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Trends and risk groups for smoking during pregnancy in Finland and other Nordic countries

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Background: Reductions in maternal smoking can prevent pregnancy complications and adverse effects to foetus. Our objective was to study how the prevalence of maternal smoking differs between Nordic countries, and to identify target groups for smoking-cessation interventions. **Methods:** Information on maternal smoking and background factors was requested from the Nordic countries (the Danish National Board of Health, the Finnish National Institute for Health and Welfare, the Public Health Institute in Iceland, the Norwegian Institute of Public Health and the Swedish National Board of Health and Welfare). Data on maternal smoking were received from 1991 to 2010 in Denmark, 1987 to 2010 in Finland, 1999 to 2009 in Norway and 1983 to 2008 in Sweden. Trends in smoking were studied by using test for relative proportion. **Results:** The prevalence of maternal smoking in early pregnancy has declined in the countries during the past 20 years (Denmark: from 30.6 to 12.5%; Norway: 20.6 to 16.5% and Sweden: 31.4 to 6.9%), except in Finland (a steady prevalence at 15%). The highest rates of smoking in early pregnancy were among teenagers (24% in Sweden and 49% in Finland and Norway). Single women were 2–3 times more likely to smoke than married women. The women in the lowest socioeconomic group were 6–7 times more likely to smoke than women in the highest group in Finland and Norway. **Conclusion:** Maternal smoking and its trends differed between the Nordic countries. The highest smoking rates during pregnancy were observed among teenagers, single women and women with a low socioeconomic position.

Introduction

The overall prevalence of smoking has decreased in many developed countries since the knowledge of its adverse effects has been described.[1] Although previously more prevalent among males, smoking rates of men and women have converged in recent decades,[1] and in some countries, have been almost parallel since the 1980s.[2] In Finland, men's smoking has been decreasing for decades, but women's smoking increased until the mid-1980s, and did not start to decrease until 2004. In 2010, 22% of Finnish men and 16% of women smoked daily.[3] In addition, young girls smoke more often than boys in several European countries[3,4]; most worryingly, smoking among teenage girls has increased more rapidly than among teenage boys.[5]

Globally, the prevalence of smoking during pregnancy has decreased. Smoking during pregnancy decreased from 18 to 11% between 1990 and 2002 in the USA,[6] and from 22 to 14% between 1994 and 2007 in Australia.[7] This decrease has also been seen in all the Nordic countries,[8–10] except Finland, where 15% of pregnant women smoke.[11]

Exposure to smoking during pregnancy has been shown to increase the risk for preterm birth[12] and low birth weight.[13] Smoking has also been shown to have harmful effects on foetal brains,[14] and possible smoking-related long-term consequences for children include affects on neurobehavioural, metabolic, cardiovascular and respiratory development.[15] In our previous Finnish nationwide epidemiological study, we showed that smoking exposure was associated with an increased risk of psychiatric morbidity and psychotropic drug use into young adulthood.[16,17]

It would be important to reduce smoking during pregnancy to prevent pregnancy complications and adverse effects to foetus. Our aim was to study how the prevalence of maternal smoking differs between the Nordic countries, and to gain a better understanding of the maternal background factors affecting smoking during pregnancy.

Methods

Data collection

A data request for detailed information on smoking during pregnancy in the five Nordic countries was sent to their birth registers in January 2010; these register-organizations were the Danish National Board of Health, the National Institute for Health and Welfare in Finland, the Public Health Institute in Iceland, the Norwegian Institute of Public Health and the Swedish National Board of Health and Welfare. Iceland reported that their Medical Birth Register does not contain information on smoking.

The following data were requested: (i) Data on smoking during pregnancy by the year of birth of the child for (a) women who smoked during the first trimester of pregnancy, and (b) who continued smoking after the first trimester of pregnancy. (ii) Data on smoking during pregnancy by background factor: maternal age,

parity (none/one or more), marital status (married or cohabiting/single) and socioeconomic position.

