Associations Between Maternal Stress and Smoking: Findings from a Population-Based Prospective Cohort Study

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Abstract

Aims—To investigate associations between maternal stress and smoking prior to, during, and six months after the pregnancy.

Design—A prospective population-based cohort study.

Setting—Norway.

Participants—71,757 women in the Norwegian Mother and Child Cohort Study (MoBa) participating twice during pregnancy and at six months postpartum.

Measurements—Respondents' estimates of anxiety and depression, relationship discord, and negative life events were measured along with self-reports of smoking behaviour and demographic variables. Smoking was assessed at gestation weeks 17 and 30 and at six months postpartum.

Findings—Of the 27.5% women who smoked at conception, 55.8% quit smoking during pregnancy. At six months postpartum, 28.9% of quitters had relapsed to smoking. In total, 12.9% of the sample reported smoking during the pregnancy. Adjusted for well-known risk factors, women reporting high levels of anxiety and depression had a decreased likelihood of quitting smoking during pregnancy (OR 0.80: 95% CI 0.73, 0.88) and an increased likelihood of relapsing after delivery (OR 1.26: 95% CI 1.11, 1.44). Both relationship discord (OR 0.82: 95% CI 0.75, 0.90) and exposure to negative life events (OR 0.93: 95% CI 0.90, 0.96) had a negative influence on quitting smoking during pregnancy but had no influence on relapse to smoking postpartum.

Conclusions—Maternal stress and relationship discord may inhibit smoking cessation during pregnancy and promote resumption of smoking after pregnancy in women who have achieved abstinence.

Keywords

Anxiety; Depression; Pregnancy; Risk Factors; Smoking; Smoking Cessation

INTRODUCTION

Despite readily available knowledge of its harmful effects, many women of fertile age smoke and continue to do so also after becoming pregnant [1, 2]. Apart from risks to their own health, women smoking during pregnancy run an increased risk of pregnancy

complications and expose their unborn to serious health hazards [3, 4]. Due to public health efforts and a general decline in smoking acceptance during pregnancy, a considerable proportion of expectant mothers manage to quit smoking once they discover they are pregnant [5, 6]. However, about half of all quitters resume smoking shortly after childbirth [7, 8]. Known risk factors for maternal smoking include being a young mother, having low educational attainment and income, being single, higher parity, having an unplanned or mistimed pregnancy, consuming alcohol, and having a smoking partner [9–11]. However, many of these factors are not readily susceptible to change and indicate that knowledge about additional factors is needed.

Given the significant risks that smoking poses to both the mother and the unborn child, it may help develop interventions to identify risk factors that could be ameliorated [11]. From studies in the general population we know that smoking is more prevalent among individuals experiencing stressful life events [12]. Nicotine from cigarette smoking may be the most readily accessible means of controlling and relieving experiences of stressful events and may therefore be an important inhibiting factor for smoking cessation [13]. However, the influence of stressful events in relation to maternal smoking has been scarcely documented so far [14].

In this study we used a large prospective population-based sample to investigate how maternal stress, conceptualised as symptoms of anxiety and depression, relationship discord and exposure to negative life events, is associated with smoking prior to, during the pregnancy, and at six months postpartum.

MATERIALS AND METHODS

Study design and participants

This study used data from the prospective population-based Norwegian Mother and Child Cohort Study (MoBa), conducted by the Norwegian Institute of Public Health [15]. Participants were recruited from 1999 to 2008 at their first prenatal ultrasound examination in Norwegian hospitals and maternity units having more than 100 births annually. Informed consent was obtained from each MoBa participant upon recruitment, and a total of 38.5% of invited women consented to participate [16]. In total, the cohort includes about 108,000 children, 90,000 mothers and 71,500 fathers. The present study is based on version five of the quality-assured data released for research in spring 2010, applying data from mothers who completed questionnaires at weeks 17 and 30 of gestation and at six months postpartum, yielding a total of 73,418 mothers participating at all three assessments. Of these, 1,661 cases were discarded due to severe missing data, leaving an effective sample size of 71,757 cases for the analyses. In addition, this study used data from the Medical Birth Registry of Norway, which contains information about all births in Norway [17]. The study was approved by the Regional Committee for Medical Research Ethics in South-Eastern Norway.

