Tobacco Use During Pregnancy and Preeclampsia Risk
Effects of Cigarette Smoking and Snuff

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Abstract—Preeclampsia is a leading cause of maternal and infant mortality and morbidity worldwide. Both Swedish snuff and cigarette smoke include nicotine, but combustion products accompany only smoking. The aims of this study were to compare the effects of Swedish snuff and cigarette smoking on preeclampsia risk and to estimate whether changes in tobacco habits during pregnancy affect the risk of developing term preeclampsia. We used information from the Swedish Birth Register on all singleton births in Sweden during the years 1999–2006 (n=612 712). Compared with nontobacco users, women who used snuff in early pregnancy had an adjusted odds ratio (OR) for preeclampsia of 1.11 (95% CI: 0.97 to 1.28). The corresponding ORs for light and heavy smokers were 0.66 (95% CI: 0.61 to 0.71) and 0.51 (95% CI: 0.44 to 0.58), respectively, with ORs lower for term than preterm preeclampsia. Compared with nontobacco users, women who smoked in early pregnancy but had quit smoking before late pregnancy (weeks 30 to 32) had an adjusted OR for term preeclampsia of 0.94 (95% CI: 0.83 to 1.08). The corresponding OR for women who did not use tobacco in early pregnancy but had started to smoke before late pregnancy was 0.65 (95% CI: 0.50 to 0.85). We conclude that tobacco combustion products rather than nicotine are the probable protective ingredients against preeclampsia in cigarette smoke. Because change of smoking habits during pregnancy influence risk, we further conclude that it is the smoking habits in the middle or late rather than in the beginning of pregnancy that seem to affect the risk of preeclampsia. **(*Hypertension*. 2010;55:00-00.)**

Key Words: preeclampsia ■ pregnancy ■ tobacco ■ smokeless ■ snuff ■ smoking ■ smoking cessation

Preeclampsia is a pregnancy complication recognized by new-onset gestational hypertension and proteinuria.[1] The disorder affects both mothers and fetuses and can only be cured by delivery.

Cigarette smoking during pregnancy is known to increase the risk of a number of adverse outcomes, such as fetal growth restriction and preterm birth.[2,3] Paradoxically, smoking reduces the risk of preeclampsia.[4,5] Understanding the underlying mechanisms and which ingredients in cigarette smoke that influence preeclampsia risk may enhance our understanding of the pathogenesis of the disorder and contribute to the development of prevention strategies.

Swedish snuff, called "snus," is a kind of smokeless tobacco that is typically placed behind the upper lip. In contrast to cigarette smoking, which includes nicotine, carbon monoxide, and a large number of other products of combustion, Swedish snuff contains nicotine as the sole substance that has been implicated as a possible etiologic factor for adverse pregnancy outcomes.[6–8] The plasma nicotine levels have been found to be equivalent among habitual Swedish snuff users and cigarette smokers.[6] The use of smokeless tobacco has increased globally, especially in women of childbearing age.[8,9]

To our knowledge there is only one former study that has evaluated the effect of smokeless tobacco on preeclampsia risk.[10] The study was composed of data from the Swedish Medical Birth Register between 1999 and 2000, the 2 first years that snuff use was registered. The study only included 789 snuff users, and snuff users had, in contrast to smokers, an increased risk to develop preeclampsia.

In the present study, we had the opportunity to obtain data from an additional 6 years from the Swedish Birth Register, which made it possible to estimate potential effects of Swedish snuff on the risk of preeclampsia in greater detail, such as the risk of preeclampsia of a different severity. Furthermore, we compared the effect of Swedish snuff and cigarette smoking on the risk of preeclampsia to get indirect insights into whether it is nicotine or some combustion product that is responsible for the protective effect of smoking on the risk of preeclampsia. An additional aim was to estimate whether changes in tobacco habits during pregnancy affect the risk of developing preeclampsia.

Methods

We used information from the population-based Swedish Medical Birth Register to define the study population. Women born in the

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Nordic countries (Sweden, Norway, Denmark, Finland, or Iceland) who delivered a singleton infant during 1999–2006 were eligible for inclusion in our analysis (n=612 712). The Medical Birth Register contains data on >99% of all births in Sweden[11] and includes prospectively collected demographic data, information on reproductive history, and complications that occur during pregnancy, delivery, and the neonatal period. By means of each individual's unique national registration number, the birth register can be linked with other Swedish data sources. Women with prepregnancy diagnosis of chronic hypertension (n=3850) and/or pregestational insulin-dependent diabetes mellitus (n=4022) were excluded (identified at the first antenatal visit and/or at the discharge from hospital after the delivery, diagnosed according to the International Classification of Diseases, 10th version [ICD-10] codes O10, O11, O240, or O243).