The available data on general smoking for all females aged >15 years by country were derived from the WHO European Health for All Database (http://data.euro.who.int/hfadb/).[18]

Data sources

The Finnish Medical Birth Register includes data on both live-born and stillborn foetuses with a gestational age of 22 weeks or more, or with a birth weight of 500 g or more. The register keeper, currently the National Institute for Health and Welfare, receives the register data from all delivery hospitals. This information includes maternal background and delivery factors and the newborn's outcome until 7 days of age. A midwife collected information on maternal smoking from the mothers during antenatal care (none/<10/>10 cigarettes per day between 1987 and 1990, and since 1991 whether she was smoking during the first trimester/continued smoking after the first trimester of pregnancy). Most of the Medical Birth Register content corresponds well or satisfactorily with hospital record data according to two data quality studies.[19,20]

The Danish Medical Birth Register (the Danish National Board of Health, currently Statens Serum Institut) contains information on all deliveries since 1973. Maternal smoking data have been collected since 1991, with information on continued smoking after the first trimester of pregnancy collected separately since 1997. The database contains 99.8% of all deliveries in Denmark and the data quality has been shown to be reliable.[21]

The Medical Birth Register of Norway (the Norwegian Institute of Public Health) contains information on all pregnancies after 12 weeks of gestation in Norway since 1967. The attending midwife or physician responsible for delivery records the background data on standardized notification forms shortly after the delivery. The information on smoking (smoking during the first trimester/continued smoking after the first trimester) has been gathered since 1999. Contrary to the other Nordic countries, the mother's informed consent for collecting smoking data is required; permission has been received from 81 to 88% of mothers. The Medical Birth Register of Norway has frequently been used for scientific research and is deemed a reliable source.[22]

The Swedish Medical Birth Register (the Swedish National Board of Health and Welfare) contains information on deliveries and newborn infants since 1973. Stillbirths were included from 28 weeks of gestation until 2006, and thereafter from 22 weeks of gestation. The register contains information on various maternal characteristics; information on smoking has been collected since 1983, with more detailed information (smoking during the first trimester/continued smoking after the first trimester) since 2000. Quality studies have reported that the Swedish Medical Birth Register includes information on 99% of all infants born in Sweden.[23]

The socioeconomic position (high/intermediate/low) was evaluated in Finland by working background (upper white-collar workers such as teachers, physicians and journalists/lower white-collar workers such as secretaries, nurses and shop assistants/blue-collar workers such as dressmakers, cooks and cleaners) and in Norway by education (1–10 years of education, compulsory education/11–13 years of education/at least 14 years of education and university level and higher).

The women who smoked only during the first trimester of pregnancy are referred to as 'smoked in early pregnancy', whereas women who continued smoking after the first trimester are referred to as 'smoked in the end of pregnancy or throughout pregnancy'.

The number of deliveries and average maternal smoking prevalence in early pregnancy (number of smokers during pregnancy) during the included period for smoking data by each country were: 1 298 685 deliveries with an average of 21% (274 469) smoking prevalence in Denmark, 1 432 969 and 15% (215 889) in Finland, 637 752 and 20% (107 103) in Norway and 2 627 178 and 17% (450 290) in Sweden, respectively. The age and parity structure are similar in all Nordic countries.[24] According to our data, the proportion of single women of all pregnant women was 8% in Finland, 10% in Norway and 6% in Sweden. The proportion of high socioeconomic position was around 28% in Finland and 50% in Norway and the proportion of intermediate socioeconomic position 52 and 30%, respectively.

Permission of data delivery was granted by the register-keeping organizations. Due to strict data protection legislation, only aggregated unidentifiable statistical data were received from the participating Nordic countries. In Norway, the Regional Committees for Medical and Health Research Ethics also approved the data request.

Statistics

Trends in smoking during pregnancy from year 2000 to the latest rate of smoking were studied by using test for relative proportion. The results are also shown by average annual percentage change. The prevalence of smoking was analysed separately, according to background factors in all countries. In addition, the smoking rates were analysed more closely by age and marital status in Finland. The data analysis was performed using commercially available software (Microsoft Office Excel 2007). A P value of <0.05 was considered to be statistically significant.

The data on pregnant teenagers' smoking in Denmark were suspected to be unreliable because of a data discrepancy, showing 0.2–0.4% of all pregnancies to be teenage pregnancies, whereas the WHO European Health for All Database showed a rate of 1.3–2.5% for the same period.[18] Therefore, the Danish information on pregnant teenagers' smoking was excluded from figure 2.

