BJOG An International Journal of Obstetrics and Gynaecology

DOI: 10.1111/1471-0528.13891
www.bjog.org

General obstetrics

Prenatal parental depression and preterm birth: a national cohort study

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Accepted 3 December 2015. Published Online 19 January 2016.

Objective To investigate the effects of maternal and paternal depression on the risk for preterm birth.

Design National cohort study.

Setting Medical Birth Register of Sweden, 2007–2012.

Population A total of 366 499 singleton births with linked information for parents' filled drug prescriptions and hospital care.

Methods Prenatal depression was defined as having filled a prescription for an antidepressant drug or having been in outpatient or inpatient hospital care with a diagnosis of depression from 12 months before conception until 24 weeks after conception. An indication of depression after 12 months with no depression was defined as 'new depression', whereas all other cases were defined as 'recurrent depression'.

Main outcome measures Odds ratios (ORs) for very preterm (22–31 weeks of gestation) and moderately preterm (32–36 weeks of gestation) births were estimated using multinomial logistic regression models.

Results After adjustment for maternal depression and sociodemographic covariates, new paternal prenatal depression was associated with very preterm birth [adjusted OR (aOR) 1.38, 95% confidence interval (95% CI) 1.04–1.83], whereas recurrent paternal depression was not associated with an increased risk of preterm birth. Both new and recurrent maternal prenatal depression were associated with an increased risk of moderately preterm birth (aOR 1.34, 95% CI 1.22–1.46, and aOR 1.42, 95% CI 1.32–1.53, respectively).

Conclusions New paternal and maternal prenatal depression are potential risk factors for preterm birth. Mental health problems in both parents should be addressed for the prevention of preterm birth.

Keywords Depression, father, maternal depression, preterm, very preterm.

Tweetable abstract Depression in both mothers and fathers is associated with an increased risk of preterm birth.

Linked article The article has journal club questions by EYL Leung, p. 1982 in this issue. To view these visit http://dx.doi.org/10.1111/1471-0528.14031.

Please cite this paper as: Liu C, Cnattingius S, Bergström M, Östberg V, Hjern A. Prenatal parental depression and preterm birth: a national cohort study. BJOG 2016;123:1973–1982.

Introduction

Preterm birth is a major cause of infant mortality in high- and middle-income countries, with considerable long-term health consequences for survivors.[1,2] A major obstacle for strategies to prevent preterm birth is that the precise aetiology remains unclear.[3] An aetiological classification of preterm birth could be medically indicated, with spontaneous preterm birth described as the spontaneous onset of delivery and preterm prelabour rupture of the membranes.[4] Preterm birth could also be classified into very preterm and moderately preterm birth (<32 and 32–36 weeks of gestation, respectively).

Maternal psychosocial stress has been suggested to be involved in the mechanism of preterm birth, but findings have been inconsistent and vary by sample size and by the methods used to measure stress.[5–7] Large population-based studies that use objective measures of stress have shown more consistent associations, but have mostly been limited to using single stressful life events as indicators of maternal prenatal stress.[8,9]

Both depressive symptoms and medical treatment of depression in pregnant women have been reported to be associated with adverse birth outcomes, including preterm birth.[10,11] But the effect of a maternal major depressive episode is hard to disentangle from medical treatment,

with the foremost treatment being selective serotonin reuptake inhibitors (SSRIs) nowadays.[12] In addition to stressful life events, a lack of social support and troublesome intimate relationships are risk factors for maternal depressive symptomatology.[13] Previous studies have shown that both the quality and effectiveness of the emotional and social support from the woman's partner is associated with perinatal health outcomes,[14–16] and may act as a buffer to stress.[17,18] Yet, expectant and new fathers have increased risks of depression compared with men in the general population.[19] Paternal depression may limit the level of emotional support the mother receives, and thereby have a negative effect on the mother and possibly also on the fetus. In addition to emotional withdrawal, depressed mood, and lack of energy, men's depressive symptomatology more often includes high levels of irritability and anger, compared with depression in women, which may be perceived as particularly stressful for the expectant mother.[20]

Despite this indirect evidence linking paternal mental health with perinatal health outcomes, the role of the father as a key component in the psychosocial environment of the mother–fetus dyad has been surprisingly neglected in research on birth outcomes and preventive interventions. This study aims to investigate both maternal and paternal depression as risk factors for preterm birth. It is hypothesized that paternal depression is associated with an increased risk of preterm birth, probably by increasing maternal stress levels, and the effect size may differ between new and recurrent paternal depression.