Measures

Maternal smoking was assessed by self-report items at gestation weeks 17 and 30 and at six months postpartum, as well as by face-to-face interviews when the mothers were hospitalised to give birth, as reported to the Medical Birth Registry of Norway. At all assessment points, mothers were asked to report whether they smoked at all or whether they smoked occasionally or daily. At gestation week 17, mothers were asked to report if they smoked three months prior to the pregnancy and if they were currently smoking. At gestation week 30 and at six months postpartum, mothers were asked to indicate their current smoking status in addition to retrospectively indicate their smoking status at

gestation weeks 17 and 30, respectively. If the woman reported smoking at either source, she was coded as a smoker for the time point in question. Similarly, retrospectively reporting to have smoked at earlier stages in the data collection was coded as smoking at that time, over-riding possible prior reports of non-smoking. Smoking status at all three time points was analysed as binary variables coded *"no"* and *"yes"*.

Symptoms of anxiety and depression were assessed using a five-item short-version of the Hopkins Symptom Checklist (SCL-5), administered at weeks 17 and 30 of gestation [18]. Typical items are *"Feeling fearful"* and *"Worrying too much about things",* all measured on the four-point scale *"not bothered", "a little bothered", "quite bothered",* and *"very bothered".* The SCL-5 showed adequate internal consistency at both measurements (α 0.79 and α 0.81, respectively). To obtain a robust measurement of anxiety and depression during the pregnancy, a pooled mean score of the SCL-5 at weeks 17 and 30 was computed, showing adequate temporal stability (r 0.58).

Relationship discord was also assessed at weeks 17 and 30 of gestation, using 10 items developed for MoBa based on typical items from scales of relationship satisfaction [19, 20]. Examples of items are *"My partner and I have problems in our relationship"* and *"I often think about ending our relationship,"* all measured on a six-point scale ranging from *"disagree completely"* to *"agree completely".* The internal consistency was adequate, with an alpha coefficient of 0.91 at both assessments. To obtain a robust measurement of relationship discord during the pregnancy, a pooled mean score of the scales at weeks 17 and 30 of gestation was computed, showing satisfactory temporal stability (r 0.79).

Exposure to negative life events during the last 12 months was assessed with eight items at week 30 of gestation. Examples of items are *"Had financial problems?", "Had problems at work or study?", "Been seriously ill or injured?",* and *"Lost someone close to you?",* all measured as binary variables coded *"no"* and *"yes".*

Information regarding age and parity was retrieved from the Medical Birth Registry of Norway, while information regarding educational attainment, marital status, planned pregnancy, alcohol consumption and partner's smoking status were assessed by self-report from the women at week 17 of gestation (see http://www.fhi.no/moba for complete questionnaires).

Statistical analyses

The purpose of the study is threefold. First, to investigate the influence of maternal stress for smoking at conception, a regression model was estimated for the full sample. Second, to investigate predictors for quitting smoking during pregnancy, a regression model was estimated for a subsample of smokers at conception. Last, to investigate relapse to smoking at six months postpartum, a regression model was estimated for a subsample of women who quit smoking during the pregnancy. All analyses were adjusted for relevant confounders, with the covariates age, education, parity, planned pregnancy, and partner's smoking status adjusted for at all assessment points, in addition to weight concerns and alcohol consumption for quitting smoking during pregnancy, as well as breastfeeding status for relapse to smoking at six months postpartum.

Exposure to negative life events was analysed as a continuous variable with a possible range from zero to eight events. The scores for anxiety and depression and for marital discord were divided into two categories using a cut-off for respondents scoring more than one standard deviation above the mean. For marital discord, respondents without a partner were analysed as a separate category. All analyses were conducted using logistic regression in M*plus* version 4.2, applying an estimator with standard errors robust to non-normality [21].

RESULTS

As Table 1 shows, 27.5% of the participants smoked at conception, and of these women, 55.8% managed to quit smoking during the pregnancy. Among the quitters, 28.9% had relapsed to smoking by six months postpartum. Among all the women who smoked at conception, 39.7% remained abstinent during the pregnancy as well as at six months postpartum. In total, 12.9% of the sample smoked during the pregnancy.

