Published in final edited form as:

BJOG. 2013 March ; 120(4): 446–455. doi:10.1111/1471-0528.12073.

Are prenatal, obstetric, and infant complications associated with postpartum psychosis among women with pre-conception psychiatric hospitalisations?

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Abstract

Objective—To examine the associations of maternal and infant complications with postpartum hospitalisation for psychosis in women with a pre-conception history of psychiatric hospitalisation.

Design—Population-based study.

Setting—Swedish medical birth register.

Population—Primiparous women who gave birth between 1 January 1987 and 31 December 2001, and who had a pre-conception history of psychiatric hospitalisation but who were not hospitalised during pregnancy ($n = 1842$).

Methods—International Classification of Diseases (ICD) codes were used to identify prenatal, obstetric, postpartum maternal complications, and newborn health conditions. We used

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Please cite this paper as: Hellerstedt W, Phelan S, Cnattingius S, Hultman C, Harlow B. Are prenatal, obstetric, and infant complications associated with postpartum psychosis among women with pre-conception psychiatric hospitalisations? BJOG 2013;120:446–455.

Contribution to authorship

WLH analysed the data and wrote the article. SMP analysed the data and wrote earlier drafts of the article. SC contributed to the writing of the article and the interpretation of findings. CMH contributed to the writing of the article. BLH had the original idea for the article, participated in data analyses and decision-making, and contributed to the writing of the article.

Disclosure of interests

There are no conflicts of interest to disclose.

multivariable logistic regression to describe the associations between maternal and infant health conditions and the odds for postpartum hospitalisation for psychosis.

Main outcome measure—Psychiatric hospitalisation within 90 days of delivery.

Results—Compared with women who did not have a postpartum psychiatric hospitalisation, hospitalised women were at 2.3 times higher odds (95% CI 1.0–4.9) of having non-psychiatric puerperium complications (e.g. infection, lactation problems or venous complications). No other maternal complications were associated with postpartum psychiatric hospitalisation. Although their infants were at no higher odds for health complications, the offspring of women who had a postpartum psychiatric hospitalisation were at 4.1 times higher odds (95% CI 1.3–12.6) of death within the first 365 days of life than those of women who were not hospitalised.

Conclusions—We found no prenatal indicators of postpartum risk for psychiatric hospitalisation among high-risk women, but they had higher odds of postpartum pregnancy-related medical problems and, rarely, offspring death.

Keywords

Infant mortality; maternal health; postpartum health; psychosis

Introduction

Postpartum psychosis affects one or two in every 1000 childbearing women.^{1–3} Its onset is rapid and usually occurs in the first 4 weeks after delivery.² Affected women experience mania, severe depression, delusions, and confusion.^{1,3} Postpartum psychosis is a critical condition that usually requires hospitalisation,^{1,3} presenting risks for women and their offspring. For example, suicidal and homicidal ideation about their infants, although not common, are higher among women with postpartum psychosis than among other women.^{3–5}

The potential to prevent and treat postpartum psychosis is linked to understanding its etiology and its triggers.⁶ It has been positively associated with primiparity,^{2,7} older maternal age,⁸ sleep loss,^{9,10} low social support,^{8,11} the use of prescribed drugs,¹² and estrogen withdrawal.¹³ It is most strongly and consistently associated with a pre-conception history and family history of psychosis.^{1–3,6,14–18} Harlow et al.¹⁴ reported that pre-conception psychotic or bipolar illness significantly increased the likelihood of postpartum hospitalisation for psychotic disorder, with increased likelihood among women with more recent, more frequent, and lengthier pre-conception psychiatric hospitalisations. Although women with pre-conception psychosis may account for less than 1% of a prenatal population, they account for more than half of all cases of postpartum psychosis,¹⁴ and may have a 100 times greater risk of postpartum psychiatric hospitalisation than women without such a pre-conception history.¹⁵ The question of whether postpartum psychosis is a distinct clinical entity is controversial, but many consider pregnancy and postpartum to be vulnerable periods for psychiatric episodes among women with pre-existing illness.¹⁷ A postpartum psychiatric hospitalisation may thus be considered ‘...a manifestation of a lifetime vulnerability to affective disorders with childbirth as the precipitating factor’.¹⁹ One common theory to explain why women may have a psychotic episode postpartum relates to their sensitivity to the loss of estrogen and progesterone after childbirth.²⁰ Some hormones

increase 200-fold over the course of pregnancy, and then abruptly decline with childbirth.^{19,20}