Methods

For this register-based study, data from social and medical national registers in Sweden were linked via a unique personal identification number assigned to each Swedish resident. Before analysis, the personal identification numbers were replaced with other (non-traceable) unique identifiers to secure anonymity.

Study population

All singleton live births with estimated conception dates from 21 June 2007 and/or born before 31 December 2012 were identified with their mothers in the Swedish Medical Birth Register (SMBR; n = 505 542). The fathers of the liveborn infants were identified in the Multigeneration Register and Register of the Total Population in the year of childbirth (n = 494 430). Very young parents (<20 years of age; n = 7691) and foreign-born mothers (n = 111 263) were excluded from the study population (n = 130 067), as they may have different consumption patterns of psychotropic care and psychotropic drugs because of their age and/or sociocultural background.[21] In order to estimate the direct effect of parental depression on preterm birth, major malformation was excluded as a potential pathway (n = 8977), after which the study population consisted of 366 499 births.

The study was approved by the Regional Ethical Committee in Stockholm.

Exposures of paternal and maternal depression

The dates of filling the prescription of antidepressant medication were obtained from the National Drug Register, and antidepressants were identified according to the World Health Organization's anatomical therapeutic chemical (ATC) classification of N06A. Dates of outpatient care and inpatient hospital admissions with a depression diagnosis for the mother and/or father were retrieved from the Patient Discharge Register, which includes nationwide information on the dates and diagnoses of all hospital inpatient and outpatient care since 2001. Depression in care was defined as a visit or a hospital admission with a main or complimentary diagnosis, using the tenth revision of the International Classification of Diseases (ICD–10). All main or complimentary diagnoses with a mood disorder (ICD–10 codes F32–F39) were included in our concept of depression. For all our exposures (filling a drug prescription, and outpatient and inpatient care), an observation period of at least 24 months before conception was available, with an earliest observation date of 1 July 2005, when the National Drug Register was created.

The dates of the father's and/or mother's filling of a prescription for an antidepressant drug as well as outpatient and/or inpatient hospital care records with a diagnosis of depression were merged together as an indicator of depression. The time intervals from each indication of depression to the estimated conception date of the index birth were calculated. Based on the time intervals, an indication of having, or not having, paternal/maternal depression was created for every 3-month period within the 24 months before conception and/or during the first two trimesters of pregnancy. Having any indication of depression from 12 months before conception until 24 completed weeks of gestation was considered as having a preconception–early pregnancy exposure to depression. This indicator was further divided into 'new depression' and 'recurrent depression': 'new depression' was defined as an indication of depression within a 3–month interval after 12 months with no indication of depression; and 'recurrent depression' was defined as all other cases.

Outcome

Several outcome variables of preterm birth were created based on completed weeks of gestation: very preterm birth (22–31 weeks of gestation); and moderately preterm birth

(32–36 weeks of gestation). Spontaneous preterm birth was defined as being born preterm after a spontaneous onset of labour (as recorded on the delivery record) or having a diagnosis of preterm prelabour rupture of membranes (ICD–10 code O42). Medically indicated preterm birth was defined as being born preterm and having an induced onset of labour or a caesarean section before the onset of labour.

Covariates

Information on maternal, pregnancy, and birth characteristics were obtained from the Swedish Medical Birth Register. Information on history of previous miscarriage or ectopic pregnancy, height, smoking status, and body weight was recorded at the first antenatal care visit, and information on maternal age, parity, pregnancy complications, sex, birthweight, gestational age, and year of delivery were recorded at or shortly after delivery. Information about pregnancy complications included pre-eclampsia (ICD–10 codes O14 and O15), gestational diabetes (ICD–10 code O244), and placental abruption (ICD–10 code O45). Maternal body mass index (BMI) was calculated from information on weight and height, and further categorized into underweight (<18.5), normal weight (from 18.5 to <25.0), overweight (from 25.0 to <30.0), obese class I (from 30.0 to 35.0), and obese classes II–III (≥35.0), based on the international categorisation of BMI.[22] Small for gestational age (SGA) was defined as a birthweight of less than two standard deviations (<2 SDs) below the mean for gestational age, according to the Swedish growth chart of normal fetal growth.[23] Paternal age and paternal education until the year of childbirth and disposable household income in the year before childbirth were collected from the Swedish Income and Enumeration Survey, held by Statistics Sweden.

