

ORIGINAL ARTICLE

## Smoking during pregnancy: A population-based study

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### Abstract

**Aims:** Tobacco is a major cause of disease and mortality in modern times. The risk of smoking in pregnancy is a serious threat to the development and future health of an unborn child. The aim of this study was to explore the epidemiological factors associated with smoking during pregnancy in a primary healthcare setting. **Methods:** All 856 maternity records at the Glaesibaer Health Care Centre in Reykjavik during 2006–2013 were reviewed and information on smoking habits investigated. **Results:** The records showed that in 108 (12.2%) pregnancies, women smoked at first visit and 63 stopped smoking in early pregnancy, leaving 45 (5.3%) mothers smoking throughout the whole gestational period. The mean age of the smoking women was 27.8 years and for the non-smokers 29.7 years. Low social status (odds ratio (OR) = 2.66; 95% confidence interval (CI): 1.19–5.96), previous mental health diagnosis (OR = 2.7; 95% CI: 1.3–5.6), and unstable relationship with a partner (OR = 3.78; 95% CI: 2.1–7.0) were associated with smoking. Smoking fewer cigarettes was associated with a 0.04-unit lower risk of smoking during pregnancy (OR = 0.04; 95% CI: 0.02–0.08). **Conclusions: Our results indicated that the women who smoked during pregnancy were often heavy smokers and living without a partner. They were younger, had worse mental health, and a lower social status than those pregnant women who did not smoke. Bearing in mind the consequence of smoking in pregnancy, this subgroup should get increased assistance to quit smoking before and during early pregnancy, as well as appropriate medical and social support.**

**Key Words:** Smoking, pregnancy, social status, education, age, tobacco use, mental health, medicines in pregnancy

### Introduction

Tobacco is still a major cause of disease and mortality in modern times. Smoking and its related nicotine dependency often begins during adolescence and half of its users will die because of the devastating effects smoking has on human health [1]. The prevalence of smoking by women of childbearing age is the same as for the society in general, and about half of the pregnant women were able to quit smoking [2]. Smoking is a serious threat to the development of the unborn child. Its malicious effects are caused by the teratotoxins in the tobacco and nicotine, which is a highly addictive substance [1,2]. This risk also applies to the use of smokeless tobacco [3]. Tobacco use in pregnancy increases the risk of miscarriages, placental abruption and stillbirths, as well as sudden infant

death [4,5]. The newborn children of smoking mothers have been shown to be smaller, and preterm deliveries are more common than for non-smoking mothers [6,7]. Smoking has also been associated with birth defects, including congenital heart defects, musculoskeletal defects, spina bifida, orofacial clefts, and gastrointestinal malformations [8]. Maternal smoking and nicotine replacement therapy are related to attention deficit hyperactivity disorder (ADHD) in children [9,10]. Additionally, maternal smoking may have consequences later in life, such as mental illness including psychotic symptoms in young people [11]. While children born of smoking mothers have lower preterm weight, they paradoxically have increased weight and lower height in childhood [5,12,13]. Thus,

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it is imperative that women of childbearing age are educated about the risk of smoking during pregnancy for the future health of their babies and that by quitting smoking, the risk appears to return to normal [14,15]. Iceland, like many other countries, has a comprehensive tobacco control policy with mass coverage of tobacco banned, and tobacco products must not be visible at the point of sale. Bars and restaurants are smoke-free [16].

The aim of this study was to assess the maternal social characteristics and health determinants of smoking in pregnant women, including the prevalence and quitting rate of smoking, age, social status, mental health, and smoking habits.