It is not clear whether prenatal, obstetric, or infant complications exacerbate the risk for a postpartum psychotic episode. Studies have found positive associations with caesarean delivery and delivery complications, including preterm delivery.^{2,7,10,15,21,22} Because postpartum psychosis is rare in the general population, many studies have been limited by small sample sizes. The most convincing evidence that postpartum psychosis may be associated with prenatal conditions comes from recent population-based epidemiological studies. A study that examined 1.1 million births in Sweden between 1975 and 2003 found that the risk for women with pre-pregnancy psychiatric hospitalisations was weakly, but positively, associated with preterm delivery and caesarean delivery, after adjustment for pre-pregnancy psychiatric history.¹⁵ Another recent population-based study of women who had no previous psychiatric hospitalisations (i.e. low-risk women) found that postpartum psychosis, although extremely rare, was positively associated with older maternal age and negatively associated with maternal diabetes and delivery of offspring with high birthweights.²³

We used the population-based Swedish medical birth register to assess the associations between prenatal, obstetric, and infant complications and postpartum psychosis. We examined the records of 1842 women who: (1) had a previous hospitalisation for psychiatric illness, putting them at high risk for postpartum psychosis;^{14,15} (2) were not hospitalised for psychiatric illness during pregnancy, thereby reducing the likelihood that postpartum hospitalisation was a continuation of a prenatal psychotic episode; and (3) were primiparous, thus excluding women whose only previous hospitalisation may have been for puerperal psychosis, which may be a discrete condition from other postpartum psychosis related to pre-existing illness.²⁴

Methods

Sample

We used the Swedish medical birth register, administered by the National Board of Health and Welfare in Stockholm, to identify all women who delivered a first-born live singleton infant between 1 January 1987 and 31 December 2001. The register contains information on more than 99% of all births in Sweden.²⁵ We obtained data on pre-conception, prenatal, and postpartum psychiatric hospitalisations from the hospital admissions and discharge information in the Swedish hospital discharge register, which links individual records with a unique personal identity number.²⁶

We identified 612 306 women with first-birth deliveries during the study period. We limited analyses to 2134 women who had a pre-conception hospitalisation for bipolar disorder or psychotic disorder, identified by International Classification of Diseases (ICD) admission codes, because they have the highest risk for a postpartum psychotic episode.^{1–3,14–17} To reduce the likelihood that the event leading to a postpartum psychotic hospitalisation was a continuation of a prenatal psychotic episode, we excluded 287 women with prenatal psychiatric hospitalisations. Because women who deliver multiples are at higher medical

risk, we further excluded five women who gave birth to twins, resulting in a sample of 1842 primiparous women who delivered singleton liveborns and who had a pre-conception (but not prenatal) psychiatric hospitalisation for bipolar or psychotic disorder. This study was approved by the Research Ethics Committee of the Karolinska Institutet in Stockholm, Sweden, and the Institutional Review Board at the University of Minnesota.

Psychiatric hospitalisation data

When individuals are hospitalised, primary and secondary discharge diagnoses are assigned by a treating physician and forwarded electronically to the Swedish hospital discharge register. The register has nationwide coverage of discharges from all of the hospitals in Sweden, including psychiatric care facilities. A number of studies have demonstrated good agreement between the discharge register and medical records,^{27–29} including one that found a 94% agreement between register diagnoses of schizophrenia and diagnoses obtained through a medical record audit and a semi-structured interview.²⁸ We obtained information on all of the unique psychiatric discharges for women who delivered a first birth between 1987 and 2001. By comparing gestational age, the date of hospital admission, and the date of delivery, we knew whether each hospitalisation occurred before pregnancy, during pregnancy, or during the postpartum period (i.e. within 90 days of delivery).