Results

Nordic trends in maternal smoking and overall smoking among women

The country-specific data received are shown with the latest smoking rates (%) in early and in the end of pregnancy and trends with annual change of smoking during pregnancy since 2000 in table 1. The prevalence of maternal smoking in early pregnancy and general smoking among all women has declined significantly in the Nordic countries, excluding Finland (figure 1 and table 1). The most rapid decline of smoking during early pregnancy has been in Sweden and Denmark (annual change since 2000 −7.2 and −5.7%, respectively), even though this decline started 10 years earlier in Sweden. The prevalence of smoking during early pregnancy has been stable in Finland (annual change 0.5%), even if general smoking among all females has started to decline from 2004.

The proportion of women who smoke throughout the pregnancy has decreased in all countries during the past decade. The results show that women tend to stop smoking more often during pregnancy in Finland (annual change −2.6%) and Norway (annual change −9.2%), as the prevalence of smoking throughout pregnancy has been decreasing more than the smoking rates in early pregnancy (annual change 0.5 and −1.9%, respectively). Contrarily in Sweden, smoking in early pregnancy (annual change −7.2%) has decreased more than smoking in the end of pregnancy (annual change −4.7%). The proportion of women who stopped smoking after the first trimester of the pregnancy has increased in Finland from 10 to 36% in a decade, but decreased in Sweden from 45 to 27%.

Smoking by maternal age

The highest maternal smoking prevalence during pregnancy in all countries was among teenagers (table 1). Since 2000, maternal

Table 1 The received smoking information with the latest smoking rates (%) in early and the end of pregnancy and annual change since 2000

Smoking information available	Denmark		Finland		Norway		Sweden	
During the first trimester	1991–2010		1987–2010		1999–2009		1983–2008	
After the first trimester	1997–2010		1991–2010		1999–2009		2000–2008	
Background information	Latest rate, %	Annual change, %	Latest rate, %	Annual change, %	Latest rate, %	Annual change, %	Latest rate, %	Annual change, %
Smoking during early pregnancy	12	−5.7**	15	0.5**	17	−1.9**	7	−7.2**
Age								
Teenagers	41	−1.4	49	1.8**	49	0.3	24	−3.3**
All <25	28	−1.4**	32	2.1**	32	0.8*	15	−3.0**
25–34	10	−6.6**	12	0.5*	14	−2.8**	5	−6.6**
35 or more	9	−10.3**	9	−1.4**	12	−3.9**	5	−12.0**
Marital status								
Single			35	2.7**	35	−0.3	21	−5.8**
Married/cohabiting			13	0.3	15	−2.3**	6	−7.6**
Parity								
0			18	1.1**	20	0.2	7	−6.7**
1 or more			13	−1.3**	14	−3.6**	7	−7.6**
Socioeconomic position								
High			5	2.1*	6	−3.8**		
Intermediate			14	1.2**	21	−0.9**		
Low			26	0.5	41	1.4**		
Smoking in the end of pregnancy	10	−7.0**	10	−2.6**	7	−9.2**	5	−4.7**
Age								
Teenagers	32	−3.1	36	−0.1	23	−3.3**	19	−1.6
All <25	22	−2.7**	22	−0.3	15	−5.5**	11	1.0*
25–34	8	−10.0**	7	−3.4**	6	−11.0**	4	−3.1**
35 or more	7	−9.4**	6	−4.4**	6	−11.1**	4	−9.5**
Marital status								
Single			24	−0.1	19	−5.7**	15	−4.1**
Married/cohabiting			8	−2.9**	6	−10.4**	4	−4.8**
Parity								
0			10	−2.8**	7	−7.9**	5	−3.6**
1 or more			9	−2.6**	7	−10.2**	5	−5.1**
Socioeconomic position								
High			2	−5.0**	2	−15.9**		
Intermediate			8	−2.7**	9	−9.0**		
Low			18	−2.1**	23	−4.1**		

**$P < 0.001$; *$P < 0.05$.

smoking in early pregnancy among teenagers has decreased in Sweden from 32 to 24%, but increased in Finland from 41 to 47% and in Norway from 43 (year 2004) to 49% (figure 2). In 2010, 36% of Finnish teenagers smoked throughout pregnancy, only one in four stopped smoking after early pregnancy. However, a higher proportion (54%) of teenagers stopped smoking after early pregnancy in Norway.

