1. Outcome variables

A daily smoking index was formed of two questions: ‘How many cigarettes, pipefuls and cigars have you smoked altogether?’ (‘None’, ‘Just one’, ‘About 2–50’, ‘More than 50’) and ‘Which of the following alternatives best describes your current smoking habits?’ (‘I smoke once a day or more often’, ‘I smoke once a week or more often, but not every day’, ‘I smoke less often than once a week’, ‘I have quit smoking [temporarily or permanently]’). Those, who had smoked at least two cigarettes and reported smoking daily, were classified as daily smokers. Respondents who did not answer both of the questions were omitted ($n = 442$ of the final data). Snus use was assessed with a question ‘Have you ever used snus?’ with answer options ‘Not at all’, ‘I have tried it once or twice’, ‘I use it now and then’, ‘I use it every day’ (classified as daily users of snus), and ‘I used to use it, but I quit’. As daily snus use among the girls in the study was almost nonexistent (0.4% in 2008–2017), it was only further examined among boys.

2.2.2. Main predictor variable

The school type of the participants was used as a proxy for individual-level SEP. General upper secondary education is interpreted as academically oriented education and vocational education is interpreted as non-academically oriented education. The respondent's SEP was used together with parental education level to compute the variable describing potential intergenerational social mobility. Maternal and paternal education was dichotomised as high education (university or other tertiary education) or other education. Following the dominance approach (Erikson, 2006), a variable for parental education was categorised (‘At least one parent has a high level of education’, ‘Both parents have a lower level of education’). Academically oriented adolescents with at least one highly educated parent were classified as stable high, and adolescents in academically oriented education with parents with a lower level of education were classified as upward-mobile. Participants following a non-academic school track with parents with a lower level of education were classified as stable low, and non-academically oriented adolescents with highly educated parents were classified as downward-mobile.

2.2.3. Covariates

A continuous age variable from 15 to 21 was used. The missing observations ($n = 7706$ of the final data) were replaced by the mean age according to the school level, gender and the study year. Since the nationwide data collection was carried out in two subsequent years in 2008–2009 and in 2010–2011, these years were pooled together. Thus,

the study variable consisted of five time points (2008–2009, 2010–2011, 2013, 2015, 2017). The smoking status of the mother and father was reported by the adolescent (as either ‘He or she is a non-smoker’, ‘He or she has smoked’, ‘He or she is a current smoker’, ‘I do not know’). The missing observations for the variable ($n = 11,708$ of the final data) were classified as ‘Did not report’. A dichotomous variable describing the unemployment of the parents (past 12 months) was used (‘Not unemployed’, ‘At least one parent is unemployed’).

The real price index of cigarettes and snus price index during 2008–2017 were used in multiple adjusted models. These data were obtained from Statistics Finland and Statistics Sweden. The mean value of the annual averages of two subsequent years was used to match the snus/cigarette price index with the corresponding year variable. As the snus that is being used in Finland comes exclusively from Sweden, the price of snus and its changes in Sweden were used.

2.3. Statistical analyses

Cross-tabulations and Pearson's χ^2 -tests were used to observe the differences in daily smoking among demographic variables and over time in the social mobility groups. Both absolute and relative differences in tobacco use were calculated to support the interpretation of whether the differences between mobility groups changed over time (Hoebel, Kuntz, Kroll, et al., 2018; Homma, Saewyc, & Zumbo, 2016). Absolute changes were calculated as percentage point changes in tobacco use within a social mobility group, while relative changes were calculated as prevalence ratios between the social mobility groups (group with the highest prevalence in a given study year/group with the lowest prevalence in a given study year).

After the descriptive analyses, logistic regression was used to test the statistical significance of the trend for the prevalence of daily smoking and daily snus use, applying the method used in earlier studies (Hoebel et al., 2018). For this analysis, study year as a continuous variable was used as the independent variable (range [0,1]): 2008–2009 was coded as 0.000, 2010–2011 as 0.143, 2013 as 0.429, 2015 as 0.714, and 2017 as 1.000. The analyses were stratified by gender and social mobility class. Multiple adjusted associations of smoking and snus use with intergenerational mobility were further analysed with binary logistic regression (Tables 2 and 3). Model 1 included social mobility, age and study year (encoded from 1 to 5). The smoking status of parents and parental unemployment were added to Model 2. The real price index for cigarettes (only for daily smoking) and the snus price index (only for daily snus use) were added to the final model (Model 3). In the Model 4, interaction term between study year and social mobility class was introduced to test whether smoking and snus use differed between the social mobility classes according to time. In all analyses, a 95% confidence level was applied. The software used was StataSE 15.1.