The dates of first depression for the mother and the father from 1 July 2005 to 31 December 2012 were compared in order to determine the chronological order of parental depression.

Statistical analysis

Multinomial logistic regression models were used to estimate the association between both paternal and maternal prenatal depression and very and moderately preterm birth. Model 1 was adjusted for calendar year of birth and maternal age as a continuous variable, with quadratic terms of maternal age, parity, paternal education, and paternal age (<45 and >45 years). In model 2 we further adjusted for maternal smoking, BMI category, and chronological order of parental depression.

Stratified analyses were performed to compare the depression exposures measured (from a diagnosis of depression or from a filled prescription of an antidepressant drug only), and to compare the effects of paternal depression on preterm birth in families where mothers cohabitated with the father against those who did not. Sensitivity analyses were performed, as follows: (1) on births of primiparous women, to exclude residual confounding from previous adverse birth outcomes; (2) on mothers who had never had a previous miscarriage or an ectopic pregnancy; (3) on the effects of paternal depression on mothers who had never experienced depression (to exclude residual confounding from maternal depression); and (4) on paternal depression only observed until 12 weeks of gestation.

We used Huber–White sandwich estimates of variance to account for correlations between maternal siblings. The same method was used in the sensitivity analysis of primiparous women to account for correlations between paternal siblings.

All statistical analyses were performed using STATA/MP 12.0 for WINDOWS (Stata Corporation, College Station, TX, USA).

Results

Table 1 describes the characteristics of mothers and fathers in the study with an indication of depression during the year before conception and during the first two trimesters of pregnancy. Young mothers (<25 years of age) and their partners were more likely to experience a new depression, whereas older mothers (≥35 years of age) were more likely to have recurrent depression. Both new and recurrent depression were more common among multiparous mothers (parity > 4), older fathers (≥45 years of age), fathers with a low level of education, and their respective partners. Maternal obesity and smoking during early pregnancy was more common among depressed mothers and among mothers with depressed partners.

Table 2 shows associations between paternal and maternal depression and adjusted risks of very and moderately preterm birth. Compared with no paternal depression, new paternal depression was associated with increased risks of very preterm birth [odds ratio (OR) 1.43, 95% confidence interval (95% CI) 1.11–1.85] and moderately preterm birth (OR 1.16, 95% CI 1.04–1.30), after adjusting for sociodemographic confounding factors (model 1). Further adjustment for maternal smoking, BMI, and maternal depression that preceded paternal depression resulted in modest changes in risks (OR 1.38, 95% CI 1.04–1.83, and OR 1.12, 95% CI 1.00–1.26, respectively; model 2).

Compared with no maternal depression, new maternal depression was associated with increased risks of very and moderately preterm birth (OR 1.51, 95% CI 1.23–1.84, and OR 1.34, 95% CI 1.23–1.46, respectively), after adjusting for sociodemographic confounding factors. After adjustment for maternal smoking, BMI, and paternal depression preceding the maternal depression (model 2), the risk of

Table 1. Characteristics of parents with prenatal depression (n = 366 499)