For women >25 years of age, the prevalence of maternal smoking in early pregnancy followed the declining general smoking trends of these countries. Yet in Norway during the past 5 years, the smoking rates among pregnant women <35 years have increased. Overall, among women <25 years (including teenagers), the prevalence of maternal smoking in early pregnancy was 2.5–3 times higher than among older pregnant women in all countries, and the difference persisted throughout pregnancy.

Smoking by socioeconomic position

The women with the lowest socioeconomic positions were 6–7 times more likely to smoke, and the women with an intermediate position were 3–3.5 times more likely to smoke than women with the highest position, both in early pregnancy and in the end of pregnancy (table 1 and figure 3). Decrease in smoking rates throughout pregnancy has been higher in women with a higher socioeconomic position.

Smoking by parity and marital status

The prevalence of smoking in early pregnancy was higher among women who have not had a previous delivery than among women who have had previous deliveries in Finland and in Norway. However, the prevalence of smoking in the end of pregnancy evened out between pregnant women who have not had and have had previous deliveries in both Finland (10–11%) and Norway (both 7%). In Sweden, no difference was observed at any time of pregnancy (both 5% smoked throughout the pregnancy).

Single women were 2–3 times more likely to smoke both during early pregnancy and in the end of pregnancy compared with married or cohabiting women in all countries (table 1). The proportion of Finnish single women who smoke throughout pregnancy has remained stable, at the level of 25–30% (annual change −0.1%), for the past decade. A decreasing trend was found in married/cohabiting pregnant women in Norway and Sweden (−10.4 and −4.8%, respectively), as in single women (−5.7 and −4.1%, respectively).

Smoking rates by marital status were calculated separately for teenagers and women >20 years of age in Finland. Smoking rates

