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Trends in socioeconomic differences in daily smoking among 15-year-old Danes 1991-2014

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Abstract

Aim: To examine trends in socioeconomic differences in daily smoking among 15-year-old Danes 1991-2014, using occupational social class (OSC) as indicator of socioeconomic status.

Methods: The study included 15-year-olds participating in seven Danish Health Behaviour in School-aged Children (HBSC) studies 1991-2014, N= 8,641. The analyses focused on absolute socioeconomic differences (prevalence difference between low and high OSC) and relative socioeconomic differences communicated by odds ratio for daily smoking.

Results: The prevalence of daily smoking declined from 18.6% in 1991 to 4.5% in 2014. Across all surveys, the prevalence was 8.9% in high, 12.8% in middle and 16.5% in low OSC ($p < 0.0001$). The absolute socioeconomic differences increased from 1991 to 2006 and declined thereafter. Across all survey years, the OR (95% CI) for daily smoking was 1.40 (1.19-1.65) in middle and 1.90 (1.56-2.32) in low vs. high OSC. The statistical interaction between OSC and survey year was significant ($p = 0.0404$), suggesting increasing relative socioeconomic differences from 1991 to 2014.

Conclusion: There was a substantial decline in daily smoking among 15-year-olds 1991-2014 in all OSC groups. The prevalence of daily smoking was highest in the low OSC during the entire period. The absolute socioeconomic differences in daily smoking increased 1991-2006 and declined thereafter. The relative socioeconomic differences increased 1991-2014. Studies of change in socioeconomic differences over time should address both absolute and relative socioeconomic differences as they may result in different conclusions and because important improvement in prevalence patterns may be disguised by exclusive focus on changes in relative socioeconomic differences.

Key words: Adolescents, Denmark, smoking, socioeconomic differences, trend study

Introduction

Smoking in adolescence is a risk factor for continued smoking in adulthood [1-2] and for the harmful health consequences of smoking [3]. From a public health perspective, it is important to monitor developments in adolescent smoking across time with a special attention to groups of adolescents at increased risk of smoking.

The prevalence of smoking among adolescents has decreased over the past twenty years in many European countries and North America [4-6]. Many studies have documented a social patterning of smoking in adolescence, i.e. increasing prevalence of smoking with decreasing socioeconomic background of the parents [6-9]. It is less clear whether these socioeconomic differences in smoking change during time periods with substantial changes in smoking habits.

A study by De Looze et al. [5] observed decreasing prevalence of daily smoking among 15-year-olds from 2002 to 2010 in Belgium, France, Germany and the Netherlands and not much change in Croatia, Hungary and Italy. They used educational track as a measure of socioeconomic status among 15-year-olds and found different trends in absolute differences across these seven European countries and a general increase in relative differences. Richter & Leppin [8] reported an increase in daily + weekly smoking among German adolescents from 1994 to 2002. They applied two measures of socioeconomic status, a measure of material assets in the family (the Family Affluence Scale, FAS) and school type. The smoking prevalence was higher in technical than in academic school tracks and higher among students from low than high FAS families. These absolute socioeconomic differences remained almost unchanged during the observation period 1994-2002. Rasmussen et al. [6] reported a decreasing prevalence of daily smoking among 15-year-old Danes from 18.0% in 1991 to 10.8% in 2006. They applied parents' occupational social class (OSC) as measure of socioeconomic status and found increasing absolute socioeconomic differences and persistent relative differences in adolescent daily smoking.

The diverse findings of trends in socioeconomic differences in smoking among adolescents call for further examination. The variations in indicators of socioeconomic status may be one reason for the varying findings. The most common indicators of socioeconomic status within public health research are education, income and occupation. The correlations between these indicators among parents of adolescents are moderate, approximately 0.3, which suggests that they tap different aspects of the family's socioeconomic status [10]. Parents' occupation is strongly related to parents' income, social standing, social networks, control and autonomy [11], variables which may be related to risk behaviour such as smoking. Parents' OSC is therefore a relevant indicator of socioeconomic status for studies of the social patterning of smoking [6,

10-11]. Pfortner et al. [12] showed that occupation of the parents is a robust measure of socioeconomic status in adolescence. De Clercq et al. [13] suggested that it is important to include measures of both economic and cultural capital in the family in studies of adolescents' lifestyles. Parents' occupation is probably closely connected to both these forms of capital [11].