3. Results

3.1. Descriptive analyses

Daily smoking was more prevalent among adolescents in vocational schools and those in the stable low and downward-mobile groups (Table 1). The offspring of less educated parents, parents with recent unemployment, and parents who smoke, smoked more often than their counterparts. Among all demographic variables, smoking was more prevalent in the beginning than at the end of the study period.

Daily smoking in boys and girls was more prevalent among stable low and downward-mobile adolescents compared with the stable high and upward-mobile groups (Fig. 1). Smoking declined in all subgroups over time among both genders (trend for all subgroups, $p < .001$). Daily snus use prevalence was around 4% in 2008–2009, and was the most common among downward-mobile boys for the whole study period (Fig. 2). Snus use increased over time among all subgroups

($p < .001$ for the trend). During 2015–2017, the increase only continued in the non-academic oriented groups. Absolute changes in smoking prevalence over the study period showed a steeper decline in the downward-mobile group (22% for boys, 16% for girls), indicating a decrease in absolute differences in smoking between socioeconomic groups. However, the relative differences between social mobility groups increased during this time; for boys the prevalence ratio increased from 3.95 to 8.94, and for girls from 4.05 to 8.68. In snus use among boys, socioeconomic differences widened as the absolute increase among the downward-mobile group was greater (14%) than the increase in other groups. The relative differences in snus use between social mobility groups also increased (prevalence ratio in 2008–2009 1.80 vs. 3.02 in 2017).

3.2. Multiple adjusted analyses

Table 2 shows the association of daily smoking by intergenerational social mobility groups when several covariates are added in the model. Smoking was more likely among the stable low and downward-mobile adolescents when compared with the stable high adolescents in each model. Smoking was less likely among the upward-mobile adolescents when compared with the stable high adolescents (Model 3). The findings were parallel among boys and girls. The estimates for intergenerational mobility groups among boys showed similar but weaker associations with daily snus use than with daily smoking (Table 3). Compared with the stable high group, adolescents in the upward-mobile group were less likely to use snus, but adolescents in the downward-mobile group were more likely to use snus (Model 3).

Statistically significant interactions between intergenerational social mobility and the study year indicated that the change over time in smoking and snus use was not the same for the different social mobility classes (Tables 2 and 3, Model 4). Analyses stratified by study year (Supplementary Table 1, 2 and 3; the price variables omitted from the models because of collinearity) showed, however, similar associations to the pooled analysis (Model 3).

4. Discussion

We studied adolescent SEP and tobacco use in the context of intergenerational social mobility in Finland during 2008–2017. Our main result is that daily smoking among youth differentiates strongly with the school type, irrespective of social mobility. That is, adolescents in vocational schools are more likely to smoke than adolescents on a more academic-oriented educational track. Our results show a decline in smoking prevalence and in absolute socioeconomic differences in smoking. Relative differences between socioeconomic groups in smoking still increased. Among boys, an increasing trend for snus use was detected, especially among non-academically oriented groups, indicating increasing absolute and relative socioeconomic differences in snus use. Parental background and the price of tobacco had a modest effect on the examined associations.

The stable low and downward-mobile groups were more likely to smoke and the upward-mobile group was less likely to smoke when compared with the stable high group. This supports earlier findings on the association between smoking and intergenerational social mobility (Karvonen et al., 1999; Kuntz & Lampert, 2013; Novak et al., 2012). Adolescent smoking is more clearly associated to the school type than to the social mobility class. As parental SEP is included in the social mobility variable but absent from the school type variable, the adolescent's SEP might be more important than parental SEP when examining smoking (Paavola et al., 2004).

When several demographic factors were taken into account, the association between smoking and intergenerational mobility was attenuated but remained statistically significant. The observed difference in smoking between the stable high group and the upward-mobile group was reversed when the characteristics of the parents were taken into

Table 1
Daily smoking by demographic variables in 2008–2017 by study wave, N^a and %^b.