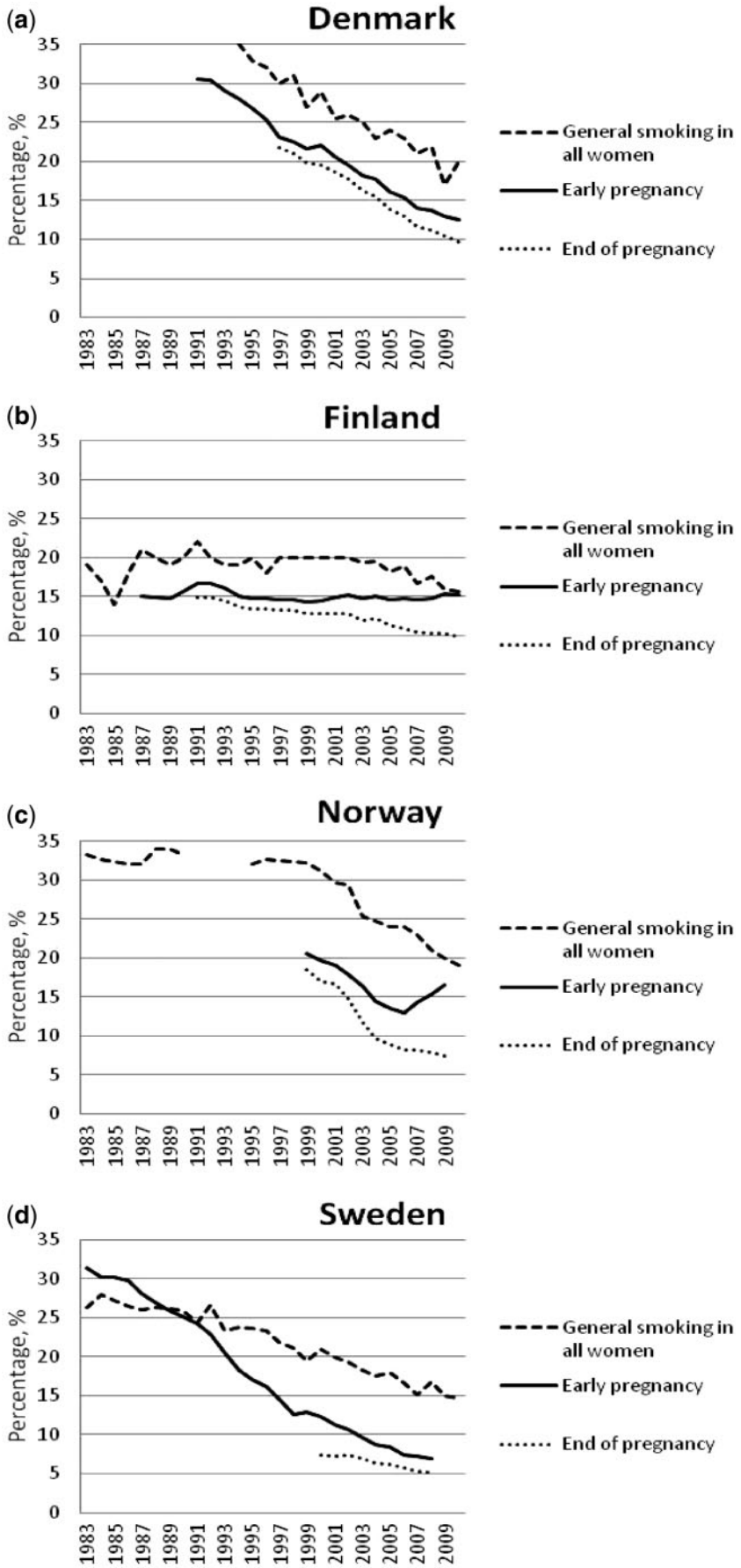

Figure 1 Trends of smoking in early and end of pregnancy and general smoking among all women by countries: (a) Finland, (b) Denmark, (c) Norway, and (d) Sweden

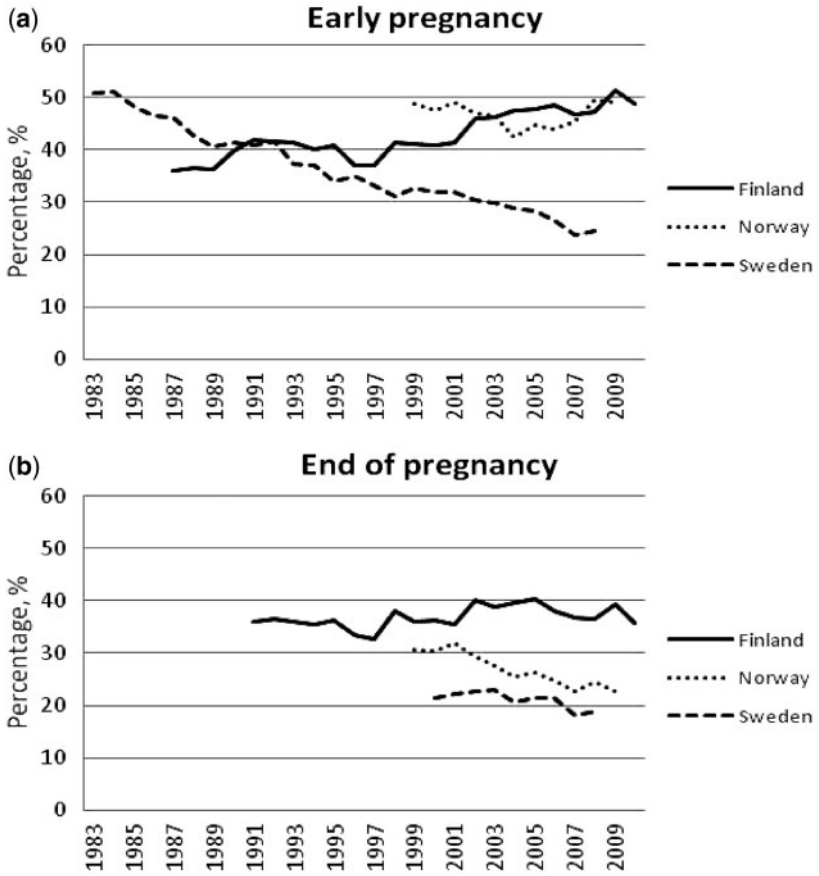

Figure 2 Trends of smoking among pregnant teenagers in (**a**) early and in (**b**) end of pregnancy by countries