At the time of registration for antenatal care, which occurs before week 15 of gestation in >95% of the pregnancies,[12] information about tobacco use is collected by midwives. Tobacco use is categorized as nontobacco user, snuff user, light smoker (1 to 9 cigarettes per day), and heavy smoker (≥10 cigarettes per day). In our study population, 7555 women were reported as snuff users, 41 121 as light smokers, and 16 806 as heavy smokers, and 480 reported that they used both snuff and cigarettes daily. In all, 39 818 women (6.5%) had missing information about tobacco use in early pregnancy. Women who were recorded as smokers but with missing information about snuff use (n=41 082) were included as smokers. Conversely, women who were recorded as snuff users but with missing information about smoking (n=2027) were included as snuff users. Women who were recorded as nonusers of one tobacco product but with missing information about the other (n=664) were included as nontobacco users.

Information about parity, family situation (living with or not living with the father to be), prepregnancy diseases, and body mass index (BMI) was also collected at this first antenatal visit. Information about maternal age was collected when the woman was discharged from the hospital. Through linkage with the Education Register, information on the number of years of formal education completed as of January 1, 2008, was obtained and categorized as ≤11 years or ≥12 years.

Complications during pregnancy and delivery were classified according to ICD-10 by the responsible doctor at discharge. Preeclampsia was defined as a rise in blood pressure (≥140/90 mm Hg) combined with proteinuria (≥0.3 g/24 hours or 2 urinary protein dip sticks of at least +1) occurring after 20 weeks of gestation (ICD-10 codes O140, O141, O149, or O15). Gestational hypertension was defined as a rise in blood pressure but without proteinuria (ICD-10 code O13). The qualities of these diagnoses have previously been validated previously; of 148 pregnancies coded as preeclampsia in the birth register, 137 subjects (93%) had the disease according to the individual records and among 115 pregnancies coded as gestational hypertension, and 97 subjects (84%) had the disease according to the records.[13] In Sweden, gestational age is assessed by ultrasound scans in 95% of women, usually around week 17 of gestation.[14] If no early second-trimester ultrasound scan was available, the first day of the last menstrual period was used to calculate gestational age at delivery. Small for gestational age (SGA) was defined as a birth weight of >2 SDs below the mean birth weight for gestational age according to the sex-specific Swedish fetal growth curves.[15] Stillbirth was defined as fetal death at ≤28 weeks of gestation; there is no information about the underlying cause of death.

We classified women with preeclampsia by severity of disease. First, we stratified women as having "term preeclampsia" (including women with preeclampsia and term birth [≥37 weeks]) and "preterm preeclampsia" (including women with preeclampsia and preterm birth [<37 weeks]). One woman with preeclampsia but no information about gestational length was excluded from this analysis. Second, we analyzed "preeclampsia without SGA or stillbirth" and "preeclampsia with SGA or stillbirth." In all, 112 women with preeclampsia and liveborn infants had missing information on gestational length or birth weight and were excluded from this analysis. Third, we used the ICD-10 codes to stratify women as having "mild preeclampsia" (ICD-10 codes O140 and O149) and "severe preeclampsia" (ICD-10 codes O141 and O15). Severe preeclampsia was defined as diastolic blood pressure of ≥110 mm Hg, and/or systolic blood pressure of ≥160 mm Hg, and/or proteinuria of ≥3 g/d or eclampsia.

In gestational weeks 30 to 32, a second interview about current tobacco habit was obtained in the study population using the same categorization of tobacco habits as at the first antenatal visit. To be able to estimate whether changes in tobacco habits during pregnancy affect the risk of developing preeclampsia, we created a second study population. Among the women in the former final study population (n=564 725), we lacked information about tobacco habits in gestational weeks 30 to 32 from 171 784 women, and 211 women had changed from using snuff in early pregnancy to cigarette smoking in late pregnancy or vice versa and 98 women had started to use both snuff and cigarettes. These women were excluded from the second study population. We wanted the women who started to use tobacco to be exposed for at least a few weeks before estimating the potential effect on preeclampsia and gestational hypertension risk and, therefore, excluded 13 393 women because of preterm delivery (before 37 weeks) and 19 women who had no information on gestational length at delivery. Our second study population, with information about tobacco habits from both the first antenatal visit and gestational week 30 to 32, consisted of 379 214 women with term deliveries (≥37 weeks).