	n	Paternal depression		
		No (*n* = 351 763) *n* (%)	**New (*n* = 7075) *n* (%)**	**Recurrent (*n* = 7661) *n* (%)**
Parental characteristics				
Maternal age				
20–24 years	46 157	44 005 (12.5)	1244 (17.6)	908 (11.9)
25–29 years	107 92	103 008 (29.3)	1986 (28.1)	2098 (27.4)
30–34 years	131 452	126 492 (36.0)	2216 (31.3)	2744 (35.8)
≥35 years	81 798	78 258 (22.3)	1629 (23.0)	1911 (24.9)
Parity				
1	165 284	158 827 (45.2)	3068 (43.4)	3389 (44.2)
2 or 3	186 277	178 914 (50.9)	3529 (49.9)	3834 (50.1)
4+	14 938	14 022 (4.0)	478 (6.8)	438 (5.7)
Paternal age				
≥45 years	12 953	12 213 (3.5)	409 (5.8)	331 (4.3)
Paternal education				
Compulsory school ≤9 years	35 453	32 884 (9.4)	1409 (19.9)	1160 (15.1)
Secondary school	51 385	48 605 (13.8)	1427 (20.2)	1353 (17.7)
University <3 years	175 793	169 813 (48.3)	2816 (39.8)	3164 (41.3)
University ≥3 years	103 868	100 461 (28.6)	1423 (20.1)	1984 (25.9)
Maternal smoking				
No smoking	333 679	321 156 (91.3)	5871 (83.0)	6652 (86.8)
1–9 cigarettes per day	16 820	15 542 (4.4)	703 (9.9)	575 (7.5)
10+ cigarettes per day	5002	4548 (1.3)	260 (3.7)	194 (2.5)
Missing	10 998	10 517 (3.0)	241 (3.4)	240 (3.1)
Maternal BMI				
<18.5 kg/m^2	6982	6669 (1.9)	163 (2.3)	150 (2.0)
18.5–24.9 kg/m^2	211 524	203 560 (57.9)	3804 (53.8)	4160 (54.3)
25.0–29.9 kg/m^2	83 945	80 504 (22.9)	1649 (23.3)	1792 (23.4)
30.0–34.9 kg/m^2	28 620	27 275 (7.8)	677 (9.6)	668 (8.7)
≥35 kg/m^2	12 655	11 968 (3.4)	312 (4.4)	375 (4.9)
Missing	22 773	21 787 (6.2)	470 (6.6)	516 (6.7)
Family situation				
Cohabiting	340 951	327 954 (93.2)	6151 (86.9)	6846 (89.4)
Not cohabiting	14 147	12 917 (3.7)	675 (9.5)	555 (7.2)
Missing	11 401	10 892 (3.1)	249 (3.5)	260 (3.4)
Pregnancy complications and outcomes				
Pre-eclampsia	11 097	10 596 (3.0)	231 (3.3)	270 (3.5)
Gestational diabetes	2957	2814 (0.8)	64 (0.9)	79 (1.0)
Placental abruption	1156	1101 (0.3)	35 (0.5)	20 (0.3)
SGA	6569	6268 (1.8)	155 (2.2)	146 (1.9)
Sex of child				
Male	186 741	179 282 (51.0)	3602 (50.9)	3857 (50.4)

very preterm birth was of borderline significance (OR 1.23, 95% CI 0.97–1.56), and the risk of moderately preterm birth was unaltered (OR 1.34, 95% CI 1.22–1.46).

Maternal recurrent depression was associated with an increased risk of moderately preterm birth (OR 1.42, 95% CI 1.32–1.53), whereas recurrent paternal depression was not associated with risks of either very or moderately preterm birth.

Further analyses of medically indicated and spontaneous very and moderately preterm birth showed an effect of new paternal depression on medically indicated preterm birth, especially medically indicated very preterm birth (OR 1.76, 95% CI 1.17–2.66; Table 3). This association was marginally attenuated when we further adjusted for SGA and pregnancy complications that commonly initiate medical intervention (OR 1.67, 95% CI 1.07–2.61; Table S1).

Table 1. (Continued)