Adjusted for known risk factors (Table 2), women reporting high levels of anxiety and depression had an increased likelihood for smoking at conception (OR 1.45: 95% CI 1.38, 1.52), a decreased likelihood for quitting during pregnancy (OR 0.80: 95% CI 0.73, 0.88), and an increased likelihood for relapsing to smoking at six months postpartum (OR 1.26: 95% CI 1.11, 1.44). Women high in relationship discord had an increased likelihood for smoking at conception (OR 1.25: 95% CI 1.18, 1.31) and a decreased likelihood for quitting smoking during pregnancy (OR 0.82: 95% CI 0.75, 0.90), whereas relationship discord had no influence on relapse to smoking postpartum. Similarly, women living without a partner had an increased likelihood for smoking at conception (OR 1.29: 95% CI 1.16, 1.44) and a decreased likelihood for quitting smoking during pregnancy (OR 0.70: 95% CI 0.59, 0.83). Exposure to negative life events had a negative influence on quitting smoking during pregnancy (OR 0.93: 95% CI 0.90, 0.96) but had no influence on relapse to smoking at six months postpartum. The risk factors adjusted for in this study showed the same direction of associations as those documented in previous comparable studies [8, 9, 11].

Given a true causal association in relation to smoking during pregnancy, we calculated the population attributable risk percentage for anxiety and depression and for relationship discord by subtracting their fractions among non-smokers from their fractions in the total population, divided by their fractions in the total population [22]. The population attributable risk percentage was 10.8% for a one unit decrease in anxiety and depression, and the equivalent for relationship discord was 6.3%.

DISCUSSION

Adjusted for well-known risk factors for smoking, symptoms of anxiety and depression were associated with smoking prior to pregnancy, with a lower likelihood of becoming abstinent during pregnancy, and a higher likelihood of relapse to smoking after birth. The findings for relationship discord and exposure to negative life events showed similar patterns, although not for relapse to smoking postpartum.

The proportion of smokers at conception and quitters during pregnancy in this study are similar to findings from previous comparable studies [8, 9, 11], but the postpartum relapse rate is markedly lower than those of other studies. We reported a relapse rate below 30% at six months postpartum but other studies report relapse rates ranging from 50 to 80% [7–9, 11]. One factor that may explain this disparity is the high percentage of mothers who breastfeed in Norway. Norwegian health authorities strongly encourage breastfeeding and abstinence from smoking during this period, and with a proportion of about 80% breastfeeding at six months postpartum, Norway has one of the highest breastfeeding rates in Europe and most industrialised countries [23]. This fact may explain this discrepancy as continued breastfeeding has been identified as one of the strongest protective factors against postpartum relapse to smoking [24].

The present study has several strengths. Many previous studies investigating risk factors for smoking during pregnancy or relapse to smoking postpartum were based on relatively small samples or included only a limited set of theoretically relevant variables. Investigating behavioural risk factors for maternal smoking in a large-scale population-based sample at

three assessment points, while adjusting for most well-known risk factors, increases the robustness of the findings and allows for evaluations of the unique effects of maternal stress during this critical period, factors whose influence has been scarcely documented previously. Still, the findings should be interpreted keeping some limitations in mind.

First, smoking was assessed subjectively by means of self-report. However, in addition to repeated questionnaire assessments, smoking was also assessed directly by means of face-to-face interviews as reported to the Medical Birth Registry of Norway. As with most socially undesirable behaviours, self-report of smoking tends to result in an underreporting of actual smoking prevalence as compared to objective assessments such as serum cotinine concentrations [25–28]. However, such nondisclosure does not necessarily invalidate the findings but rather attenuates the observed associations. By coding smoking status as a function of reporting smoking at different assessments and by different sources, and by overriding possible prior reports of non-smoking, nondisclosure is likely a lesser threat than if the study had relied on one source only or limited measurement points. Moreover, as the proportion of smokers at conception and quitters during pregnancy found in this study are fairly equal to findings from other comparable studies [8, 9], more confidence can be given to the estimates obtained. Nevertheless, replicating the findings using objective assessments of smoking will significantly strengthen future studies.