The study was approved by the research ethics committee at Karolinska Institutet. The board did not require the women to provide informed consent.

SAS PROC GENMOD was used to estimate the association between tobacco exposure and preeclampsia risk. Odds ratios (ORs), presented with 95% CIs, were calculated before and after adjustments for maternal characteristics. The risks of preeclampsia and gestational hypertension were estimated in snuff users, light smokers, heavy smokers, and women who used snuff and smoked (dual users), with nontobacco users as the reference group. Women with missing information on tobacco consumption were excluded from analyses. Potential confounders considered were maternal age at delivery, early pregnancy BMI, parity, and years of formal education. There were no statistically significant interactions between tobacco use and the other exposure variables with respect to risk of preeclampsia or gestational hypertension ($P>0.05$, respectively). When we investigated whether tobacco exposure affected the risks of preeclampsia of a different severity, we also excluded dual users (because of low numbers). All of the analyses were performed using the SAS version 9.1 (SAS Institute, Inc).

Results

Compared with nontobacco users, women who used snuff at the first antenatal visit had a tendency toward a slightly higher risk of developing preeclampsia but no increased risk of gestational hypertension. Women who smoked had dose-dependent reductions in risks for preeclampsia and gestational hypertension (Table 1). Data from the Swedish Birth Register between 1999 and 2000 had been used in a previous study.[10] In the present study, 17% of the women defined as snuff users were delivered during 1999 and 2000 and were, therefore, also available for inclusion in the former study. When we repeated the analysis after restricting the study population to women giving birth in 2001–2006, snuff users had an OR for preeclampsia of 1.11 (95% CI: 0.95 to 1.29). There was a u-shaped relation between maternal age and risk of preeclampsia, with the highest risks in teenage women and women aged ≥35 years. Nulliparous women had a higher risk of preeclampsia and gestational hypertension than multiparous women. The risks of preeclampsia and gestational hypertension increased with early pregnancy BMI. The risk

Table 1. Adjusted ORs for Preeclampsia by Maternal Characteristics Among Nordic Women: Single Births in Sweden, 1999–2006

Maternal Characteristics	Total Births, n (n=605 023)	Preeclampsia (n=17 729)		Gestational Hypertension (n=5548)	
		Rate, %	Adjusted OR (95% CI)*	Rate, %	Adjusted OR (95% CI)*
Tobacco habit					
Nonuser	499 243	3.01	Reference	0.94	Reference
Snuff user	7555	3.41	1.11 (0.97 to 1.28)	0.86	0.89 (0.68 to 1.15)
Cigarette smoker					
1 to 9 cigarettes per day	41 121	2.32	0.66 (0.61 to 0.71)	0.62	0.64 (0.55 to 0.73)
>9 cigarettes per day	16 806	1.69	0.51 (0.44 to 0.58)	0.48	0.49 (0.39 to 0.62)
Snuff and cigarette user	480	2.71	0.74 (0.40 to 1.34)	1.46	1.61 (0.78 to 3.35)
Missing	39 818	3.11		1.08	
Maternal age, y					
<19	9763	4.45	1.20 (1.06 to 1.34)	0.58	0.82 (0.61 to 1.10)
20 to 24	69 769	3.70	Reference	0.78	Reference
25 to 29	193 416	3.04	0.98 (0.93 to 1.03)	0.85	1.19 (1.07 to 1.33)
30 to 34	219 897	2.58	1.02 (0.96 to 1.08)	0.88	1.41 (1.26 to 1.57)
≥35	112 178	2.85	1.30 (1.22 to 1.38)	1.24	2.07 (1.84 to 2.33)
Parity					
0	274 022	4.45	3.08 (2.97 to 3.19)	1.18	2.12 (2.00 to 2.26)
1 to 2	301 191	1.65	Reference	0.67	Reference
≥3	29 809	1.98	1.02 (0.92 to 1.12)	0.96	1.12 (0.97 to 1.29)
BMI, kg/m^2†					
<19.9	46 518	1.72	0.75 (0.70 to 0.81)	0.44	0.68 (0.58 to 0.78)
20.0 to 24.9	285 561	2.20	Reference	0.67	Reference
25.0 to 29.9	127 237	3.50	1.70 (1.64 to 1.77)	1.13	1.77 (1.65 to 1.90)
≥30.0	55 550	6.37	3.33 (3.18 to 3.48)	1.99	3.31 (3.06 to 3.58)
Missing	90 157	2.97		1.00	
Education, y					
<12	325 237	3.18	1.18 (1.13 to 1.22)	0.90	1.00 (0.94 to 1.07)
≥13	278 622	2.65	Reference	0.94	Reference
Missing	1164	2.75		0.60	