The aim of this study is to examine trends in socioeconomic differences in daily smoking among 15-year-old Danish students participating in seven comparative nationwide surveys in a 23-year period (1991 to 2014) by using parents' occupational social class (OSC) as indicator of socioeconomic status. OSC is defined by the occupational skills and competencies necessary for the job as well as the power and control associated with the position [14]. The Danish OSC measure has strong similarities with the British Registrar-General's social classification and the European Socio-economic Classification (ESeC), although with an adaption to the Danish labour market [14].

The study is a follow up of a similar study published in 2009 in this journal which covered the period 1991-2006 [6]. Our first study showed that socioeconomic differences in daily smoking fluctuated over time and that trends in absolute and relative socioeconomic differences in daily smoking developed differently. The current study addresses trends in both absolute and relative socioeconomic differences, including the importance of absolute prevalence levels in all socioeconomic groups.

Methods

National context: The Danish government introduced four smoking control policies during the study period. Smoking has been prohibited among schoolchildren on the school premises since 2001, although teachers were still allowed to smoke. Since 2012, there has been a complete ban on smoking on the school premises. In 2004-2008 sales of tobacco products had been prohibited to people younger than 16 and since 2008 this has applied to people younger than 18.

Design and study population: The study applied data from the Danish part of the international Health Behaviour in School-aged Children study (HBSC) [15-16]. The overall aim of HBSC is to enhance insight into young people's health behaviours in their social settings. The study design is repeated cross-sectional surveys of representative samples of schoolchildren every four years. The procedures for sampling, data collection and measurements were similar across all surveys. Each time the sampling procedure started with a complete list of private and public schools covering the entire country. From this list, we chose schools at random, i.e. cluster sampling. The participating schools and communities were not the same in each survey except in cases where this happened at random. Each survey included all schoolchildren in the

fifth, seventh and ninth grade, corresponding to the age groups 11-, 13- and 15-year-olds, mean age (SD) 11.4 (0.4), 13.4 (0.4) and 15.4 (0.4).

We included data from the surveys in 1991, 1994, 1998, 2002, 2006, 2010 and 2014. The response rate (number of participants in the surveys as percentage of schoolchildren enrolled in the participating classes) was 88.2%, N=31,660. This study only includes the oldest age group because the prevalence of daily smoking among younger schoolchildren is very low. After exclusion of participants with missing data on smoking and OSC the final N was 8,641 (Table 1).

Data collection and measurements: The participants completed the internationally standardised HBSC questionnaire in the classroom [16]. Frequency of smoking was measured by the question: “How often do you smoke tobacco at present?” (“every day”, “at least once a week, but not every day”, “less than once a week”, “I do not smoke”). We dichotomised the responses into “every day” vs. other responses.

The participants reported their father’s and mother’s occupation and the research group coded this information into OSC from I (highest) to V (lowest) [14]. We added OSC VI to include economically inactive parents who receive unemployment benefits, disability pension, or other kinds of transfer income. Each schoolchild was categorised by the highest ranking parent into high (I-II), middle (III-IV) and low (V-VI) OSC. The coding procedure was identical in all seven surveys. The applied OSC measure categorized occupations by two general features which are more stable than occupations: required educational qualifications and control (over capital or people) connected with the occupation. Several studies have demonstrated that schoolchildren in this age group are able to report their parents' occupation with a fair validity [12, 17-18].

Statistical analyses: We used the Cochran-Armitage test for trend to study trends in prevalence of daily smoking over time. We applied two measures of socioeconomic differences in daily smoking: 1) Prevalence difference in daily smoking between low and high OSC as a measure of absolute socioeconomic differences and 2) logistic regression analyses, performed in multilevel models (SAS PROC GLIMMIX) to adjust for the cluster sampling to generate a relative measure (Odds Ratio, OR) of socioeconomic differences. In the first regression analyses we separated boys and girls. The pattern of associations between OSC and smoking were similar for boys and girls and all subsequent analyses we combined boys and girls. In the second step, we analysed the association between OSC and daily smoking with sex and survey year as categorical control variables. The third step included a statistical interaction term (survey year * OSC) to study whether socioeconomic differences in daily smoking changed over time. Finally, we repeated all analyses with two other cut-points on smoking, 1) “every day” + “at least once a week” vs. “less than once week” + “I do not

smoke” and 2) “every day” + “at least once a week” + “less than once week” vs. “I do not smoke” in order to study whether the findings were robust across levels of smoking.