	n	Maternal depression		
		No (*n* = 340 197) *n* (%)	New (*n* = 11 153) *n* (%)	Recurrent (*n* = 15 149) *n* (%)
Parental characteristics				
Maternal age years				
20–24 years	46 157	42 193 (12.4)	2242 (20.1)	1722 (11.4)
25–29 years	107 092	99 721 (29.3)	3266 (29.3)	4105 (27.1)
30–34 years	131 452	122 769 (36.1)	3256 (29.2)	5427 (35.8)
≥35 years	81 798	75 514 (22.2)	2389 (21.4)	3895 (25.7)
Parity				
1	165 284	152 547 (44.8)	5071 (45.5)	7666 (50.6)
2 or 3	186 277	174 383 (51.3)	5246 (47.0)	6648 (43.9)
4+	14 938	13 267 (3.9)	836 (7.5)	835 (5.5)
Paternal age				
≥45 years	12 953	11 711 (3.4)	513 (4.6)	729 (4.8)
Paternal education				
Compulsory school ≤9 years	35 453	31 796 (9.4)	1796 (16.1)	1861 (12.3)
Secondary school	51 385	46 738 (13.7)	2049 (18.4)	2598 (17.2)
University <3 years	175 793	163 612 (48.1)	5220 (46.8)	6961 (46.0)
University ≥3 years	103 868	98 051 (28.8)	2088 (18.7)	3729 (24.6)
Maternal smoking				
No smoking	333 679	311 773 (91.6)	9064 (81.3)	12 842 (84.8)
1–9 cigarettes per day	16 820	14 288 (4.2)	1231 (11.0)	1301 (8.6)
10+ cigarettes per day	5002	3930 (1.2)	519 (4.7)	553 (3.7)
Missing	10 998	10 206 (3.0)	339 (3.0)	453 (3.0)
Maternal BMI				
<18.5 kg/m^2	6982	6422 (1.9)	276 (2.5)	284 (1.9)
18.5–24.9 kg/m^2	211 524	198 150 (58.3)	5822 (52.2)	7552 (49.9)
25.0–29.9 kg/m^2	83 945	77 531 (22.8)	2619 (23.5)	3795 (25.1)
30.0–34.9 kg/m^2	28 620	25 901 (7.6)	1120 (10.0)	1599 (10.6)
≥35.0 kg/m^2	12 655	11 255 (3.3)	565 (5.1)	835 (5.5)
Missing	22 773	20 938 (6.2)	751 (6.7)	1084 (7.2)
Family situation				
Cohabiting	340 951	318 043 (93.5)	9585 (85.9)	13 323 (88.0)
Not cohabiting	14 147	11 589 (3.4)	1209 (10.8)	1349 (8.9)
Missing	11 401	10 565 (3.1)	359 (3.2)	477 (3.2)
Pregnancy complications and outcomes				
Pre-eclampsia	11 097	10 054 (3.0)	378 (3.4)	665 (4.4)
Gestational diabetes	2957	2669 (0.8)	111 (1.0)	177 (1.2)
Placental abruption	1156	1062 (0.3)	44 (0.4)	50 (0.3)
SGA	6569	5968 (1.8)	252 (2.3)	349 (2.3)
Sex of child				
Male	186 741	173 378 (51.0)	5760 (51.7)	7603 (50.2)

Sensitivity analysis showed that paternal depression was associated with an increased risk for very preterm birth among births of women cohabitating with the father at the time of registration to antenatal care (adjusted odds ratio (aOR) 1.47, 95% CI 1.09–1.98), but not among women who were not living with the father (aOR 0.77, 95% CI 0.29–2.07) (Table S2). Admittance to hospital a more pronounced effect size of new paternal depression than did the filling of a prescription of antidepressant as the measure of exposure (aOR 1.73, 95% CI 1.07–2.81 versus aOR 1.33, 95% CI 1.02–1.74). Among births of primiparous women, the association between new paternal depression and very preterm birth was of borderline significance (aOR 1.45, 95% CI 1.00–2.12). Among births of

Table 2. Paternal and maternal depression and risks of very (≤31 weeks of gestation) and moderately (32–36 weeks of gestation) preterm birth (*n* = 366 499)

	Very preterm (*n* = 2194)			Moderately preterm (*n* = 14 739)		
	n (%)	OR (95% CI)		*n* (%)	OR (95% CI)	
		Model 1	Model 2		Model 1	Model 2
Paternal depression						
No depression	2076 (0.6)	1.00	1.00	14 063 (4.0)	1.00	1.00
New depression	63 (0.9)	**1.43** (1.11–1.85)	**1.38** (1.04–1.83)	337 (4.8)	**1.16** (1.04–1.30)	1.12 (1.00–1.26)
Recurrent depression	55 (0.7)	1.20 (0.91–1.58)	1.14 (0.84–1.55)	339 (4.4)	1.09 (0.98–1.22)	1.05 (0.94–1.18)
Maternal depression						
No depression	1982 (0.6)	1.00	1.00	13 250 (3.9)	1.00	1.00
New depression	103 (0.9)	**1.51** (1.23–1.84)	1.23 (0.97–1.56)	598 (5.4)	**1.34** (1.23–1.46)	**1.34** (1.22–1.46)
Recurrent depression	109 (0.7)	1.19 (0.98–1.44)	1.11 (0.90–1.38)	891 (5.9)	**1.47** (1.37–1.58)	**1.42** (1.32–1.53)