The disorders related to psychiatric hospitalisations were identified in the Swedish hospital discharge register using the ICD ninth revision (ICD–9) for hospitalisations between 1987 and 1996, and the ICD tenth revision (ICD–10) for hospitalisations from 1997 to 2001 (Table 1). A board-certified psychiatrist, blinded to postpartum hospitalisation status, evaluated the records for the women who were hospitalised more than once with different psychiatric diagnoses (8% of the sample), and classified them according to the predominant diagnosis across all hospitalisations. For those who had more than one psychiatric admission diagnosis and multiple hospitalisations, the most frequent diagnosis was used to code the cause of the pre-conception psychiatric hospitalisation. For example, if a woman had been hospitalised four times for bipolar illness and once for schizophrenia prior to pregnancy, the reason for her pre-conception hospitalisation would have been coded as bipolar illness.

We examined four factors related to pre-conception psychiatric hospitalisations: admission diagnosis for the last pre-conception hospitalisation (i.e. schizophrenia or schizoaffective disorders, bipolar disorder, or non-affective disorder), length of time between last pre-conception psychiatric hospitalisation and delivery (categorised as less than 3 years, 3–6 years, or greater than 6 years), length of last pre-conception hospitalisation (recorded as 1–7 days, 8–28 days, or more than 28 days), and number of preconception hospitalisations (recorded as one, two, three, or four or more hospitalisations).

Maternal characteristics and complications

From the medical birth register, we abstracted information about maternal characteristics, pregnancy and delivery complications and procedures, and pregnancy outcomes. We obtained information on the following maternal characteristics: age at delivery (categorised as younger than 25, 25–29, 30–34, and 35 years or older), country of birth (Sweden, other Nordic country, or other non-Nordic country), years of completed education at the first

prenatal visit (less than 9 years or 9 years or more), cohabitation with the infant's father at the first prenatal visit, and tobacco use at the first prenatal visit.

We documented the following pregnancy-related, mutually exclusive complications through ICD-9 or ICD-10 codes: hypertensive diseases (e.g. pre-eclampsia or gestational hypertension); malpresentation or disproportion; laceration or damage from instruments; caesarean delivery; premature rupture of membranes; other amniotic fluid and membrane disorders; other labour and delivery complications [e.g. related to the umbilical cord, anaesthesia, labour trauma (except lacerations) retained placenta or membranes, or haemorrhage]; other pregnancy complications (e.g. infections, abnormal pelvic organs or soft tissues, diabetes, excessive vomiting, or haemorrhage); and puerperium complications (e.g. infection, lactation problems, or venous complications). We counted every discrete pregnancy-related complication to record the presence of any complication and the mean number of complications.

Infant complications

The medical birth register included infant birthweight (in grams), gestational age at birth (in days), and ICD-9 and ICD-10 codes for medical complications. Low birthweight was defined as a birthweight of less than 2500 grams and preterm was defined as a gestational age at birth of less than 259 days. Small for gestational age was defined as less than the tenth percentile of a reference based on North American births.³⁰ All birthweights were plausible given the infant's gestational age.³¹ Congenital anomalies were identified as ICD-9 codes 740–759 and ICD-10 codes Q00–Q99. Because fewer than 5% of the infants had congenital anomalies and some infants had multiple diagnoses, we did not categorise anomalies by severity. We created a category for fetal and newborn complications that included fetal abnormalities that affected maternal management, abnormal fetal heart rate, and other fetal conditions originating in the perinatal period. We also examined infant mortality (i.e. death within the first 365 days of life).