Ethical issues: This study collected anonymous questionnaire data without data about the identity of the participating students. There is no formal agency for approval of questionnaire based surveys in Denmark. Therefore, we asked the school board as the parents’ representative, the headmaster, and the students’ council in each of the participating schools to approve the study. The participants received oral and written information that participation was voluntary and anonymous. The study complies with national standards for data protection. From 2014 the Danish Data Protection Authority has requested notification of such studies and has granted acceptance (Case No. 2013-54-0576).

Results

Table 1 shows that the prevalence of daily smoking declined from 18.6% in 1991 to 4.5% in 2014 (Cochran-Armitage test, $p < 0.0001$). The absolute socioeconomic differences (prevalence difference between low and high OSC) increased from 5.4% in 1991 to 8.1% in 2002 where after it declined to 5.7 % in 2014. Figure 1 shows that this decline was consistent in high, middle and low OSC (all p -values < 0.0001).

In the entire pooled study population, the prevalence of daily smoking was 8.9% in high and 16.5% in low OSC (chi²-test, $p < 0.0001$). Socioeconomic differences leaving low OSC at highest risk appeared in all seven surveys (Table 1). The confidence limits show that the prevalence differences between low and high OSC were statistically significant in 2002, 2006, 2010 and 2014. There were 863 students who were excluded from the analyses because of missing data on OSC. The prevalence of daily smoking in this group was 22.1% (not shown in table).

Model 1 in Table 2 shows the OR (95% CI) for daily smoking by OSC in the total study population. The OR was 1.40 (1.19-1.65) in middle vs. high OSC and 1.90 (1.56-2.32) in low vs. high OSC. These estimates remained almost unchanged when adjusted for sex and survey year (Table 2, model 2). The statistical interaction between OSC and survey year was significant ($p=0.0404$) which suggests that the relative socioeconomic differences increased from 1991 to 2014. This tendency is illustrated by the analyses stratified by survey year (table 2, stratified analyses).

The sensitivity analyses with other cut-points for smoking (not shown in Table 2) resulted in the following estimates: The OR for daily + weekly smoking was 1.27 (1.11-1.46) in middle and 1.59 (1.34-1.89) in low OSC and the OR for daily + weekly + occasional smoking was 1.10 (0.99-1.24) in middle and 1.21 (1.05-1.40)

in the low OSC. The relative socioeconomic difference in smoking was robust to cut-point for smoking although with more pronounced socioeconomic differences in daily smoking than daily + weekly + occasional smoking.

Discussion

Main findings: This study has three main findings. First, there was a substantial reduction in daily smoking among adolescents in Denmark 1991-2014. Second, there were consistent socioeconomic differences in daily smoking with higher prevalence levels among adolescents from low OSC. Third, although substantial reduction in smoking prevalence was achieved, socioeconomic differences in smoking remained throughout the study period. The absolute socioeconomic differences increased from 1991 to 2002 and decreased from 2006 to 2014. The relative socioeconomic differences increased from 1991 to 2014.

From a public health point of view absolute social inequality in smoking may be more relevant than relative social inequality. Absolute social inequality reflects the excess number of adolescents from lower socioeconomic strata who smoke. A high relative social inequality in smoking may not be so important if the smoking prevalence is low and/or declining rapidly.

The finding of a decreasing smoking prevalence among adolescents is consistent with other studies from Europe and North America [4-6]. The finding of socioeconomic differences in adolescents' smoking is also consistent with other studies from Europe and North America [6-9]. The finding that changes in absolute and relative socioeconomic differences in daily smoking may appear different corresponds with two former studies [5-6]. The finding of fluctuating absolute socioeconomic differences and increasing relative socioeconomic differences in daily smoking corresponds with the findings by de Looze et al. [5]. Studies of change in socioeconomic differences over time should address both absolute and relative socioeconomic differences in connection with the directions of the absolute trends as they may result in different conclusions [6].

