



## Research paper

## Effects of smoking on perinatal depression and anxiety in mothers and fathers: A prospective cohort study



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## ABSTRACT

**Introduction:** Considerable concern persists on tobacco use during perinatal periods. No study has simultaneously investigated the longitudinal association of paternal smoking with maternal and paternal depressive and anxiety symptoms during perinatal periods.

**Methods:** In this prospective study, 533 couples (pregnant women and their husbands) completed 5 self-report instruments from early pregnancy until 6 months postpartum. Generalized estimating equations were used for the analyses.

**Results:** We found that fathers who smoked in the mother's presence had higher depressive (regression coefficient = 1.0, 95% confidence interval (CI) 0.3–1.8) and anxiety symptoms (3.0, 95% CI = 1.2–4.7) during perinatal periods compared with nonsmoking fathers. Paternal smoking in the mother's presence also increased maternal disturbances, especially for depression during pregnancy (1.2, 95% CI = 0.1–2.3) and anxiety during the postpartum period (3.4, 95% CI = 0.6–6.3). No significant association was found between paternal smoking but not in the mother's presence and maternal emotional disturbances. Paternal smoking but not in the mother's presence affected only paternal anxiety, especially in the postpartum period (regression coefficient 2.7, 95% CI 0.7–4.7) compared with nonsmokers.

**Limitations:** Self-report measures were used. The effects of maternal smoking could not be estimated because of the small sample of pregnant women who disclosed their smoking status.

**Conclusions:** These findings imply a necessity to combine strategies for smoking cessation with interventions for affective disturbances in fathers. We also stress the importance of at least restricting the father's smoking in the presence of the pregnant wife during perinatal periods if smoking cessation is tentatively unattainable.

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## 1. Introduction

Pregnancy and the postpartum period may be associated with mental health problems in many women. Numerous studies worldwide have indicated that postpartum depression is a common illness (Goldbort, 2006; Lee and Chung, 2007; O'Hara and Swain, 1996), as are antenatal depression and anxiety (Andersson et al., 2006; Evans et al., 2001; Heron et al., 2004; Nasreen et al., 2011). Furthermore, evidence has shown that postpartum depression in men is a considerable problem and is linked to maternal depression (Ballard et al., 1994; Goodman, 2004; Paulson

and Bazemore, 2010). Studies have found that men presented with fewer anxiety and depression symptoms compared with women, but exhibited the same symptomatic patterns throughout the perinatal period (Figueiredo and Conde, 2011; Matthey et al., 2003; Wang and Chen, 2006). These parental emotional disturbances may contribute to adverse outcomes. For example, maternal depressive and anxiety symptoms during perinatal periods have been found to be associated with adverse obstetric outcomes (Chung et al., 2001), preterm delivery (Dayan et al., 2006; Grigoriadis et al., 2013), a low birth weight (Rahman et al., 2007), and newborn behavior (Diego et al., 2004). The role of prenatal and postnatal paternal mental health in child behavioral and emotional development has also been acknowledged (Ramchandani et al., 2005; van den Berg et al., 2009).

Understanding the factors that influence parental mental illnesses in perinatal periods is crucial for developing effective

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interventions. Smoking is a critical modifiable factor to consider in people's emotional status, including depression and anxiety. Both cross-sectional and longitudinal studies have reported a positive association between smoking and major depressive disorders (Michal et al., 2013; Pasco et al., 2008), but the causal direction of this association is uncertain (Fergusson et al., 2003). At present, the literature contains evidence of smoking raising the risks of panic disorder and generalized anxiety disorder (Moylan et al., 2012; Piper et al., 2011). A large population survey found a stronger association for anxiety and smoking relative to depression and smoking (Mykletun et al., 2008).

Studies on the mental health effects of passive smoking are emerging; however, the findings are currently inconsistent. Studies have shown that passive smoking is associated with poor mental health at work (Nakata et al., 2008) and in private spaces (Asbridge et al., 2013; Michal et al., 2013). Objectively measured secondhand smoke (SHS) exposure through serum cotinine has been found to increase the risks of psychological distress, future psychiatric illnesses (Hamer et al., 2010), and depressive symptoms (Bandiera, 2011). Nevertheless, findings from well-designed prospective studies have recently indicated that SHS exposure is not related to depression or anxiety in nonsmoking men and women (Bot et al., 2013; Lam et al., 2013).

An even higher level of concern persists regarding tobacco use during perinatal periods. Significant associations of active smoking with depression (Pritchard, 1994; Zhu and Valbo, 2002) and anxiety disorders (Goodwin et al., 2007) have been found during pregnancy. Furthermore, although the level may drop during pregnancy (Fu et al., 2008), SHS remains common in Chinese women (Li et al., 2011; Yang et al., 2005). One recent clinic-based study reported an elevated risk for prenatal depressive symptoms among women exposed to SHS (Mbah et al., 2013). This evidence suggests that paternal smoking may represent a potential risk factor for both maternal and paternal emotional disturbances throughout the perinatal period, through both passive and active smoking. Nevertheless, few studies have investigated the effects of passive smoking on mental health during perinatal periods. No study has simultaneously investigated the longitudinal effects of passive and active smoking on parental depression and anxiety across the critical interval spanning pregnancy to the postpartum period.