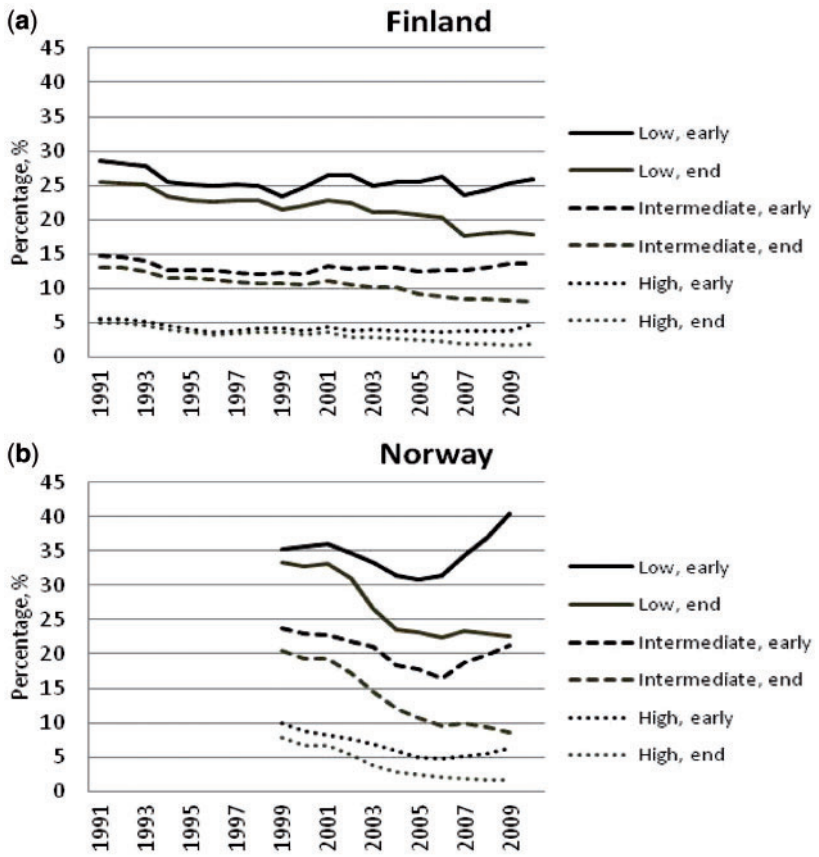

Figure 3 Trends of smoking during pregnancy according to socioeconomic position in (**a**) Finland and (**b**) Norway

of pregnant single women >20 years of age were at the same level as all single pregnant women. However, smoking rates among single pregnant teenagers were high, remaining between 50 and 60% during the past decade.

Discussion

This study, based on four national registers, showed that smoking throughout pregnancy has been decreasing in all Nordic countries. However, very few Finnish women stop smoking before pregnancy, which is contrary to the other Nordic countries. We also identified that teenagers, single women and women with lower socioeconomic positions were more likely to smoke during pregnancy than older women, married women and those with a higher socioeconomic position. Most worryingly, we found that the smoking prevalence was increasing among teenagers in both Finland and Norway. Smoking during pregnancy did not directly follow the decrease in general smoking prevalence, suggesting that there might be specific issues related to smoking during pregnancy in different countries.

The prevalence of smoking in early pregnancy has been stable in Finland for >20 years. However, 2 decades ago, the baseline level of smoking during pregnancy was clearly lower in Finland than in the other Nordic countries. Yet, since then, smoking in early pregnancy has significantly decreased in these other countries. However, smoking in early pregnancy has slightly increased in Norway in recent years. Decreasing smoking rates in pregnancy have been observed in most developed countries[7,25]; however, despite the decreasing general trend in the USA, the prevalence of smoking during pregnancy has in fact increased in four states during recent years.[25]

Nevertheless, the proportion of women who smoke throughout pregnancy has decreased in Finland, as well as in the other Nordic countries. In Sweden, the proportion of women who stop smoking during pregnancy has slightly decreased in recent years as a consequence of a decreasing overall trend in smoking during pregnancy. Globally, the proportion of women who stop smoking during pregnancy varies dramatically, as only 4% of smokers stopped during pregnancy in Australia,[26] whereas 67% stopped in Japan.[27] As the final smoking prevalence throughout gestation is the lowest in Sweden and Norway, the effectiveness of smoking prevention/cessation interventions seem to work best in these countries. The cessation percentages are high in, for example, Finland because more women smoke during early pregnancy.