Explanations for changes in smoking prevalence often focus on tobacco control policies. Pfortner et al. [19] found that most European tobacco control policies focus on the general population with less focus on adolescent smoking. Studies on the effect of tobacco control policies differ in their conclusion. Some studies show that tobacco price is adequate to reduce smoking among boys (but not girls), irrespective of their socioeconomic status [19]. Hublet et al. [20] found that price policy was of borderline significance for the prevalence of smoking among adolescents. The study by Schnohr et al. [21] found an association between bans on smoking and lower smoking prevalence and that tobacco price was unrelated to smoking

prevalence among adolescents. The study by Kuipers et al. [22] found that daily smoking was not clearly associated with school smoking policies but that ban on smoking at school premises may reduce smoking at school premises. A recent literature review from The Council on Health and Disease Prevention [23] concluded that high tobacco prices and smoke free homes are the most effective ways to prevent young people from starting to smoke. Other interventions have moderate effect: multi-component interventions at schools (e.g. combining teaching, parental efforts and changes in the school environment), a ban on advertisements, enforced ban on the sale of tobacco to minors, and enforced smoking ban on school premises. Although high tobacco prices and smoke free homes contribute to reduce smoking initiation among adolescents, it is unknown whether they contribute to reduce socioeconomic differences in smoking.

The processes underlying socioeconomic differences in adolescent smoking are multiple and complex. Moor et al. [9] suggests that the socioeconomic differences in adolescent smoking can be explained by socioeconomic differences in risk factors for smoking such as family structure, relationships with parents, academic achievement and school satisfaction. Pampel [24] suggest that differences in smoking between socioeconomic groups may reflect so-called symbolic distinction, i.e. that socioeconomic groups use smoking to distinguish their lifestyles from those of others. Link & Phelen [25] suggest yet another set of explanations, namely that socioeconomic status embody access to important resources. Resources such as knowledge and information about smoking may produce and maintain socioeconomic differences in smoking because adolescents from lower socioeconomic groups may have less knowledge and awareness of smoking as harmful to health [25-26]. Therefore, it is possible that higher socioeconomic groups may be more responsive to stricter tobacco control measures. The explanation may also be ascribed to the general delay in adoption of new ideas. The sequential decrease in daily smoking in different socioeconomic groups seems to fit the pattern proposed by Roger's theory on diffusion of innovations [27].

Pförtner et al. [19] suggests that the most common tobacco control policies are not really effective in reducing socioeconomic differences in adolescent smoking. A study from the Netherlands found that introduction of stricter tobacco control policies (bans on tobacco sales to minors, advertising and sponsoring and tobacco sales in government institutions) resulted in decreasing smoking prevalence among adolescents of both higher and lower educational levels but increasing relative socioeconomic differences in adolescent smoking [22]. The Danish smoking control policy during this period introduced ban on smoking and age limits for buying tobacco products but these measures are directed against the general level of smoking rather than against socioeconomic differences in smoking.

Limitations: It is a virtue of the study that it includes seven comparable surveys during a 23-year period. Although the participation rate was high (88.2%), non-participating students may still cause selection bias. Another kind of selection bias relate to students who did not answer questions about parents' occupation. These students had a high prevalence of daily smoking. Therefore, the study may underestimate the prevalence of daily smoking but we have no reason to suspect that this underestimation invalidates the findings about socioeconomic differences in daily smoking.

It is important that the applied social background measure (occupation) is sufficiently stable over time. Types of jobs are not stationary and new types of jobs occur. The applied OSC measure categorize occupations by two general features which are much more stable than occupations themselves, namely required educational qualifications and the control (over capital or people) connected with the occupation [14].

Implications: It is important to address socioeconomic differences in smoking in future interventions to prevent smoking in the entire adolescent population.

It is encouraging that the overall rate of daily smoking among adolescents declined from 18% in 1991 to 4.5% in 2015, although it is important to keep in mind that the prevalence of weekly and occasional smoking remains high. Still there seems to be a ten-year delay until the smoking prevalence in lower socioeconomic status groups reaches the level of the higher socioeconomic status groups.