	2008–2009		2010–2011		2013		2015		2017		Total (2008–2017)		p ^c
Age in years, mean (SD)	17.6 (0.82)	88,624	17.6 (0.84)	87,760	17.7 (0.86)	80,764	17.6 (0.90)	68,243	17.2 (1.16)	58,988	17.6 (0.89)	384,379	
	%	N	%	N	%	N	%	N	%	N	%	N	
Daily smoking	23.1	88,624	23.8	87,760	19.5	80,764	16.5	68,243	11.7	58,988	19.6	384,379	
Gender													< 0.001
Boys	24.8	42,559	25.9	42,695	20.6	38,423	16.8	32,068	12.3	28,505	20.9	184,250	
Girls	21.4	46,065	21.8	45,065	18.5	42,341	16.2	36,175	11.2	30,483	18.41	200,129	
School type													< 0.001
General	10.2	49,361	10.6	47,595	8.1	47,412	5.6	38,262	3.3	33,468	7.9	216,098	
Vocational	39.2	39,263	39.4	40,165	35.8	33,352	30.4	29,981	22.8	25,520	34.5	168,281	
Intergenerational social mobility													< 0.001
Stable high	9.8	24,712	10.5	23,665	7.7	28,353	5.1	22,869	2.8	20,808	7.3	120,407	
Upward mobile	10.6	24,649	10.7	23,930	8.7	19,059	6.4	15,393	4.0	12,660	8.7	95,691	
Downward mobile	40.0	8659	40.1	9124	34.8	9571	28.8	8739	20.2	7959	33.1	44,051	
Stable low	39.0	30,604	39.2	31,041	36.2	23,781	31.1	21,243	24.0	17,561	35.0	124,230	
Daily snus use ^d													< 0.001
No	24.7	40,838	26.0	40,414	20.7	35,099	16.3	28,519	11.6	24,940	20.8	169,810	
Yes	27.5	1721	25.2	2281	20.2	3324	21.0	3549	17.3	3565	21.3	14,440	
Parental education													< 0.001
Both parents less educated	26.3	55,253	26.8	54,971	24.0	42,840	20.7	36,636	15.6	30,221	23.6	219,921	
At least one parent highly educated	17.6	33,371	18.8	32,789	14.5	37,924	11.6	31,607	7.6	28,767	14.2	164,459	
Mother's education													< 0.001
Other	25.6	62,938	26.0	62,557	23.0	49,966	19.7	42,533	14.7	35,365	22.7	253,359	
High education	16.8	25,686	18.4	25,203	14.0	30,798	11.2	25,710	7.3	23,623	13.6	131,020	
Father's education													< 0.001
Other	25.6	66,095	26.2	65,823	22.7	54,642	19.6	46,816	14.5	39,542	22.5	272,918	
High education	15.7	22,529	16.7	21,937	12.9	26,122	9.9	21,427	6.2	19,446	12.5	111,461	
Mother's smoking status													< 0.001
Has not smoked	15.5	52,151	16.2	52,268	12.7	49,768	10.3	42,176	6.8	37,275	12.7	233,638	
Has quit	30.0	14,914	31.6	14,936	27.3	13,674	22.7	11,879	17.6	8293	26.8	63,696	
Smokes	39.6	16,967	41.2	16,349	37.1	13,560	33.0	11,270	26.5	8999	36.6	67,145	
Do not know	23.0	3096	22.9	3155	20.2	2912	17.3	2543	12.7	1753	20.0	13,459	
Did not report	27.6	1496	25.7	1052	13.4	850	16.0	375	12.2	2668	18.4	6441	
Father's smoking status													< 0.001
Has not smoked	13.9	38,245	14.3	38,678	11.3	37,356	8.8	31,563	5.9	29,315	11.2	175,157	
Has quit	26.6	21,331	27.6	21,035	23.5	19,472	19.5	16,716	14.8	12,768	23.2	91,322	
Smokes	34.9	22,724	36.5	21,978	31.9	18,585	28.4	15,420	21.8	12,115	31.8	90,822	
Do not know	21.7	5014	23.4	5034	20.4	4609	18.6	4230	13.5	2924	20.1	21,811	
Did not report	31.5	1310	31.5	1035	16.7	742	20.1	314	14.6	1866	22.8	5267	
Parental unemployment													< 0.001
None	21.2	64,847	21.8	60,532	17.5	57,530	14.3	45,799	10.3	40,314	17.7	269,022	
At least one	28.1	23,777	28.2	27,228	24.7	23,234	21.0	22,444	14.9	18,674	23.9	115,357	

^a Number of respondents altogether.