Model 1: adjusted for calendar year of birth, maternal age, parity, paternal education, and paternal age (≥45 years). Model 2: adjusted for the variables listed in model 1, plus smoking, BMI, and also chronological order of parental depression. Note: parental depression was measured in the 12 months before conception up until 24 weeks of gestation. Model 1 is based on 366 499 observations with complete information on the covariates. Model 2 is based on 342 248 observations with complete information on the covariates. Bold numbers represent Wald test P-values less than 0.05.

women with no previous miscarriage or ectopic pregnancy, there was an association between new paternal depression and very preterm birth (aOR 1.48, 95% CI 1.07–2.07), as well as associations between new maternal depression and very preterm birth (aOR 1.34, 95% CI 1.02–1.76) and moderately preterm birth (aOR 1.29, 95% CI 1.16–1.43). Among births of women who did not have depression, there was an association between paternal depression and very preterm birth (aOR 1.47, 95% CI 1.09–2.00), but not for moderately preterm birth (aOR 1.08, 95% CI 0.94–1.23), after adjusting for all covariates. Similar to the main results, limiting the observation time of exposure from 24 to 12 weeks of gestation revealed an association between new paternal depression and very preterm birth (aOR 1.44, 95% CI 1.09–1.90), but not for moderately preterm birth (aOR 1.11, 95% CI 0.98–1.25).

Discussion

Main findings

In this national cohort of more than 366 000 singleton births, an indication of a new paternal depression during the year prior to conception or in early pregnancy was associated with an increased risk of very preterm birth, after adjustment for maternal depression and sociodemographic variables. New maternal depression was associated with increased risk for moderately preterm birth. Recurrent maternal depression was associated with moderately preterm birth, whereas recurrent paternal depression was not associated with preterm birth.

Strengths and limitations

This is a national cohort study with minimal selection bias. The exposure variable is an objective marker of one type of chronic psychosocial stress within the family, and was measured before and independently of the outcome of preterm birth. The measure of depression was based on a diagnosis from clinical records or on a filled prescription of antidepressant drugs from Swedish pharmacies, with a filled drug prescription accounting for the majority of the cases. Antidepressants are not prescribed solely for depression, however, but also for anxiety disorders, the association of which with preterm birth is unknown. Future studies with validated measures of depression are needed to confirm this specific association.

Gender differences in mental health service usage may affect the sensitivities of the exposure measurement between parents.[24–26] More paternal depression cases might be misclassified into the non-exposed group, in which case the effect size of paternal depression might be diluted. Nevertheless, there might be a potential higher proportion of severe cases in the paternal depression group compared with maternal depression.

The definitions of new and recurrent depression in this paper do not translate into these concepts in a clinical psychiatric sense. Depression is often a lifelong relapsing and remitting condition, and the design in this study only

Table 3. Newly occurring paternal/maternal depression and risks of spontaneous/medically indicated very (≤31 weeks of gestation) and moderately (32–36 weeks of gestation) preterm birth (*n* = 366 322)