## Methods

The study was conducted at the Glaesibaer Health Care Centre in Reykjavik, the capital and largest city in Iceland. The centre provides primary healthcare service to approximately 9000 individuals and is staffed by five family physicians and two midwives. The centre opened in January 2006 and is run by the state. The residents in this area of the capital are of average socioeconomic status, but the mean age of its inhabitants is high. The study included all women who had attended maternity care over an eight-year period, from the beginning of 2006 to the end of 2013. Information about smoking habits, including number of cigarettes smoked per day, prior to and during pregnancy, as well as marital status, ethnicity, age, social status, and educational background, were collected retrospectively from the participants' maternity records. Social class was estimated from both education and occupation, as is often done [17]. Women in the lowest social class were receiving social benefits, an invalidity pension, were officially unemployed, or were simply neither working nor in school. The records also contained information about the subjects' physical and mental health, and their use of medicines.

### *The cohort*

The total number of women included in the study was 724, but the number of pregnancies was 856, as in 132 cases the women had more than one pregnancy during the time of the study. There was no difference in smoking between women with multiple pregnancies and those with a single pregnancy. There were nine pairs of twins born during the study and they are registered as a single pregnancy for each birth. In the cohort, there were two spontaneous abortions, one medical abortion, three preterm births, one foetus died in week 26 caused by

placental ablation, and one stillbirth occurred in week 39.

The study was accepted by The Data Protection Authority (number 2012/845) and by the National Ethics Committee of Iceland (number 12-137-S1).

**Statistics:** Pearson's chi-square was used to compare the variables for smokers and non-smokers. A multiple logistic regression was conducted and odds ratios (ORs) were used to evaluate risk factors associated with smoking during pregnancy. The calculations were carried out with the SAS Enterprise Guide, version 7.1 (SAS Institute Inc., Cary, NC) and statistical significance set as  $p < 0.05$ .

## Results

The mean age of the participants was 29.6 years, with the youngest being 16 years and the oldest 49 years. The records showed that in 108 (12.2%) pregnancies, women smoked prior to the pregnancy and 63 stopped smoking, leaving 45 (5.3%) mothers smoking throughout the entire gestational period. The smoking mothers were significantly younger – the mean age was 27.8 years compared to 29.7 years for the non-smokers group (OR = 1.07; 95% confidence interval (CI): 1.0–1.1). Smokers were more likely to be single mothers or 46.7% compared to 19% of the non-smoking group (OR = 3.78; 95% CI: 2.1–7.0). No difference was observed between women of different ethnicities. A similar proportion of immigrant women smoked compared to native Icelanders (OR = 0.76; 95% CI: 0.31–1.82) (Table I). Of the 45 women that smoked through pregnancy, some 16 (35%) smoked 1–10 cigarettes a day, and seven (19%) of them smoked more than 10 cigarettes a day; of the 63 women who quit smoking, there were 12 (15%) who had smoked 1–10 cigarettes and two (3%) who had smoked more than 10 cigarettes. A low educational level and receiving an invalidity pension or social benefits were related to smoking in pregnancy (OR = 2.66; 95% CI: 1.19–5.96) (Table II).

Women who smoked during pregnancy more often had a diagnosis of depression and anxiety (OR = 2.7; 95% CI: 1.3–5.6), and were more likely to be receiving treatment for mental disorders (OR = 2.7; 95% CI: 1.0–7.2) (Table III). The variables of mental health, using psychopharmaceuticals, age, social status, living alone, and the amount of smoking, were associated with smoking during pregnancy when analysed separately (see Table IV). However, by adjusting paired variables with multiple logistic regression analysis, only two variables were associated with smoking during pregnancy. Living with a partner had a 0.24-unit lower risk of smoking during

Table I. Smoking during pregnancy with some demographic factors.