When general smoking among all women (16%) was compared with smoking in early pregnancy (15%) in Finland in 2010, we concluded that almost none of the Finnish women stopped smoking when planning a pregnancy. If compared with, for example, Sweden—where the prevalence of general smoking among all women was 15% and smoking in early pregnancy was 7%—the need for smoking-cessation interventions for women who are planning pregnancies in Finland is clearly highlighted.

Previous studies have shown that women who smoke during pregnancy are often young, single and less educated; have a lower socioeconomic status; have more unplanned pregnancies and more commonly have a partner who smokes than do non-smoking women.[26,28,29] An Australian study showed that pregnant teenagers were 2–3 times more likely to smoke than older women.[26] Our study showed similar differences between teenagers and older women in every country. Smoking rates were high among pregnant teenagers (49% in Finland and Norway) compared with general smoking among teenagers in Finland (17%),[30] Denmark (22%) and Norway (14%).[31] In contrast, there was no large difference in Sweden, where 24% of all teenagers smoke compared with 21% of pregnant teenagers.[31] Increasing rates of smoking in pregnant teenagers raise a concern for the health behaviour of teenagers. However, as the rate of teenage pregnancies has decreased in all Nordic countries,[32] the teenagers getting pregnant and smoking during pregnancy may be a very selected group and have increased risk with health and social welfare problems, even marginalization.

We also identified that Finnish pregnant teenagers stopped smoking during pregnancy less frequently than in Norway, for example, and therefore, Finnish teenagers were almost two times more likely to smoke throughout the pregnancy than compared with the other countries. Thus in Norway, antenatal care might have better succeeded in decreasing the rate of smoking among pregnant teenagers.

The prevalence of smoking during pregnancy is strongly associated with socioeconomic position in both Finland and Norway. A 6–7 times higher prevalence of smoking among women with the lowest socioeconomic position was seen, compared with highest. Higher maternal smoking among women with lower socioeconomic positions has also been seen in previous studies in other countries.[26,28] Moreover, according to our study, the differences of smoking prevalence between these groups are even increasing, especially in Norway. Similar trends are also seen in Australia, although smoking rates during pregnancy have decreased by >20% in all social groups.[7]

Living without a partner and having no previous deliveries were independent risks for higher maternal smoking, although no difference according to parity was observed after the first trimester in our study. The lower smoking rates in early pregnancy of women who have had previous deliveries might reflect their increased knowledge of the risks of smoking during pregnancy from their antenatal care visits in previous pregnancies. Therefore, they might have stopped smoking before the pregnancy, or smoke less overall. Women who have not had a previous delivery might first encounter the smoking-cessation intervention during their antenatal care, and thus tend to stop more often during pregnancy. This indicates that smoking-cessation interventions should be specially aimed towards women who have not had a previous delivery, because if they succeed in stopping smoking, they might smoke less in future pregnancies, as well as generally.

The strengths of our study included the large-scale nationwide register data from all of the Nordic countries. The data have been collected well in all these countries,[19–23] although the Danish data on teenage pregnancies were unreliable. The register data contained information on smoking both in early and end of pregnancy, which is important because an increasing number of women stop smoking during pregnancy and by doing so, some adverse effects of smoking can be avoided.[13]

The limitations of this study include the possibility of an underestimation of the true prevalence of smoking, because the information was based on self-reporting during antenatal care.[33,34] The data on smoking were gathered similarly in each country, except in Norway, where the mother's permission is required for collecting the smoking data, which might lead to an underestimation of the true smoking prevalence. Indeed, 12–19% of mothers in Norway did not give their permission. Changes in the background of women giving their informed consent may thus explain the recent increase in maternal smoking in Norway. In Sweden, the selling of snuff is legal, and thus might somewhat replace smoking. According to the statistics, only 0.5% of women use snuff throughout pregnancy.[35] In Finland, only 0.4% of women use snuff occasionally or daily,[3] but there is no information on women using snuff during pregnancy. The Medical Birth Registers do not collect information on other types of smoking, such as electronic cigarettes. Another limitation was the lack of information on the smoking statuses of partners, which is shown to correlate with smoking in pregnancy.[28]

Our study showed that the risk for smoking during pregnancy is highest in the population of single young women without previous children and with low socioeconomic positions. The low proportion of smoking during pregnancy seen in Sweden might be achievable in Finland by, first, decreasing the prevalence of unplanned pregnancies among teenagers, as teenage pregnancies are rarely planned.[36]