Second, although only 38.5% of invited women participated in the study, such a response rate is typical for large epidemiological studies [29]. Still, selection bias may result in meaningful deviations from the larger population from which the women were sampled. Comparisons of MoBa participants with all women giving birth in Norway identified strong under-representations of women below 25 years, of single women, and of women with more than two previous births [16]. However, although considerable differences in prevalence estimates were observed, no relative differences with relevant association measures were identified, thus indicating that self-selection in MoBa is a limited threat to the validity of the associations reported in this study.

CONCLUSIONS

A pregnancy is a critical event and a time when women are uniquely motivated to quit smoking and also more likely to do so than at any other point in their lives [10]. However, the finding that merely half of all smokers at conception in fact quit smoking during pregnancy substantiates the importance of implementing more target-specific measures for this group at an early stage [3]. As information-based smoking cessation interventions has not proven effective [30], and knowing that many established risk factors such as education and income are relatively stable within a short time frame, researchers and health personnel may rather focus on altering factors more susceptible to change. Although the reported associations are not necessarily causal, the finding that non-quitters experience significantly higher levels of stress than successful quitters suggests that stress may be an evident barrier to smoking cessation in pregnancy [12, 14]. Several studies show partner smoking to be strongly associated with both smoking cessation during pregnancy and the likelihood of remaining abstinent postpartum [11, 31]. The finding that relationship discord is similarly negatively associated with quitting smoking substantiates the importance of focusing also on the woman's social psychological context. Studies examining social support during pregnancy show that women living in marital-like relations with a smoking partner experience less support than women living with a non-smoking partner [31]. Although they are different concepts, relationship discord shows direct opposite associations from social support, implying that women in strained relationships may experience less support from their partners in alleviating the effects of possible stressful events encountered during this critical period. One implication of this finding may be that for smoking cessation efforts to

be more effective and long-lasting, it is important to focus also on the pregnant woman's partner and the quality of their relationship in this process. Future studies should address and examine the effects of such preventive measures aimed at helping women quit smoking prior to or during the pregnancy, as well as remaining abstinent postpartum.

Acknowledgments

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Table 1

Sample characteristics for participants in the Norwegian Mother and Child Cohort Study (MoBa)

	At conception (N=71,757)		During Pregnancy (N=19,718)		6 months postpartum (N=11,005)	
	Non-smokers (72.5%)	Smokers (27.5%)	Quitters (55.8%)	Smokers (44.2%)	Non-smokers (71.1%)	Relapsers (28.9%)
Anxiety and depression	1.22 (0.31)	1.32 (0.39)	1.28 (0.35)	1.37 (0.42)	1.27 (0.35)	1.31 (0.36)
Relationship discord[a]	1.63 (0.55)	1.72 (0.61)	1.67 (0.58)	1.78 (0.65)	1.66 (0.57)	1.70 (0.60)
Negative life events	n/a	n/a	0.96 (1.07)	1.17 (1.16)	0.96 (1.06)	0.97 (1.09)

[a]Means and standard deviations apply only for married/cohabiting women

Table 2

Adjusted odds ratios for smoking at conception, quitting during pregnancy, and relapse to smoking by six months postpartum for participants in the Norwegian Mother and Child Cohort Study (MoBa)

	Smoking at conception (N=71.757)			Quitting smoking during pregnancy (N=19.718)			Relapse to smoking 6 months postpartum (N=11.005)		
	%	OR [a]	95% CI	%	OR [b]	95% CI	%	OR [c]	95% CI
Anxiety and depression									
Low	86.1	1.00	Reference	87.9	1.00	Reference	87.4	1.00	Reference
High	13.9	1.45	1.38, 1.52	12.1	0.80	0.73, 0.88	12.6	1.26	1.11, 1.44
Relationship discord									
Low	84.8	1.00	Reference	83.0	1.00	Reference	83.4	1.00	Reference
High	12.8	1.25	1.18, 1.31	13.2	0.82	0.75, 0.90	14.0	1.06	0.93, 1.20
No partner	2.4	1.29	1.16, 1.44	3.9	0.70	0.59, 0.83	2.6	0.89	0.68, 1.17
Negative life events	-	n/a		-	0.93	0.90, 0.96	-	0.97	0.93, 1.01

[a] Adjusted for education, age, parity, planned pregnancy and partner smoking.

[b] Adjusted for all above in addition to weight concerns and alcohol consumption during pregnancy.

[c] Adjusted for all above in addition to breastfeeding at 6 months postpartum.