	Smokers		Non-smokers		OR (95% CI)
	N	%	N	%	
Number in study <sup>a</sup>	108	(12.6)	748		
During pregnancy <sup>a</sup>	45	(5.3)	811		
Quit <sup>a</sup>	63/108	(58)			
<b>Number of children</b>					
None <sup>a</sup>	20	(44.4)	351	(41)	
One <sup>a</sup>	16	(35.6)	295	(34)	
Two <sup>a</sup>	7	(15.6)	134	(15.6)	
Three or more	2	(4.5)	31	(6.6)	0.95 (0.5–1.7)
<b>Mean age<sup>a</sup></b>	27.8	SD 5.9	29.7	SD 5.4	1.07 (1.0–1.1)
20<	3	(14.2)	18	(85.8)	
20–24	9	(6.7)	125	(93.3)	
25–29	15	(5.5)	255	(94.4)	
30–34	13	(4.9)	249	(95.1)	
35–39	4	(2.7)	141	(97.3)	
40–44	1	(4.5)	20	(95.5)	
Older than 45	0	(0)	3	(100)	
Living with a partner <sup>b</sup>	24	(53.3)	657	(81.2)	
Single <sup>b,*</sup>	21	(46.7)	152	(19)	3.78 (2.1–7.0)
<b>Country of origin<sup>b</sup></b>					
Iceland	39	(86.7)	674	(83.1)	1
Scandinavia		0	2	(0.2)	
Poland	3	(6.7)	29	(3.6)	1.79 (0.52–6.13)
Thailand	1	(2.2)	9	(1.1)	1.0 (0.24–15.54)
Other EU countries	2	(4.4)	24	(3.0)	1.24 (0.33–6.32)
Southeast Asia	0	0	23	(2.8)	
Other countries outside Europe	0	0	50	(6.7)	
Total	6/45	(13.3)	137/811	(16.8)	0.76 (0.31–1.82)

<sup>a</sup>Continuous variable.

<sup>b</sup>Dichotomous variable.

\*Information on the exact marital status of two women are missing; thus, 854 in this category.

OR: odds ratio; CI: confidence interval; SD: standard deviation; EU: European Union.

Table II. Smoking during pregnancy and social background of the mothers. Comparing the OR of each class to all cohorts.

Social group <sup>a</sup>	Smoking		Not smoking		OR (95% CI)
	N	%	N	%	
University degree/specialist	1	(2.2)	237	(28.9)	0.06 (0.01–0.40)
Student	4	(8.9)	127	(15.7)	0.53 (0.18–1.49)
Learned trade/medium education	11	(24.4)	135	(16.7)	1.62 (0.80–3.28)
Workers/low education	21	(46.7)	251	(30.9)	1.96 (1.07–3.59)
Social benefits/not working	8	(17.7)	61	(7.5)	2.66 (1.19–5.96)
Total	45		811		

<sup>a</sup>Dichotomous variable.

OR: odds ratio; CI: confidence interval.

pregnancy (OR = 0.24; 95% CI: 0.11–0.52) and smoking fewer cigarettes had a 0.04-unit lower risk of smoking during pregnancy (OR = 0.04; 95% CI: 0.02–0.08) (Table IV).

## Discussion

It is estimated that some 5%–10% of pregnant women in Iceland smoke [18]. However, it has to be

taken into consideration that pregnant women may tend to underestimate or deny their smoking habits. Smoking by pregnant women is thought to be 25% more prevalent than they admit to the health provider. This was found by a comparison between cotinine measurement in the blood and the answers to questions, and the difference was even greater among pregnant women which are better off socially, where the pressure to quit smoking is greater [19]. In

Table III. Mental health and use of medicines, including SSRI inhibitors and smoking during pregnancy. Smoking during pregnancy compared to non-smokers.

	Smoker		Non-smoker		OR (95% CI)
	N	%	N	%	
Mentally healthy <sup>a</sup>	35	(78)	733	(90)	
Depression <sup>a</sup>	7	(16)	33	(4)	4.4 (1.8–10.7)
Anxiety <sup>a</sup>	2	(4)	26	(3)	1.6 (0.4–7.1)
Depression and anxiety <sup>a</sup>	1	(1)	19	(2)	1.1 (0.1–8.5)
All mental disorders	10/45	(22)	78/811	(9.6)	2.7 (1.3–5.6)
Using medicine <sup>*</sup>	5	(11.9)	37	(4.5)	2.7 (1.0–7.2)
Not using medicine <sup>a</sup>	40	(88.1)	774	(95.5)	

<sup>a</sup>Dichotomous variable.