Analysis

We performed Student's *t*-tests, chi-square tests, and bivariable and multivariable logistic regression analyses with SAS 9.3 (SAS Inc, Cary, North Carolina, USA) software package. In order to examine the associations of maternal and infant complications with the outcome variable – postpartum psychiatric hospitalisation within 90 days of delivery – we conducted two series of analyses. The aim of the first series was to characterise the sample and to identify control variables in the outcome analyses. To do so, we conducted two multivariable analyses to describe the associations of postpartum psychiatric hospitalisation: with characteristics of pre-conception hospitalisation; and with maternal characteristics. To identify the control variables, we selected those that were conceptually and statistically significant (i.e. $P < 0.05$) in adjusted analyses.

The second series of analyses was the outcomes analyses, also conducted through two major sets of analyses to investigate, separately, the associations of postpartum psychiatric hospitalisation with pregnancy-related complications and with fetal and newborn complications. To facilitate the comparison of our findings with those of others who may

have conducted unadjusted analyses – and to examine the associations of our independent variables controlled by the variables identified in the first series of analyses – we described both the unadjusted and the adjusted odds ratios and 95% confidence intervals. The multivariable models in the two sets of outcome analyses included variables found to be significant in adjusted analyses through the first series of analyses: maternal age at delivery; maternal educational attainment; year of delivery; number of pre-conception psychiatric hospitalisations; and variables associated with the most recent pre-conception psychiatric hospitalisation (i.e. recency, admitting diagnosis, and length of hospitalisation).

Results

Of the 1842 women with a pre-conception psychiatric hospitalisation, 1135 (62%) were hospitalised for schizophrenia or another psychotic disorder, and 7% of these women had psychotic paranoid states, 60% had reactive psychoses, and 33% had psychoses of childhood origin. The remaining 707 women (38%) had pre-conception admissions for bipolar disorder.

A total of 179 women (10%) were hospitalised for a psychiatric disorder within 90 days of delivery: 115 (64%) were hospitalised for psychotic disorders and 64 (36%) were hospitalised for bipolar disorder. In analyses adjusted for variables related to pre-conception psychiatric hospitalisation history, non-affective disorder diagnoses and recent, longer term, and multiple pre-conception psychiatric hospitalisations were independently associated with postpartum psychiatric hospitalisation (Table 2). Compared with the 620 women who had been hospitalised more than 6 years previously, postpartum hospitalisation was more likely for the 623 women who were hospitalised within the previous three years (5 and 15%, respectively; adjusted OR 3.2, 95% CI 2.1–5.0). Compared with the 502 women with pre-conception hospital stays of 0–7 days, the 665 women who had hospital stays of more than 28 days were 1.9 times more likely (95% CI 1.2–3.0) to have had a postpartum psychiatric hospitalisation (6.5 and 12.0%, respectively). Compared with the 937 women with one pre-conception psychiatric hospitalisation, the 545 women who had two or three pre-conception psychiatric hospitalisations had a 2.4 increased odds ratio of postpartum hospitalisation (4.5 and 11.9%, respectively; 95% CI 1.6–3.7), and those with four or more pre-conception hospitalisations had a 5.1 times increased odds of postpartum hospitalisation (4.5 and 21.1%, respectively; 95% CI 3.4–7.7).

There was no difference in mean age between women who were and were not hospitalised postpartum for a psychiatric condition (mean 29.7, SD 4.8, and mean 29.6, SD 5.4 years, respectively; $P = 0.79$). Compared with women having fewer than 9 years of completed education, those with more education had two-fold higher odds of postpartum psychiatric hospitalisation (Table 3).

Women had between zero and five documented pregnancy-related complications, with no difference between women who were and were not hospitalised postpartum in the mean number of complications (mean 0.98, SD 0.99 and mean 0.86, SD 0.99 complications, respectively; $P = 0.13$) or the prevalence of at least one complication (63 and 55%, respectively; $P = 0.27$) (Table 4). The only statistically significant ($P = 0.05$) difference was

that, compared with non-hospitalised women, those hospitalised postpartum for a psychiatric condition had two-fold higher odds of puerperium complications (e.g. infections, lactation problems, and venous complications).