^b Proportion of daily smokers.

^c P-value of Pearson chi-squared test between study year and demographic variable among daily smokers.

^d Only among boys.

account. Additional analyses showed that parental smoking had a stronger influence on this association than parental unemployment, and the smoking of mothers and fathers influenced the association similarly (data not shown). The well-known association between parental and adolescent smoking (Rainio, Rimpelä, Luukkaala, & Rimpelä, 2008; Vuolo, & Staff, J., 2013) seems to also apply in the context of

intergenerational social mobility, and appears to have an effect on smoking, especially among the upward-mobile adolescents. Surprisingly, the price of cigarettes had a negligible effect on the association between social mobility and smoking. In sensitivity analyses, the price of cigarettes was included in the model before parental factors, showing hardly any effect on the association (data not shown). This implies that

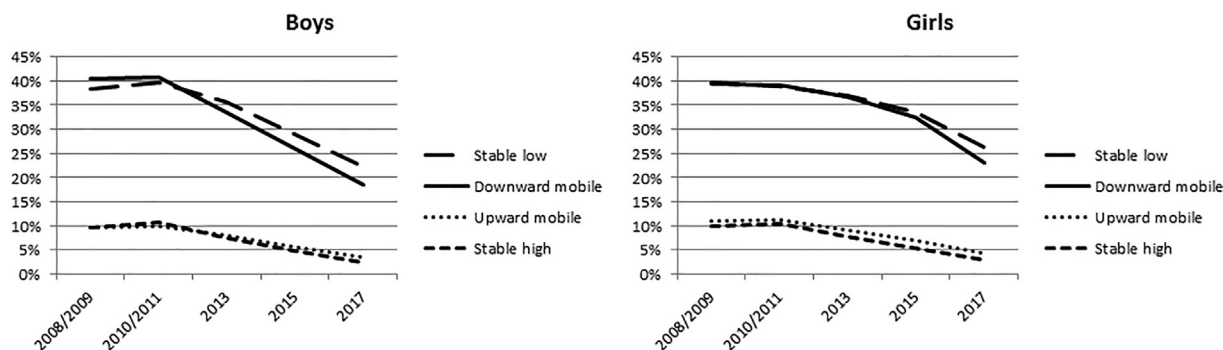


Fig. 1. Daily smoking among boys and girls by intergenerational social mobility, 2008–2017 (%).

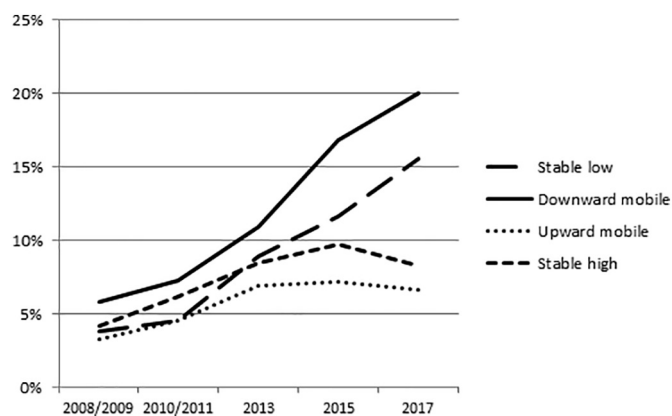


Fig. 2. Daily snus use among boys by intergenerational social mobility, 2008–2017 (%).

other parental or individual characteristics influencing youth smoking might impact on the availability of cigarettes and reduce the effect of the actual price per se. In future studies, family affluence or SEP should be measured with several indicators (Laaksonen, Rahkonen, Karvonen, & Lahelma, 2005). The stratified analysis by study year (Supplementary Tables 1, 2 and 3) revealed that the associations between social mobility groups and smoking/snus use differed only a little in different study years. One explanation for the observed significant interaction terms (study year*social mobility, see Tables 2 and 3, model 4) could be the rather large number of observations on the data.