<sup>\*</sup>Medication for anxiety or depression, such as SSRI, sleep medicine, medicines for ADHD.

SSRI: selective serotonin reuptake inhibitors; OR: odds ratio; CI: confidence interval.

Table IV. Multivariate logistic regressions evaluating the factors involved, showing that living with a partner and smoking fewer cigarettes before pregnancy diminished the risk of smoking during pregnancy.

Variable	Unadjusted		Adjusted without number of cigarettes		Adjusted with number of cigarettes	
	OR	(95% CI)	OR	(95% CI)	OR	(95% CI)
Age <sup>a</sup>	1.1	(1.0–1.1)	0.983	(0.9–1.0)	0.99	(0.94–1.06)
Mental health <sup>b</sup>	2.7	(1.3–5.6)	2.0	(0.7–5.2)	2.51	(0.86–7.33)
Cohabiting/living alone <sup>b</sup>	0.3	(0.1–0.5)	0.3	(0.18–0.7)	0.24	(0.11–0.52)
Psychopharmaceuticals <sup>b</sup>	2.6	(1.0–7.0)	0.9	(0.3–3.7)	0.23	(0.03–1.69)
Low social status <sup>b,c</sup>	0.4	(0.17–0.84)	1.6	(0.8–3.5)	1.29	(0.44–3.79)
Number of cigarettes <sup>a,d</sup>	28.0	(13.0–60.9)			27.7	(12.7–60.8)

<sup>a</sup>Continuous variable.

<sup>b</sup>Dichotomous variable.

<sup>c</sup>In the regression classified as 1, all other as 0.

<sup>d</sup>Number of cigarettes: 1–10/day registered as 1, 11+ registered as 2.

OR: odds ratio; CI: confidence interval.

Australia, some 7%–17% of pregnant women smoke [20–22]. Similar results were found in a study in the US where about 11% smoked prenatally [23], and another from the UK where 5% of women smoked during pregnancy [24]. In Scotland, about 25% of the pregnant women smoked and only 2–4% of them managed to quit smoking while pregnant [25]. These findings can be compared to studies from Australia where 4–5% were able to quit [20,22]. In some other studies, up to half of the pregnant women were able to quit smoking [2].

The results presented here indicate that women without a partner, with a high nicotine dependency, who are younger, with low social status, and with a history of mental disorders are at increased risk of smoking during pregnancy. In our study, 63 women out of 108 (58%) stopped smoking before or during pregnancy, which was a higher proportion than in a study from Michigan, USA, with quitting rates of 39% [26]. Our results were similar to an Australian study where some 7% smoked during pregnancy, and these women had a moderate to heavy nicotine dependency,

were younger, had a lower education level, unemployed, and more often living without a partner [22]. In the present study, women with anxiety and depression were more likely to smoke during pregnancy – a finding which is consistent with other findings [26,27].

This vulnerable group of women should certainly be a prime target of support in the first trimester of their pregnancy while attending maternity healthcare service. There are strong indications that a consulting service and paid nicotine replacement therapy can diminish smoking amongst gravid women [28]. There is much to gain, as quitting early in the pregnancy has been shown to diminish the risk of malformation to almost a normal risk level [29]. Controlling smoking as a part of preventive healthcare programs in the society at large is an important way to reduce smoking among the general population, and the benefits are well documented for maternal smoking as well. Raising the price of tobacco through higher taxes and legislation mandating a smoke-free working environment are well-known ways to diminish smoking amongst pregnant women [30,31].

Smoking during pregnancy has both ethical and political aspects. It is the prime duty of governments of all societies to protect the public from harm. This has been the core of the social contract from ancient times. The Roman politician and philosopher Cicero declared: ‘Salus populi suprema lex esto’ – The safety of the people is the supreme law. The famous British politician Disraeli proclaimed: ‘It is the first duty of statesmen to protect public health’ [32].