	Very preterm				Moderately preterm			
	Spontaneous (*n* = 1311) OR (95% CI)		Medically indicated (*n* = 823) OR (95% CI)		Spontaneous (*n* = 10 804) OR (95% CI)		Medically indicated (*n* = 3 818) OR (95% CI)	
	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2
Paternal depression								
No depression	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
New depression	1.26 (0.89–1.79)	1.09 (0.73–1.62)	**1.69** (1.15–2.48)	**1.76** (1.17–2.66)	1.12 (0.98–1.27)	1.09 (0.94–1.25)	**1.31** (1.08–1.60)	**1.26** (1.02–1.55)
Recurrent depression	1.26 (0.89–1.78)	1.22 (0.84–1.77)	1.12 (0.69–1.80)	1.00 (0.58–1.73)	1.08 (0.95–1.23)	1.07 (0.93–1.22)	1.11 (0.89–1.37)	1.02 (0.81–1.29)
Maternal depression								
No depression	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
New depression	**1.54** (1.19–1.99)	1.25 (0.92–1.69)	**1.48** (1.06–2.06)	1.22 (0.84–1.78)	**1.20** (1.08–1.33)	**1.20** (1.07–1.33)	**1.71** (1.48–1.97)	**1.70** (1.47–1.98)
Recurrent depression	1.15 (0.89–1.48)	1.06 (0.79–1.41)	1.22 (0.89–1.66)	1.17 (0.84–1.63)	**1.42** (1.30–1.54)	**1.38** (1.26–1.51)	**1.60** (1.41–1.83)	**1.51** (1.31–1.73)

Model 1: adjusted for calendar year of birth, maternal age, parity, paternal education, and paternal age (≥45 years). Model 2: adjusted for the variables listed in model 1, plus smoking, BMI, and also chronological order of parental depression. Note: parental depression was measured in the 12 months before conception up until 24 weeks of gestation. Model 1 is based on 366 322 observations with complete information on covariates. Model 2 is based on 342 111 observations with complete information on covariates. Bold numbers represent Wald test P-values less than 0.05.

allows for the identification of previous episodes during a short period of time. Even so, we believe that the distinction between the two concepts as we use them is important, as we can expect the depressive symptoms to be more pronounced around the time of diagnosis/initiating treatment than after treatment has been continuing for some time.

Sweden has a lower preterm rate than many other countries, which has been attributed to being a high-income country with a universal welfare system that includes equal access to high-quality obstetric and neonatal care for all. Therefore the psychosocial mechanism being discussed in this paper may be of greater importance in Sweden than in countries where poverty and unequitable access to care is more prevalent.

Interpretations

Our results indicate that paternal depression around the time of conception and in early pregnancy can have an effect on the mother–fetus dyad, and can increase the risk of preterm birth. Depression in the father-to-be is a substantial psychosocial adversity for the expectant mother. Consequently, the stress level of the mother is expected to increase and to remain high for a considerable period of time. Lacking social support from the partner, as one of the main sources of support for the expectant mother, is even more aggravating. A potential epigenetic effect of paternal stress on sperm reprogramming and DNA methylation in offspring may also contribute to the effect of preconception paternal depression found in this study.[27,28] Although a teratogenic effect of selective serotonin reuptake inhibitors on sperm cannot be ruled out,[29] the smaller effect sizes found for recurrent depression compared with new depression seem to suggest otherwise. Further experimental studies that analyse biological specimens in addition to measures of paternal depression symptoms and antidepressant consumption are needed to clarify this matter; however, the results of our study support the existence of a psychosocial pathway induced by paternal depression, independent of the sperm mechanism.

Unlike new depression, recurrent paternal depression did not have an effect on preterm birth. We speculate that the stress perceived by expectant mothers may be less severe if the partner's depression/condition has been under treatment for some time, which may entail a treatment effect that reduces depression symptom severity. Interestingly, in comparison with a previous Swedish study on traumatic life events during pregnancy, including the death of the father,[9] our study showed an even stronger effect size for new paternal depression.

The effect of paternal depression was most pronounced with regards to medically indicated very preterm birth, which is mostly associated with maternal or fetal conditions, e.g. pre-eclampsia, severe fetal growth failure, signs of fetal asphyxia, or premature separation of the placenta.[30] Previous research has suggested that paternal genetic factors may have an effect on placentation and abnormal placentation,[31] which is a potential etiological factor for these conditions. In comparison, there was only a borderline association between maternal depression and very preterm birth, after adjusting for maternal BMI and smoking. Meanwhile, unlike a potential positive treatment effect of paternal recurrent depression, the pharmacological treatment of maternal recurrent depression might be associated with more teratogenic effects,[32] as suggested by the increased risk of moderately preterm birth. The discrepancy between paternal and maternal exposure might suggest different mechanisms that require further investigation.