*Data were adjusted for early pregnancy BMI, maternal age, parity, and years of education.
†Data show BMI in early pregnancy.

of preeclampsia was higher for women with shorter formal education (<13 years).

Table 2 presents rates and adjusted ORs for preeclampsia by tobacco habits at first antenatal visit. Compared with women who did not use tobacco, women who used snuff at the first antenatal visit had a slightly higher risk to develop preeclampsia with preterm birth (adjusted OR: 1.30 [95% CI: 1.00 to 1.70]), whereas snuff users did not have an increased risk to develop preeclampsia with term birth. Snuff users also had a tendency of a stronger association with preeclampsia with an SGA or stillbirth (adjusted OR: 1.35 [95% CI: 0.94 to 1.93]) than with preeclampsia without an SGA or stillbirth (adjusted OR: 1.09 [95% CI: 0.94 to 1.26]). Compared with nontobacco users, women who were cigarette smokers at the first antenatal visit had reduced risks of developing preeclampsia of any severity. However, there was no protective effect of smoking on preeclampsia with an SGA or stillbirth, and heavy smokers appeared, if anything, to have an increased risk of development (adjusted OR: 1.26 [95% CI: 0.97 to 1.65]). This is to be compared with an adjusted OR of 0.41 (95% CI: 0.35 to 0.48) for heavy smokers to develop preeclampsia without an SGA or stillbirth.

We had information on tobacco habits both from the first antenatal visit and from 30 to 32 gestational weeks in 379 214 term pregnancies. Of these, 2.3% developed preeclampsia and 0.9% gestational hypertension. Compared with women who did not use tobacco during pregnancy, women who smoked both at the first antenatal visit and at 30 to 32 gestational weeks had reduced risks of term preeclampsia and gestational hypertension (adjusted ORs: 0.50 [95% CI: 0.45 to 0.56] and 0.48 [95% CI: 0.40 to 0.58], respectively; Table 3). In contrast, women who smoked at the first antenatal visit but had quit smoking before 30 to 32 gestational weeks did not have reduced risks (adjusted ORs: 0.94 [95% CI: 0.83 to 1.08] and 0.92 [95% CI: 0.73 to 1.16], respectively). Women who did not use tobacco at the first antenatal visit but had started to smoke before 30 to 32

Table 2. Rates and Adjusted ORs for Preeclampsia by Severity Depending on Tobacco Habits at First Antenatal Visit

	Term Preeclampsia			Preterm Preeclampsia		
Tobacco Habit	No.	Rate, %	Adjusted OR (95% CI)*	No.	Rate, %	Adjusted OR (95% CI)*
Nontobacco user	11 854	2.37	Reference	3128	0.63	Reference
Snuff user	198	2.62	1.06 (0.91 to 1.24)	60	0.79	1.30 (1.00 to 1.70)
Cigarette smoker						
1 to 9 cigarettes per day	741	1.80	0.65 (0.60 to 0.71)	213	0.71	0.70 (0.61 to 0.82)
>9 cigarettes per day	203	1.21	0.46 (0.39 to 0.53)	81	0.48	0.72 (0.56 to 0.91)
	Preeclampsia Without SGA or Stillbirth			Preeclampsia With SGA or Stillbirth		
Nontobacco user	13 243	2.67	Reference	1643	0.33	Reference
Snuff user	226	3.01	1.09 (0.94 to 1.26)	32	0.43	1.35 (0.94 to 1.93)
Cigarette smoker						
1 to 9 cigarettes per day	784	1.92	0.61 (0.56 to 0.66)	162	0.40	1.08 (0.90 to 1.28)
>9 cigarettes per day	210	1.26	0.41 (0.35 to 0.48)	67	0.40	1.26 (0.97 to 1.65)
	Mild Preeclampsia			Severe Preeclampsia		
Nontobacco user	10 270	2.06	Reference	4713	0.94	Reference
Snuff user	176	2.33	1.09 (0.92 to 1.29)	82	1.09	1.17 (0.93 to 1.47)
Cigarette smoker						
1 to 9 cigarettes per day	695	1.69	0.70 (0.64 to 0.76)	259	0.63	0.59 (0.51 to 0.67)
>9 cigarettes per day	208	1.24	0.53 (0.45 to 0.62)	76	0.45	0.46 (0.36 to 0.60)