In boys, the association between snus use and social mobility was similar to smoking when all examined demographic variables were taken into account. Earlier studies have shown that SEP and other characteristics may be different for snus users than for smokers (Mattila et al., 2012; Øverland et al., 2010), but the characteristics probably overlap since the concurrent use of these products is common (Tseveenjav et al., 2015). The differences in snus use between academically oriented and non-academically oriented adolescents were not as pronounced as with smoking, however, the differences increased over time. Snus use may contribute to widening inequalities in health if the current trend continues. It is also notable that in 2017 the prevalence of snus use was higher than that of smoking among boys except among the stable low adolescents. This change in tobacco use should be taken into account when designing both preventive and legislative measures. As snus consumption has increased in Finland (National Institute for Health and Welfare, 2018), possible new policy actions should be considered to restrict the availability of snus even more. Probably, no strong opposition would occur as the acceptance of strict tobacco control policy is high in Finland (Ruokolainen et al., 2018). Studying the possible regional differences in both snus use and social mobility within Finland would be an interesting theme for further studies. The price of snus did not affect the association between snus use and SEP. One explanation could be that the price index of snus in Sweden does not correlate to the actual prices at which snus is sold (il)legally in Finland. The price elasticity found in cigarettes is also present in the demand for smokeless tobacco (Jawad, Lee, Glantz, & Millett, 2018), so price rises could be recommended in order to prevent the increase in snus use.

It is undecided which tobacco control policies help to reduce the socioeconomic differences in smoking among adolescents (Brown, Platt, & Amos, 2014; Kuipers, Monshouwer, van Laar, & Kunst, 2015). Price has been shown to be effective in decreasing adolescent smoking (Ross & Chaloupka, 2003). Several tax increases were enacted during 2008 and 2017 in Finland, raising the nominal price of cigarettes by 63% (National Institute for Health and Welfare, 2018). In the Netherlands, nationally implemented policies (for example, a ban on the sale of cigarettes to children and national mass media campaigns) decreased

smoking among adolescents, but increased the socioeconomic differences in smoking (Kuipers et al., 2014). A quasi-experimental study suggested that the implementation of point-of-sale bans in Europe decreased smoking, caused by the further denormalization of smoking rather than by actually decreasing the accessibility of tobacco (van Hurck, Nuyts, Monshouwer, Kunst, & Kuipers, 2018). A total ban on tobacco use on all school premises came into force in 2010. Smoking continued to decline and snus use continued to increase after this enactment. It is possible that some of the smokers switched to use snus during this time. However, longitudinal data for answering this question would be needed. The point-of-sale ban was enacted in Finland in 2012. Smoking decreased from the period 2010–2011 to 2013 among adolescents. In terms of the denormalization of smoking, the endgame policy (McDaniel, Smith, & Malone, 2016) was incorporated in the objective of the Tobacco Act in 2010 and expanded further in 2016. The objective is to end the use of tobacco (and since 2016, also the use of other nicotine-containing products) altogether instead of just restricting it (Finlex, 2016). This will be reached if 5% or less of population use tobacco or nicotine products daily. It is possible that mass media communication on this strong denormalization policy, together with consecutive tax increases since 2009, may have influenced the declining smoking rates among adolescents (Pekurinen & Valtonen, 1987).

As Finnish policy aims at both tackling inequalities in health (Melkas, 2013) and ending the use of tobacco products, our results indicate that further actions are needed. As non-academic orientation and low school performance predict smoking (Pennanen, Haukkala, de Vries, & Vartiainen, 2011), prevention should be targeted more on adolescents with such an orientation and performance. Prevention should include, in addition to cigarettes, also other tobacco products, especially among boys. More strict policy actions, as well as support for stopping snus use, are needed in order to reach the objective of a tobacco-free society.

4.1. Strengths and limitations

The strengths of this study are that the School Health Promotion Study is a large nationwide survey and the questions are comparable over the study period. We were able to take into account several demographic factors. The declining coverage rate of the survey in general and the fact that the coverage cannot be estimated for vocational schools need to be taken into account when interpreting the results. A lower educational level predicts both non-responsiveness and smoking (Kopra, Härkänen, Tolonen, & Karvanen, 2015; Reinikainen, Tolonen, Borodulin, et al., 2018). There are probably more vocational school pupils among the non-respondents, and the socioeconomic differences in tobacco use may be larger than observed in this study. School dropout has been found to predict smoking (Pedersen & von Soest, 2017). Those adolescents who leave school after basic education (5%) were not included in our study population. Education as a proxy for socioeconomic status is not without its challenges (Gagné, Lee, Steinmetz-Wood, & Frohlich, 2018). As the education of adolescents is still in progress, we can only interpret the social mobility as potential social mobility. Another limitation is that the data is self-reported and students might deny smoking (Patrick et al., 1994). However, the questionnaire was anonymous, which might reduce the possibility of misreporting.