There is a need for studies thoroughly exploring the observed changes in smoking prevalence among adolescents. Apparently, the factors which contributed to the dramatic decline in daily smoking influenced adolescents from all social classes. Positive findings have been produced by recent studies showing that multi-component and school-based interventions have significant effect on reducing uptake of smoking among adolescents [28], in particular if these interventions are implemented with a high degree of compliance [29]. Future interventions to prevent adolescent smoking should be thoroughly developed to specifically address socioeconomic differences in smoking. Also, we recommend that further studies explore how tobacco control policies may contribute to reduce socioeconomic differences in smoking.

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Table 1 Study population of 15-year-olds by survey year, sex, occupational social class (OSC) and smoking prevalence

	Survey year							Total
	1991	1994	1998	2002	2006	2010	2014	
Overall response rate ^a	90.2%	90.9%	88.0%	89.3%	88.8%	86.3%	85.8%	88.2%
N of 15-year-olds	623	1,351	1,570	1,432	1,668	1,402	1,472	9,518
Included in this study ^b	593	1,270	1,472	1,336	1,392	1,233	1,345	8,641
Pct. boys	47.2	51.3	48.9	48.1	49.3	48.6	47.2	48.8
Pct. Girls	52.8	48.7	51.2	52.0	50.7	51.4	52.8	51.2
Pct. high OSC	26.8	34.6	30.6	28.4	27.3	40.4	44.0	33.5
Pct. middle OSC	57.2	49.6	53.3	52.2	51.2	43.2	41.6	49.2
Pct. low OSC	16.0	15.8	16.2	19.5	21.5	16.4	14.4	17.2
Pct. smoking ...								
daily	18.6	13.0	17.6	14.0	10.3	10.1	4.5	12.2
daily+weekly	22.1	18.2	23.9	18.3	14.7	14.3	7.8	16.7
daily+weekly+occasional	28.7	28.2	34.2	26.6	25.1	25.2	17.6	26.4
Pct. daily smoking ^c								
... in high OSC	15.7	10.0	14.7	11.1	7.6	6.4	3.6	8.9
(95% CI)	10.4-22.3	7.4-13.2	11.5-18.3	8.1-14.6	5.2-10.8	4.4-9.0	2.2-5.4	6.9-11.0
... in middle OSC	19.2	13.8	18.4	13.6	9.5	12.2	3.7	12.8
(95% CI)	15.1-23.8	11.2-16.8	15.7-21.3	11.2-16.4	7.5-11.9	9.5-15.3	2.3-5.7	12.7-14.8
... in low OSC	21.1	16.9	20.6	19.2	15.7	13.9	9.3	16.5
(95% CI)	13.4-30.6	12.0-22.8	15.6-26.3	14.6-24.6	11.8-20.4	9.4-19.4	5.6-14.3	14.7-18.5
Difference low-high	5.4	6.9	5.9	8.1	8.1	7.5	5.7	7.6

^a Number of participants in the data file as percentage of schoolchildren enrolled in the participating classes

^b The analyses only include students with full data on all applied variables

^c Inclusive exact 95% confidence limits

Table 2 OR (95% CI) for daily smoking among 15-year-olds by occupational social class (N=8,641)

	High OSC	Middle SOC	Low OSC
Entire study population (n=8,641)			
Model 1, unadjusted	1	1.40 (1.19-1.65)	1.90 (1.56-2.32)
Model 2, adjusted for sex and survey year ^a	1	1.35 (1.15-1.59)	1.88 (1.55-2.29)
Stratified analyses adjusted for sex			
The 1991 survey (n=593)	1	1.33 (0.79-2.24)	1.57 (0.89-3.09)
The 1994 survey (n=1,270)	1	1.31 (0.87-1.97)	1.68 (1.00-2.80)
The 1998 survey (n=1,472)	1	1.27 (0.92-1.76)	1.45 (0.95-2.22)
The 2002 survey (n=1,336)	1	1.29 (0.87-1.92)	1.96 (1.24-3.10)
The 2006 survey (n=1,392)	1	1.30 (0.82-2.06)	2.28 (1.38-3.79)
The 2010 survey (n=1,233)	1	1.99 (1.27-3.12)	2.33 (1.34-4.04)
The 2014 survey (n=1,345)	1	0.96 (0.51-1.80)	2.19 (1.10-4.36)

^a Included in the analysis as an indicator variable (categorical variabel)

Estimates in bold are statistically significant

Figure 1. Pct of 15-year-olds who smoke daily, by survey year and occupational social class