*Data were adjusted for early pregnancy BMI, maternal age, parity, and years of education.

gestational weeks had a reduced risk of developing term preeclampsia (adjusted OR: 0.65 [95% CI: 0.50 to 0.85]) and possibly also a reduced risk of gestational hypertension (adjusted OR: 0.69 [95% CI: 0.44 to 1.07]). Snuff use or change of snuff use did not appear to influence the risk of developing term preeclampsia or gestational hypertension (Table 3).

Discussion

Cigarette smoking but not snuff use during pregnancy decreased the risk for the development of preeclampsia and gestational hypertension. Because nicotine is the major common ingredient in cigarette smoke and snuff, the protective effect of cigarette smoke is probably not mediated by nicotine but rather by some ingredient(s) in combustion. Persistent smoking during pregnancy reduced the risk of term preeclampsia, whereas corresponding risk among women who stopped smoking was similar to that of nontobacco users.

A 2-stage model has been implicated in the pathophysiology of preeclampsia. The first stage is abnormal placentation, and the second stage is mediated by a hypoxic and dysfunctional placenta that releases some factor into the maternal circulation that causes the clinical features of the disease.[16]

Table 3. Rates and Adjusted OR for Preeclampsia, Gestational Hypertension, and Preeclampsia or Gestational Hypertension Among Term Pregnancies (≥37 Gestational Weeks) by Maternal Tobacco Habits at the First Antenatal Visit and Gestational Weeks 30 to 32

Tobacco Habit			Preeclampsia			Gestational Hypertension			Preeclampsia or Gestational Hypertension		
First Antenatal Visit	Weeks 30 to 32	Total No.	No. of Cases	Rate, %	Adjusted OR (95% CI)*	No. of Cases	Rate, %	Adjusted OR (95% CI)*	No. of Cases	Rate, %	Adjusted OR (95% CI)*
Nontobacco user	Nontobacco user	331 085	7876	2.4	Reference	3034	0.92	Reference	10 910	3.30	Reference
Smoker	Smoker	29 037	393	1.4	0.50 (0.45 to 0.56)	130	0.45	0.48 (0.40 to 0.58)	523	1.80	0.48 (0.44 to 0.53)
Smoker	Nontobacco user	9596	274	2.9	0.94 (0.83 to 1.08)	82	0.85	0.92 (0.73 to 1.16)	356	3.71	0.94 (0.83 to 1.05)
Nontobacco user	Smoker	3480	61	1.8	0.65 (0.50 to 0.85)	21	0.60	0.69 (0.44 to 1.07)	82	2.36	0.66 (0.52 to 0.83)
Snuff	Snuff	1861	42	2.3	1.03 (0.74 to 1.42)	12	0.64	0.71 (0.39 to 1.29)	54	2.90	0.93 (0.70 to 1.24)
Snuff	Nontobacco user	3438	83	2.4	0.99 (0.79 to 1.25)	25	0.73	0.82 (0.54 to 1.22)	108	3.14	0.94 (0.77 to 1.15)
Nontobacco user	Snuff	717	19	2.7	0.93 (0.56 to 1.57)	7	0.98	1.19 (0.56 to 2.51)	26	3.63	1.00 (0.65 to 1.54)

*Data were adjusted for early pregnancy BMI, maternal age, parity, and years of education.