In *post hoc* chi-square analyses, 78% of women who had puerperium complications and 55% of those who did not also had at least one pregnancy complication ($P = 0.0004$). In logistic regression analyses, adjusted for pre-conception hospitalisation variables, maternal age, and maternal education, women with pregnancy complications were 2.8 times more likely (95% CI 1.5–5.1) to have puerperium complications than those with no complications. Maternal death was not associated with postpartum psychiatric hospitalisation. Death was recorded for 20 women, with time of death ranging between 8 months and 13 years postpartum. There was no difference in the mean time of death between women with and without postpartum psychiatric hospitalisations (mean 4.1, SD 3.7 and mean 6.9, SD 3.3 years, respectively; $P = 0.16$).

There was no difference in the mean birthweight of offspring of women who were and were not hospitalised postpartum (mean 3401, SD 611 and mean 3382, SD 625 grams, respectively; $P = 0.70$), nor was there any difference in gestational age at delivery (39.2 weeks for both groups; $P = 0.81$). The mean Apgar score at 5 minutes was 9.6 for both groups: 96% of all infants had scores between 8 and 10. Fourteen infants were delivered after 42 weeks and 34 infants (1.9%) were large for gestational age, with no difference by group ($P = 0.89$).

Postpartum psychiatric hospitalisation was not associated with other infant complications, except for infant death (Table 5). Seventeen infants died within their first year of life. The odds of infant death was 4.1 times higher (95% CI 1.3–12.6) for infants of women who had a postpartum psychiatric hospitalisation (2.8%) compared with infants of those who did not (0.7%). Among the 17 infant deaths, 80% of the offspring of hospitalised women and 75% of the offspring of women who were not hospitalised postpartum died within the first month of life ($P = 0.85$). In *post hoc* analyses, infant mortality was not associated with any maternal characteristic, including variables related to pre-conception psychiatric hospitalisation. Infant mortality was positively associated with infant low birthweight ($P = 0.0001$), preterm delivery ($P < 0.0001$), and congenital anomalies ($P = 0.0002$). Five of the 17 infants who died were of low birthweight (29%), six infants were preterm (35%), and four infants had congenital anomalies (24%).

Discussion

We restricted our analyses to women who had been hospitalised for psychosis or bipolar disease prior to pregnancy. Such women are at 100 times greater risk for postpartum hospitalisation than women with no pre-pregnancy history,¹⁵ but this group of women are rarely studied. Our findings suggest that prenatal complications in women with pre-conception psychiatric hospitalisations will not help clinicians identify who, among these high-risk women, will have a postpartum psychotic or bipolar recurrence. Furthermore, we saw no association between number of complications and postpartum hospitalisation. Similarly, Blackmore et al. examined several maternal and pregnancy-related variables in

129 women with histories of bipolar spectrum disorder.⁷ They found that only primiparity and delivery complications were associated with postpartum psychosis; other factors, including a broad range of pregnancy complications, caesarean delivery, and infant gestation, were unrelated.

Several other studies have reported mixed associations with maternal and prenatal characteristics and postpartum psychosis, depression, and bipolar disease in general populations. One study, using the same data source we used, examined women with no history of psychiatric hospitalisation (i.e. women at very low risk) for a broad range of postpartum psychiatric illnesses. The authors reported that postpartum psychiatric illness was positively associated with older maternal age and negatively associated with infant birthweight and some maternal complications.²³ We examined the same correlates and found no associations for women at high risk, suggesting that the etiology of postpartum psychiatric conditions may be different for women with a history of psychiatric illness than for women at very low risk with no such history. Another recent study using data from the Swedish medical birth register examined obstetric complications and postpartum psychosis in more than a million women who gave birth between 1975 and 2003.¹⁵ After statistical adjustment for pre-pregnancy psychiatric hospitalisation, the authors found that postpartum psychosis was slightly associated with preterm birth (OR 1.2), but was not associated with 16 other pregnancy (e.g. anaemia or pre-eclampsia) or infant (e.g. malposition, asphyxia or small for gestational age) complications. Similarly, Videbech and Gouliaev examined the Danish medical birth register data and found that only preterm delivery was associated with a first episode of psychosis within 1 year postpartum in the general population, but other pregnancy and birth complications were not.²² They also found that a first episode of postpartum psychosis was rare (one in every 2000 women), and that bipolar disorder was the most prevalent; their sample included no cases of schizophrenia.²²