Therefore, our prospective study attempted to investigate whether the paternal smoking status is longitudinally associated with maternal and paternal depression and anxiety from early pregnancy until 6 months postpartum. Because fathers have frequently been observed to avoid smoking in the family's presence, especially around perinatal women, we categorized the paternal smoking status into nonsmoking, smoking but not in the mother's presence, and smoking in the mother's presence. The rationale for this categorization was supported by a study by Roza et al. (2009) in order to evaluate whether the association between active/passive smoking and emotional disturbances is driven by tobacco use/passive smoking inhalation or may be caused by certain psychological impacts (e.g., worry or guilt about smoking behaviors especially during maternal pregnancy/postpartum). We identified the patterns of depression and anxiety symptoms at early pregnancy (T1, < 17 gestational weeks), mid-pregnancy (T2, 17–29 gestational weeks), late pregnancy (T3, > 29 gestational weeks), 1 month postpartum (T4), and 6 months (T5) postpartum.

## 2. Methods

### 2.1. Study design and sample

A prospective cohort study design was adopted. Pregnant

women (mothers) were approached consecutively from July 2011 until May 2014 and were invited to participate during their prenatal visits at the outpatient clinics of 5 selected hospitals in Taipei, Taiwan. Pregnant women were eligible to participate if they were undergoing their early prenatal visit ( $\leq 16$  gestational weeks), planned to carry the baby to term, provided informed consent, and their spouse or partner (father) was available and also willing to participate. Women who were unable to read or write in Chinese were excluded. Among the 686 couples recruited, 533 ( $n=1066$ ) successfully completed 5 assessments from T1 to T5, yielding an overall follow-up rate of 0.78. Self-report instruments were completed by both the mothers and fathers, either in the hospital or by postal mail followed by a telephone reminder. The interviewers were trained for standardization. Ethical approval for this study was obtained from the institutional review boards of the relevant hospitals.

### 2.2. Measures

All of the following information was gathered 5 times from T1 (early pregnancy) to T5 (6 months postpartum), except for the sociodemographic characteristics, which were collected only at T1.

#### 2.2.1. Assessment of depression

The Edinburgh Postnatal Depression Scale (EPDS) was used for assessing depression symptoms in both mothers and fathers. The EPDS consists of 10 items used to assess how participants have been feeling in the past 7 days. Items 1, 2, and 4 are rated on a 4-point scale, ranging from 0 (*yes, most of the time*) to 3 (*no, not at all*), with a maximum score of 9. Items 3 and 5–10 have reversed scoring, from 3 (*yes, most of the time*) to 0 (*no, not at all*). The total score is calculated by summing all of the participant responses, and a higher score reflects a greater level of depressive symptoms. The Chinese version of the EPDS has appropriate reliability and validity, with Cronbach's  $\alpha=0.87$  (Heh, 2001; Lee et al., 1998). In our sample, the internal consistency was 0.88 for mothers and 0.82 for fathers. Continuous scores were used to identify the depression trajectories.

#### 2.2.2. Assessment of anxiety

Anxiety was assessed using the State-Trait Anxiety Inventory (STAI) (Spielberger et al., 1970). The 20 items of the state subscale, measuring anxiety in the present (related to a specific situation or period), were included in our questionnaire. Respondents answer items on a 4-point scale, with the scores being 1 (*not at all*), 2 (*a little*), 3 (*somewhat*), and 4 (*very much so*). The total score ranges from 20 to 80, with a greater score indicating a more severe level of anxiety. Nine of the 20 items have reversed scoring. The STAI-S, Chinese version, has a test-retest reliability of 0.74 and excellent internal consistency with a Cronbach's  $\alpha$  value of 0.90 (Chung and Lun, 1984).

#### 2.2.3. Paternal smoking status

Participants who currently smoked and who had consumed up to 100 cigarettes in their lifetime at the time of the interview were categorized as smokers. The fathers were also asked whether they would smoke in the mother's presence. The response was either "yes" or "no." Paternal smoking was categorized into 3 groups: nonsmoking, smoking but not in the mother's presence, and smoking in the mother's presence. Roza et al. (2009) reported that fathers who smoked indoors had higher psychopathology scores than those of fathers who smoked outside of the house. With a similar rationale, it was crucial to assess whether paternal smoking in the presence or absence of the mother may lead to varying risks of parental emotional distress. For women, because maternal smoking during pregnancy is illegal in Taiwan, few maternal

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