The antiangiogenic protein soluble fms-like tyrosine kinase 1 (sFlt1) is the strongest candidate today to be this circulating factor,[17] and sFlt1 levels start to increase ≈5 weeks before the onset of clinical signs of preeclampsia.[18] Earlier studies indicate that cigarette smokers have lower circulating levels of sFlt1 than nontobacco users.[19,20] In vitro studies have reported that carbon monoxide, a major component in combustion, diminishes sFlt1 release from cultured endothelial cells,[21] whereas nicotine does not influence the production of sFlt1 from cultured placental cells.[22] Our findings of a lower risk of preeclampsia in cigarette smokers, who are exposed to carbon monoxide, but not in snuff users, who are only exposed to nicotine, are in agreement with these results.

Women who used snuff had a slightly increased risk of developing preterm but not term preeclampsia and may also have a stronger association with preeclampsia complicated with SGA or stillbirth than with preeclampsia without SGA or stillbirth. Smokers generally had a reduced risk of developing preeclampsia of all kinds of severity, except for preeclampsia with SGA or stillbirth. Preeclampsia, preterm birth, intrauterine growth restriction, and stillbirth are all pregnancy complications associated with abnormal placentation.[23–25] We speculate that our findings indicate that both snuff and cigarette smoke are associated with abnormal placentation and that some common ingredient, such as nicotine, may affect placentation. In the development of preeclampsia, nicotine may affect the first stage, the placentation, but not the second stage, the development of a clinical disease. This could explain why snuff users may only have increased risks of developing preeclampsia with placental involvement (ie, preterm birth, SGA, and stillbirth). Smokers are not only continuously exposed to nicotine but also to products of combustion. As discussed above, ingredients in combustion (ie, carbon monoxide) probably protect the women from developing the second stage of preeclampsia. However, carbon monoxide forms carboxyhemoglobin, which inhibits the release of oxygen into fetal tissues.[26] Thus, carbon monoxide probably acts synergistic to consequences of abnormal placentation, resulting in aggravated fetal growth restriction.

There are previous reports of a decreased risk of pregnancy-induced hypertension in women who quit smoking in the beginning of pregnancy,[27,28] although the decrease was not significant in one of the studies.[28] The inclusion and exclusion criteria in our study are, however, quite different from those of the former studies. Importantly, in the previous reports, records of smoking habits were only available from one time point during pregnancy (at 13 to 27 and 13 to 21 weeks' gestation, respectively). Women who reported that they had smoked earlier in the pregnancy but had quit at this time point were included as quitters. Approximately 10% of women who stop smoking in early pregnancy are estimated to resume later in pregnancy,[29] and potentially resuming may have contributed to the protective effect.

To our knowledge, there is only one former study of a potential association between smokeless tobacco and preeclampsia. The study included deliveries between 1999 and 2000 in the Swedish Birth Register and reported that snuff use increased the risk of preeclampsia (OR: 1.58 [95% CI: 1.09 to 2.27]).[10] The larger study sample made it possible for us to estimate preeclampsia risks with more precision and in more detail. In this extended investigation, we only found snuff use to be associated with an increased risk of preterm preeclampsia.

A major strength of the present study is the nationwide population-based design with information on current tobacco use both from the first antenatal visit and from gestational weeks 30 to 32. Other than the adjustment for possible confounding variables, the relatively homogeneous population of women born in the Nordic countries and the use of standardized records should further minimize the potential for confounding by unmeasured sociodemographic factors or differences in management. Additional strengths of the study are that information about current tobacco use was collected by interviews during pregnancy, before onset of potential adverse pregnancy outcomes, which precludes recall bias.

The major weakness in this study is the self-reported information on tobacco use during pregnancy; we had no access to cotinine levels that could confirm the information. Most women in Sweden are aware of potential adverse effects of tobacco on pregnancy outcomes, and underreporting of actual use of tobacco used must be considered. Self-reported information on smoking during pregnancy is reported as rather valid in Sweden,[30] whereas similar information on snuff use is missing. Another weakness is that we only have information about tobacco exposure at 2 time points during pregnancy. It is likely that many women who do not smoke at the first antenatal visit (commonly occurring before 15 gestational weeks)[12] but have started to smoke in gestational weeks 30 to 32 are former smokers.[2] Thus, it is plausible that some women in this group were cigarette smokers during the first weeks of pregnancy.

Perspectives

In contrast to cigarette smoking, Swedish snuff use during pregnancy did not reduce the risk of preeclampsia. Therefore, nicotine does not seem to be the protective ingredient against preeclampsia in cigarette smoke. It is the smoking habits in the middle or end of pregnancy that primarily seems to affect the risk of preeclampsia.

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Disclosures

None.

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