Although prenatal complications were not associated with postpartum psychiatric hospitalisation, we found that women with puerperium complications were twice as likely as those without them to be hospitalised for a psychiatric illness within 90 days of a live birth. Less than 4% of our sample had such complications, and thus we did not have sufficient data to examine the nature of this association. This is a shortcoming of our study, given that the category of complications included diverse conditions (e.g. lactation problems, haemorrhage, or infection) that could have been chronic or acute, severe or mild. It is plausible that pregnancy-related postpartum conditions could be sufficiently stressful to affect maternal mental health, but we have not located other literature with which to compare our results. We are unable to assess the temporal association of the puerperium complications and postpartum hospitalisation. It is plausible that women who were hospitalised for a psychiatric condition were more likely to have a complication detected and documented on their medical records, and thus the increased risk we report here is a result of detection bias, rather than a true association.

We found no differences in infant complications between hospitalised and non-hospitalised women during the postpartum period. This may not be surprising, given that the two groups did not vary in maternal characteristics or pregnancy complications, and they all entered their pregnancies with similar psychiatric backgrounds. Despite there being no differences in

vulnerability, the infants of hospitalised women were four times more likely to die in the first year of life, after adjustment for the variables associated with pre-conception hospitalisation (i.e. markers for the severity of maternal mental health problems prior to pregnancy). Maternal postpartum psychiatric hospitalisation itself was thus associated with infant survival, independent of the severity of maternal mental illness. As recently reviewed by Webb et al., parental psychosis is a risk marker for infant mortality.³² Two studies of Scandinavian populations similar to ours provide evidence of this. Bennedsen et al. found that infants of schizophrenic women had an almost three-fold higher risk for postneonatal death, but no increased risk for neonatal death, compared with infants of mothers in the general Danish population.³³ Nilsson et al. reported a twofold higher risk of mortality in infants of schizophrenic women compared with the general population, using the same data source that we used.³⁴ Our work extends these findings because we restricted our analyses to infants of high-risk women and we examined the severity of psychosis (defined by postpartum hospitalisation). Like the other studies, we did not have sufficient data to examine temporality. In our sample, at least three-quarters of the infant deaths occurred during the first 30 days of life. We saw no difference in the timing of deaths by maternal hospitalisation within 90 days of delivery, but we do not know whether hospitalisation preceded or followed infant death. Because postpartum psychosis often has a rapid onset after delivery,² we assume that maternal hospitalisation and infant death occurred close together in time. Without actual dates of hospitalisation and infant death, however, we can only make two conclusions: (1) infant mortality and the severity of postpartum mental health (as measured by hospitalisation) are associated; and (2) infant mortality was relatively rare in our sample of women with pre-conception psychiatric illnesses.

The population-based sample provided by the Swedish medical birth register was large enough to allow us to examine a rare outcome (postpartum psychiatric hospitalisation) and some rare exposures. Although we examined broad categories of obstetric complications, many studies about fetal or maternal psychiatric outcomes have categorised the discrete conditions we examined as a single category of obstetrical complications. Cannon and colleagues, in a review of maternal complications and offspring risk for schizophrenia, concluded that this common practice of grouping complications together limits extant research, as it is meaningless to consider diverse conditions as a single risk factor.³⁵ The external validity of our findings may be limited to Sweden or to the study period, as patterns of diagnosis, care for psychiatric illness, and institutional pregnancy support may vary geographically, and/or change even during a short period of time. Women whose symptoms were less severe, or for whom psychiatric diagnoses were unclear, may not have been hospitalised. If this is the case, our outcome – hospitalisation – is a clear marker of severe postpartum psychiatric illness.