Conclusion

Depression in both mothers and fathers is associated with an increased risk of preterm birth. Intervention studies that identify and treat depressed fathers are needed to confirm the clinical implications of this study.

Interventions to prevent preterm birth in maternal and child health programmes usually target the mother–fetus dyad only. If the father is targeted at all, it is generally as a potential perpetrator of abuse. Yet, both prenatal and postnatal paternal depressive symptoms have been shown to be related to adverse health and developmental outcomes in children.[33] This study indicates that the mother–child dyad should be upgraded to a mother–father–child triad in prevention and pregnancy care, with screening for and treatment of mental health problems in both parents. As men, on average, are less likely than women to identify themselves as suffering from mental health problems, and to seek professional help, an active approach towards targeting expectant fathers' wellbeing may be appropriate.[27]

Disclosure of interests

Full disclosure of interests available to view online as supporting information.

Contribution to authorship

CL participated in the design, conducted the statistical analysis, drafted the article, managed the data set, and takes responsibility for the integrity of the data; AH conceived the study, directed the study, participated in the design, had full access to the data, and participated in the writing of the article; SC, MB, and VÖ participated in the design, gave important intellectual content in all phases, and participated in the writing of the article.

Details of ethics approval

The study was approved by the Regional Ethical Committee in Stockholm (no. 2015/1347-32) on 13 August 2015.

Funding

This study was funded by Karolinska Institutet.

Acknowledgements

We also thank Emma Fransson and Andrea Dunlavy, Centre for Health Equity Studies (CHESS), Karolinska Institutet/ Stockholm University, for commenting on the first draft.

Supporting Information

Additional Supporting Information may be found in the online version of this article:

Table S1. Newly occurred paternal/maternal depression and risks of spontaneous/medically indicated very (≤31 weeks) preterm birth and moderately (32–36 weeks) preterm birth (n = 341 827) .

Table S2. Paternal and maternal depression and risks of very preterm birth (≤31 weeks of gestation) and moderately preterm birth (32–36 weeks of gestation) among mothers living and not living with the father (n = 340 951).

Data S1. Powerpoint slides summarising the study. ■

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Supporting slide set prepared by the author available online.

PAPER FOR DISCUSSION

Liu C, Cnattingius S, Bergström M, Östberg V, Hjern A. Prenatal parental depression and preterm birth: a national cohort study. *BJOG* 2016;123:1973–1982. To view this article visit http://dx.doi.org/10.1111/1471-0528.13891.

SCENARIO

Mental health awareness in pregnancy was emphasised during an obstetrics continual professional development event. The speaker summarised adverse perinatal outcomes that has been linked with maternal depression. A midwife asked, "Does depression in dads have similar impact on these outcomes?"

DESCRIPTION OF RESEARCH

Participants

Singleton births recorded in the Medical Birth Register of Sweden between 2007–2012.

Exposure

Parents with depression.

Comparison

Parents without depression.

Outcomes

Odds ratios (ORs) for very preterm and moderately preterm births.

Study design

A population-based cohort study.

Authors' conclusion

New paternal and maternal prenatal depression are potential risk factors for preterm birth.

DISCUSSION POINTS

- How common is paternal depression in the perinatal period? (See suggested reading)
- What are the risk factors of parental depression identified in this study?
- How was parental depression defined in this study? What are the pros and cons of using this definition?
- What is Huber-White sandwich estimates of variance? Was its use appropriate?
- What were the relationships between paternal depression, spontaneous preterm births and medically-indicated preterm births?
- How was cohabitation of parents related to preterm birth rates?
- What are the possible mechanisms behind the above associations?
- How do the demographics of the study participants compare to parents you encounter in your usual practice? (See Table 1–2)
- How may the results of this study influence your daily practice?

SUGGESTED READING

- Paulson JF, Bazemore SD. Prenatal and postpartum depression in fathers and its association with maternal depression: a meta-analysis. JAMA. 2010 May 19;303(19):1961–9.
- Scottish Intercollegiate Guidelines Network. Critical Appraisal: notes and checklists. Methodology checklist 3: Cohort study. http://www.sign.ac.uk/methodology/checklists.html (Last access 15 February 2016)

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