The unborn person has no means to protect itself. Ethically, this is a strong argument that the law and policymakers, and society as a whole, should protect its children by legally restricting the distribution and trading of tobacco [32].

The strength of this study is that it covered a clearly defined sector of the capital city of Reykjavik, Iceland, as the primary health maternity care service is provided in this area or district of the city. The sample is thought to be representative of the population of Reykjavik as a whole.

As the study was retrospective in nature, all women who attended during the eight-year period were included, so neither families who were well off, nor those in a difficult social situation, could exclude themselves. This type of study has its obvious and known weaknesses. We were not directly interacting with the mothers who would possibly have answered the questions in another way. We built our observations on documents from the maternity care papers that are usually well written and punctilious, but on occasion had to be interpreted by us; for example, how to classify the recorded job according to its status in the social hierarchical order.

## Conclusion

Our results indicate that the women who smoked during pregnancy had a history of smoking more cigarettes. They were often living without a partner, were younger, had worse mental health, and a lower social status than those pregnant women who did not smoke. Bearing in mind the potential consequences of smoking in pregnancy, this subgroup should get increased assistance to quit smoking before and during early pregnancy, as well as appropriate medical and social support.

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## References

- [1] Centers for Disease Control and Prevention. The biology and behavioral basis for smoking-attributable disease: a report of the Surgeon General, <http://www.ncbi.nlm.nih.gov/pubmed/21452462> (2010, accessed 25 November 2015).
- [2] Anderka M, Romitti PA, Sun L, et al. Patterns of tobacco exposure before and during pregnancy. *Acta Obstet Gynecol Scand* 2010;89(4):505–14.
- [3] Baba S, Wikstrom A, Stephansson O, et al. Influence of snuff and smoking habits in early pregnancy on risks for stillbirth and early neonatal mortality. *Nicotine Tob Res* 2014;16(1):78–83.
- [4] Cnattingius S. The epidemiology of smoking during pregnancy: smoking prevalence, maternal characteristics, and pregnancy outcomes. *Nicotine Tob Res* 2004;6(Suppl 2):S125–40.
- [5] Andres RL and Day M-C. Perinatal complications associated with maternal tobacco use. *Semin Neonatol* 2000;5(3): 231–41.
- [6] Ananth CV and Platt RW. Reexamining the effects of gestational age, fetal growth, and maternal smoking on neonatal mortality. *BMC Pregnancy Childbirth* 2004;4(1):22.
- [7] Gardosi J and Francis A. Early pregnancy predictors of preterm birth: the role of a prolonged menstruation-conception interval. *Int J Obstet Gynaecol* 2000;107(2):228–37.
- [8] Hackshaw A, Rodeck C and Boniface S. Maternal smoking in pregnancy and birth defects: a systematic review based on 173,687 malformed cases and 11.7 million controls. *Hum Reprod Update* 2011;17(5):589–604.
- [9] Obel C, Linnet KM, Henriksen TB, et al. Smoking during pregnancy and hyperactivity-inattention in the offspring—comparing results from three Nordic cohorts. *Int J Epidemiol* 2009;38(3):698–705.
- [10] Zhu J, Olsen J, Liew Z, et al. Parental smoking during pregnancy and ADHD in children: the Danish national birth cohort. *Pediatrics* 2014;134(2):382–8.
- [11] Zammit S, Thomas K, Thompson A, et al. Maternal tobacco, cannabis and alcohol use during pregnancy and risk of adolescent psychotic symptoms in offspring. *Br J Psychiatry* 2009;195(4):294–300.
- [12] Gorog K, Pattenden S, Antova T, et al. Maternal smoking during pregnancy and childhood obesity: results from the CESAR study. *Matern Child Health J* 2011;15(7): 985–92.
- [13] Ino T, Shibuya T, Saito K, et al. Effects of maternal smoking during pregnancy on body composition in offspring. *Pediatr Int* 2011;53(6):851–7.
- [14] Bailey BA, McCook JG, Hodge A, et al. Infant birth outcomes among substance using women: why quitting smoking during pregnancy is just as important as quitting illicit drug use. *Matern Child Health J* 2012;16(2):414–22.