Whereas medical registries are an accessible, and perhaps the only feasible, data source for population-based studies, the precision of the data rely entirely on physician and hospital staff. Incomplete data could bias results, but only if they resulted in the differential misclassification of women who were and were not hospitalised postpartum for psychiatric illnesses. Because the prenatal and delivery data were recorded before the outcome, this is unlikely. In addition to the quality of the existing data, some variables were not available in our data source. Our analyses would have been stronger if we could have explored the risk

associated with the use of anti-psychotic medications in the perinatal period. We were also unable to examine the associations of postpartum psychiatric illness and other reproductive events, such as endocrine function or postpartum hormonal contraceptive use.¹³ Other unmeasured and possibly important variables that would have strengthened our study include sleep quality,^{9,10} and partner and/or general social support.^{1,11,21} Our findings of few associations between routinely documented variables and postpartum psychosis do not preclude – in fact, they may encourage – the future examination of the social and environmental factors that may exacerbate postpartum psychological risks in vulnerable women.

Conclusion

Although postpartum psychosis is a rare occurrence,¹ it can lead to tragic outcomes.³ The identification of risk markers would enhance the ability to prevent and treat it. Only about 10% of the women in our study experienced a psychiatric hospitalisation within 90 days postpartum, suggesting that the high-risk women in our sample may have been well supported by their medical and social communities during pregnancy and after they experienced their first childbirth. Puerperium physical conditions (beyond those associated with body weight and lactation) are not often studied. Although such complications are rare, they were associated with postpartum psychiatric hospitalisation in our study, suggesting they may warrant research interest. We also found a strong association between infant mortality and postpartum psychiatric hospitalisation. Although we cannot address temporality, this finding nonetheless highlights the vulnerability of mothers whose infants die and of infants whose mothers are hospitalised for a psychiatric illness. Given how rare both maternal psychosis and infant mortality are, the nature of this association would be best explored in future studies with population-based data sets like ours.

Acknowledgments

We thank Hadine Joffe, MD, MSc, Harvard Medical School, Boston, MA, USA, for her diagnostic classification of women who were hospitalised more than once, and Allison Vitonis for her assistance with the database.

Details of ethics approval

The Research Ethics Committee of the Karolinska Institutet in Stockholm, Sweden, and the Institutional Review Board at the University of Minnesota approved this study.

Funding

This research was supported by a grant from the National Alliance for Research on Schizophrenia and Depression (recently renamed Brain & Behavioral Research Foundation).

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Table 1

International Disease Classification (ICD) codes related to the psychiatric admitting diagnoses recorded in the Swedish medical birth register in the period 1987–2001

Admission diagnosis	ICD-9 code Hospitalisations in 1987–1996	ICD-10 code Hospitalisations in 1997–2001
Schizophrenia	295 and subcategories (excluding schizoaffective disorders)	F20, F23.1, F23.2
Schizoaffective disorders	295.7, 295H	F21, F25
Bipolar illness	296 and subcategories	F30, F31
Other non-affective psychoses	297–298	F22–F24 (except F23.1 and F23.2) and F28–F29

Table 2

Pre-conception psychiatric hospitalisation characteristics of 1842 primiparous women who had singleton live births and a history of pre-conception psychiatric hospitalisation, by postpartum hospitalisation for psychosis, taken from the Swedish medical birth register for 1987–2001

Characteristic of pre-conception hospitalisation	No postpartum hospitalisation for psychosis (<i>n</i> = 1663)	Postpartum hospitalisation for psychosis (<i>n</i> = 179)	Adjusted OR (95% CI) [*]	<i>P</i> ^{**}
Diagnosis at most recent pre-conception psychiatric hospitalisation				
Schizophrenia or schizoaffective disorder	11.7%	11.8%	0.72 (0.45–1.18)	0.187
Bipolar disorder	39.5%	28.5%	0.55 (0.38–0.80)	0.002
Non-affective disorder	48.8%	57.0%	1.0	
Recency of last pre-conception psychiatric hospitalisation				
>6 years	35.5%	16.8%	1.0	
3–6 years	32.5%	32.4%	2.15 (1.35–3.43)	0.001
<3 years	32.0%	50.8%	3.22 (2.07–5.01)	0.0001
Length of most recent pre-conception psychiatric hospitalisation				
0–7 days	28.2%	18.4%	1.0	
8–28 days	36.6%	36.9%	1.48 (0.94–2.33)	0.088
>28 days	35.2%	44.7%	1.90 (1.22–2.95)	0.004
Number of pre-conception psychiatric hospitalisations				
1	53.8%	23.5%	1.0	
2–3	29.1%	34.1%	2.44 (1.61–3.70)	0.0001
4+	17.1%	42.5%	5.09 (3.38–7.67)	0.0001