4.2. Conclusions

Adolescent smoking and snus use is strongly associated with the educational track, irrespective of the social mobility class and there are vast differences in tobacco use between these groups. During the study period, absolute differences in smoking between social mobility groups declined while relative differences increased. In snus use, both the absolute and the relative differences increased. To fight inequalities in

Table 2
Associations of daily smoking by intergenerational social mobility and demographic variables among boys and girls, 2008–2017. Odds ratios (OR) and their 95% confidence intervals (95% CI).

	Boys						Girls									
	Model 1 ^a		Model 2 ^b		Model 3 ^c		Model 4 ^d		Model 1 ^a		Model 2 ^b		Model 3 ^c		Model 4 ^d	
	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Intergenerational social mobility	1.00		1.00		1.00		1.00		1.00		1.00		1.00		1.00	
Stable high	1.05	1.00 to 1.10	0.85	0.81 to 0.89	0.85	0.81 to 0.90	0.72	0.65 to 0.81	1.20	1.15 to 1.25	0.92	0.89 to 0.96	0.93	0.89 to 0.97	0.82	0.75 to 0.89
Upward mobile	6.08	5.83 to 6.34	5.20	4.98 to 5.43	5.24	5.02 to 5.46	4.82	4.39 to 5.30	6.50	6.22 to 6.78	5.45	5.24 to 5.69	5.48	5.24 to 5.73	4.18	3.78 to 4.63
Downward mobile	6.37	6.14 to 6.61	4.64	4.47 to 4.82	4.68	4.51 to 4.86	3.45	3.18 to 3.74	6.69	6.47 to 6.92	4.52	4.36 to 4.68	4.56	4.40 to 4.72	3.23	2.99 to 3.49
Stable low	0.81	0.80 to 0.82	0.81	0.80 to 0.82	1.04	1.00 to 1.08	0.96	0.91 to 1.01	0.84	0.83 to 0.85	0.84	0.83 to 0.85	1.07	1.03 to 1.12	0.99	0.94 to 1.04
Study year																
Mother's smoking status																
Has not smoked	1.00		1.00		1.00		1.00		1.00		1.00		1.00		1.00	
Has quit	1.59	1.54 to 1.65	1.59	1.54 to 1.65	1.59	1.54 to 1.64	1.59	1.53 to 1.64	1.87	1.81 to 1.93	1.87	1.81 to 1.93	1.86	1.80 to 1.93	1.86	1.80 to 1.92
Smokes	2.00	1.93 to 2.07	2.00	1.93 to 2.07	2.00	1.94 to 2.07	2.00	1.93 to 2.07	2.59	2.51 to 2.67	2.59	2.51 to 2.67	2.59	2.51 to 2.67	2.58	2.50 to 2.66
Do not know	1.25	1.17 to 1.33	1.25	1.17 to 1.33	1.25	1.17 to 1.33	1.24	1.16 to 1.33	1.30	1.20 to 1.40	1.30	1.20 to 1.40	1.29	1.19 to 1.39	1.29	1.19 to 1.39
Did not report	1.00	0.92 to 1.10	1.00	0.92 to 1.10	1.04	0.95 to 1.14	1.04	0.95 to 1.14	0.95	0.84 to 1.07	0.95	0.84 to 1.07	0.98	0.87 to 1.11	0.98	0.87 to 1.11
Father's smoking status																
Has not smoked	1.00		1.00		1.00		1.00		1.00		1.00		1.00		1.00	
Has quit	1.74	1.68 to 1.80	1.74	1.68 to 1.80	1.73	1.68 to 1.79	1.73	1.68 to 1.79	1.62	1.57 to 1.68	1.62	1.57 to 1.68	1.62	1.57 to 1.68	1.62	1.56 to 1.67
Smokes	2.13	2.05 to 2.20	2.13	2.05 to 2.20	2.12	2.05 to 2.20	2.12	2.05 to 2.19	1.98	1.91 to 2.05	1.98	1.91 to 2.05	1.97	1.91 to 2.04	1.97	1.91 to 2.04
Do not know	1.34	1.27 to 1.43	1.34	1.27 to 1.43	1.34	1.26 to 1.42	1.34	1.26 to 1.42	1.30	1.23 to 1.38	1.30	1.23 to 1.38	1.30	1.23 to 1.38	1.30	1.22 to 1.38
Did not report	1.30	1.18 to 1.43	1.30	1.18 to 1.43	1.33	1.21 to 1.47	1.33	1.21 to 1.47	1.40	1.26 to 1.57	1.40	1.26 to 1.57	1.44	1.29 to 1.61	1.43	1.28 to 1.60
Unemployment of parents																
None	1.00		1.00		1.00		1.00		1.00		1.00		1.00		1.00	
At least one	1.08	1.05 to 1.11	1.08	1.05 to 1.11	1.08	1.05 to 1.11	1.08	1.05 to 1.11	1.10	1.08 to 1.13	1.10	1.08 to 1.13	1.11	1.08 to 1.13	1.11	1.08 to 1.14
Real price index for cigarettes																
Study year*intergenerational social mobility																
Stable high																
Upward mobile																
Downward mobile																
Stable low																
N	184,250		184,250		184,250		184,250		200,129		200,129		200,129		200,129	