- [15] Seybold DJ, Broce M, Siegel E, et al. Smoking in pregnancy in West Virginia: does cessation/reduction improve perinatal outcomes? *Matern Child Health J* 2012;16(1):133–8.
- [16] News analysis. Iceland: a pioneer's saga. *Tob Control* 2007;16:364.
- [17] Galobardes B, Lynch J and Smith GD. Measuring socio-economic position in health research. *Br Med Bull* 2007;81–82(1):21–37.
- [18] Erlingsdottir A, Sigurdsson EL, Jonsson JS, et al. Smoking during pregnancy: childbirth and health study in primary care in Iceland. *Scand J Prim Health Care* 2014;32(1):11–6.
- [19] Shipton D, Tappin DM, Vadiveloo T, et al. Reliability of self-reported smoking status by pregnant women for estimating smoking prevalence: a retrospective, cross-sectional study. *BMJ* 2009;339:b4347.
- [20] Rattan D, Al Mamun A, Najman JM, et al. Smoking during pregnancy—need for consistent Public Health data in Australia. *Aust NZ J Public Health* 2011;35(5):406–7.
- [21] Mohsin M, Bauman AE and Forero R. Socioeconomic correlates and trends in smoking in pregnancy in New South Wales, Australia. *J Epidemiol Community Health* 2010;65:727–32.
- [22] Hoekzema L, Werumeus Buning A, Bonevski B, et al. Smoking rates and smoking cessation preferences of pregnant women attending antenatal clinics of two large Australian maternity hospitals. *J Obstet* 2014;54(1):53–8.
- [23] Tong VT, Dietz PM, Farr SL, et al. Estimates of smoking before and during pregnancy, and smoking cessation during pregnancy: comparing two population-based data sources. *Public Health Rep* 2013;128(3):179.
- [24] Anonymous. Women smoking while pregnant “lowest on record”. *Community Pract J Community Pract Health Visit Assoc* 2014;87(8):7.
- [25] Tappin DM, MacAskill S, Bauld L, et al. Smoking prevalence and smoking cessation services for pregnant women in Scotland. *Subst Abuse Treat Prev Policy* 2010;5(1):1.
- [26] Holtrop JS, Meghea C, Raffo JE, et al. Smoking among pregnant women with Medicaid insurance: are mental health factors related? *Matern Child Health J* 2010;14(6):971–7.
- [27] Maxson PJ, Edwards SE, Ingram A, et al. Psychosocial differences between smokers and non-smokers during pregnancy. *Addict Behav* 2012;37(2):153–9.
- [28] Adams EK, Markowitz S, Dietz PM, et al. Expansion of Medicaid covered smoking cessation services: maternal smoking and birth outcomes. *Medicare Medicaid Res Rev* 2013;3(3):pE1–E22.
- [29] Raisanen S, Sankilampi U, Gissler M, et al. Smoking cessation in the first trimester reduces most obstetric risks, but not the risks of major congenital anomalies and admission to neonatal care: a population-based cohort study of 1,164,953 singleton pregnancies in Finland. *J Epidemiol* 2014;68(2):159–64.
- [30] Adams EK, Markowitz S, Kannan V, et al. Reducing prenatal smoking: the role of state policies. *Am J Prev Med* 2012;43(1):34–40.
- [31] Page RL, Slejko JF and Libby AM. A citywide smoking ban reduced maternal smoking and risk for preterm births: a Colorado natural experiment. *J Women's Health* 2012;21(6):621–7.
- [32] Hodge JG and Eber GB. Tobacco control legislation: tools for public health improvement. *J Law Med Ethics* 2004;32(3):516–23.