Although the use of maternal health care is similar in Finland and Sweden, there are significant differences in national health policies related to the availability and price of oral contraceptives. In Sweden, teenagers have received discount for oral contraceptives from 1975, and in recent years, these are now totally free in some parts of Sweden, which has led to a decrease in the rates of teenage pregnancies and abortions.[37,38] In Finland, without financial reimbursement for oral contraceptives for teenagers, the rate of teenage pregnancies has decreased only slightly, whereas smoking among pregnant teenagers has risen.[32]From this comparison, we can speculate that the differences in smoking during pregnancy may be a result of different strategies in health policies and one effective policy might be increasing the availability of pregnancy planning and prevention services, especially for teenagers.

In conclusion, we have identified trends and risk groups for smoking during pregnancy. Our results suggest that smoking can be reduced, as large reductions have been seen in some of the Nordic countries. The prevention strategies should be targeted in the risk groups identified in this study. The foetal exposure has long-lasting consequences, which supports the use of prevention strategies to reduce maternal smoking.

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Conflicts of interest: None declared.

Key points

- Smoking during pregnancy, and its trends, differs considerably between the Nordic countries.
- The smoking prevalence among pregnant women in Finland, contrary to other Nordic countries, has remained stable since the late 1980s.
- The highest smoking rates were found among pregnant teenagers and women with low socioeconomic positions.
- Both reducing general smoking among young girls and preventing teenage pregnancies could decrease smoking during pregnancy.

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Equity impact of European individual-level smoking cessation interventions to reduce smoking in adults: a systematic review

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Background: Smoking is the leading cause of health inequalities in Europe. Adults from lower socioeconomic status (SES) groups are more likely to smoke and less likely to quit than adults from higher SES groups. Smoking cessation support is an important element of tobacco control; however, the equity impact of individual-level cessation support is uncertain. **Methods:** Systematic review of individual-level smoking cessation interventions delivered in European countries, reporting a smoking cessation outcome (quit) in adults of lower compared with higher SES. Equity impact was assessed as positive (reduced inequality), neutral (no difference by SES), negative (increased inequality) or unclear. **Results:** Twenty-nine studies were included using different types of support: behavioural and pharmacological (17); behavioural only (11), including specialist (5), brief advice (1), mass media (2), text-based (1) and Internet-based (2); and pharmacological only (1). The distribution of equity effects on quitting was 10 neutral, 18 negative and 1 unclear. Two national studies of UK National Health Service (NHS) stop-smoking services showed overall positive equity impact on smoking prevalence. The evidence suggests that UK NHS services that target low-SES smokers achieve a relatively higher service uptake among low-SES smokers, which can compensate for their lower quit rates. **Conclusions:** Untargeted smoking cessation interventions in Europe may have contributed to reducing adult smoking but are, on balance, likely to have increased inequalities in smoking. However, UK NHS stop-smoking services appear to reduce inequalities in smoking through increased relative reach through targeting services to low-SES smokers. More research is needed to strengthen the evidence-base for reducing smoking inequalities.

Introduction

Smoking is the leading preventable cause of premature mortality and socioeconomic inequalities in health in Europe.[1,2] Smoking prevalence in the European Union (EU) is declining, but the social gradient in smoking is not. This is of increasing concern, as countries recognize that tackling inequalities in smoking is central to reducing health inequalities. Both the English and Scottish national tobacco control strategies, for example, identify reducing inequalities and smoking as their key priority.[3,4] Health equity is defined as the absence of avoidable and unfair inequalities in health.[5]

Smoking prevalence rates differ within European countries by socioeconomic status (SES).[6] The patterning of smoking by SES reflects the stage of the tobacco epidemic in that country. Most EU countries are in the fourth (last) stage, [7,8] where lower-SES groups have higher smoking prevalence and consumption, and lower quitting rates compared with higher-SES groups.[9,10] As smoking prevalence declines in Stage 4 countries, the tobacco control field has started focusing on how to achieve the 'end game', i.e. to reduce smoking prevalence to negligible levels.[11] A major challenge in achieving this goal is to reduce smoking more rapidly among low-SES groups[4]. There is an urgent need to develop the evidence-base for effective equity-orientated tobacco control