^a Adjusted for age and study year.
^b Model 1 + smoking of mother/father, unemployment of parents.
^c Model 2 + the real price index for cigarettes.
^d Model 3 + interaction term study year*intergenerational social mobility.

Table 3

Associations of daily snus use by intergenerational social mobility and demographic variables among boys, 2008–2017. Odds ratios (OR) and their 95% confidence intervals (95% CI).

	Model 1 ^a		Model 2 ^b		Model 3 ^c		Model 4 ^d	
	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Intergenerational social mobility								
Stable high	1.00		1.00		1.00		1.00	
Upward mobile	0.78	0.73 to 0.82	0.73	0.69 to 0.77	0.73	0.69 to 0.78	0.70	0.61 to 0.81
Downward mobile	1.68	1.60 to 1.77	1.56	1.49 to 1.64	1.57	1.50 to 1.66	0.82	0.72 to 0.94
Stable low	1.15	1.10 to 1.20	1.03	0.98 to 1.08	1.04	1.00 to 1.09	0.50	0.45 to 0.57
Study year	1.37	1.35 to 1.39	1.38	1.36 to 1.39	1.19	1.15 to 1.23	1.05	1.01 to 1.09
Mother's smoking status								
Has not smoked			1.00		1.00		1.00	
Has quit			1.35	1.29 to 1.42	1.35	1.28 to 1.41	1.34	1.28 to 1.41
Smokes			1.26	1.20 to 1.33	1.26	1.20 to 1.33	1.26	1.20 to 1.33
Do not know			1.38	1.26 to 1.52	1.38	1.26 to 1.51	1.38	1.26 to 1.51
Did not report			1.38	1.24 to 1.54	1.42	1.27 to 1.58	1.40	1.25 to 1.56
Father's smoking status								
Has not smoked			1.00		1.00		1.00	
Has quit			1.27	1.21 to 1.32	1.26	1.21 to 1.32	1.26	1.20 to 1.32
Smokes			1.21	1.15 to 1.27	1.21	1.15 to 1.27	1.21	1.15 to 1.27
Do not know			1.08	0.99 to 1.18	1.08	0.99 to 1.18	1.08	0.99 to 1.18
Did not report			1.47	1.29 to 1.66	1.49	1.32 to 1.69	1.47	1.30 to 1.67
Unemployment of parents								
None			1.00		1.00		1.00	
At least one			0.85	0.82 to 0.89	0.85	0.82 to 0.89	0.86	0.83 to 0.89
Snus price index					1.00	1.00 to 1.00	1.00	1.00 to 1.00
Study year*intergenerational social mobility								
Stable high							1.00	
Upward mobile							1.01	0.96 to 1.05
Downward mobile							1.22	1.17 to 1.26
Stable low							1.25	1.21 to 1.29
N	184,250		184,250		184,250		184,250	

^a Adjusted for age and study year.

^b Model 1 + smoking of mother/father, unemployment of parents.

^c Model 2 + snus price.

^d Model 3 + interaction term study year*intergenerational social mobility.

health, social mobility within academic and non-academic orientation should be better taken into account in smoking and tobacco use prevention. Actions tackling these inequalities should be carried out already in basic education.

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Contributors

O Ruokolainen, HO, JL, and O Rahkonen provided the original idea for the research. All statistical analyses were done by O Ruokolainen. The first draft was prepared by O Ruokolainen, all authors contributed in writing and editing the manuscript. All authors read and approved the final version of the manuscript.

Declaration of Competing Interest

All authors declare no competing interests.

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