* Adjusted for all variables in the table.

** *P* value, compared with referent, based on logistic regression simultaneously adjusted for all of the variables in the table.

Table 3

Characteristics of 1842 primiparous women who had singleton live births and a history of pre-conception psychiatric hospitalisation, by postpartum hospitalisation for psychosis, taken from the Swedish medical birth register for 1987–2001

Maternal characteristic	No postpartum hospitalisation for psychosis (<i>n</i> = 1663)	Postpartum hospitalisation for psychosis (<i>n</i> = 179)	Adjusted OR (95% CI) *	<i>P</i> **
Year of delivery				
1987–1991	36.3%	45.3%	1.92 (1.27–2.91)	0.002
1992–1996	33.4%	34.1%	1.58 (1.03–2.44)	0.036
1997–2001	30.3%	20.1%	1.0	
Age at delivery				
<25 years	18.6%	14.5%	1.13 (0.63–2.02)	0.688
25–29 years	30.9%	35.8%	1.56 (0.96–2.53)	0.075
30–34 years	31.3%	35.8%	1.58 (0.97–2.56)	0.066
35 years	19.2%	14.0%	1.0	
Country of birth				
Sweden	88.4%	89.4%	1.0	
Other Nordic country	3.9%	5.6%	1.56 (0.71–3.35)	0.737
Non-Nordic country	7.2%	5.0%	0.69 (0.23–1.41)	0.658
Education				
9 years	84.5%	92.2%	2.05 (1.16–3.62)	0.014
Co-habitation with father of infant				
Yes	72.5%	72.1%	1.0	
No	18.8%	15.1%	0.84 (0.54–1.30)	0.439
Unknown	8.8%	12.9%	1.49 (0.92–2.42)	0.103

* Adjusted for all variables in the table.

** *P* value, compared with referent, based on logistic regression simultaneously adjusted for all of the variables in the table.

Table 4

Pregnancy-related complications and postpartum psychiatric hospitalisation for 1842 primiparous women who had singleton live births and a history of pre-conception psychiatric hospitalisation, taken from the Swedish medical birth register for 1987–2001

Complication	No postpartum hospitalisation for psychosis (<i>n</i> = 1663)	Postpartum hospitalisation for psychosis (<i>n</i> = 179)	Unadjusted OR (95% CI)	Adjusted OR (95% CI) *
Pregnancy complications				
Hypertensive diseases **	5.7%	3.9%	0.67 (0.31–1.47)	0.62 (0.28–1.40)
Tobacco user at first prenatal visit	30.9%	40.8%	1.54 (1.13–2.12) *****	1.30 (0.93–1.83)
Other pregnancy complications ***	15.8%	22.4%	1.54 (1.06–2.24) *****	1.27 (0.85–1.89)
Obstetric complications				
Malposition or malpresentation	6.3%	6.2%	0.97 (0.51–1.85)	0.91 (0.46–1.78)
Early, false, or long labour	9.7%	10.6%	1.10 (0.67–1.83)	1.21 (0.71–2.06)
Caesarean delivery	17.6%	18.4%	1.06 (0.71–1.58)	1.03 (0.68–1.57)
Laceration or damage from instruments	8.3%	11.7%	1.47 (0.90–2.39)	1.42 (0.84–2.39)
Premature rupture of membranes	4.2%	1.7%	0.39 (0.12–1.25)	0.37 (0.11–1.21)
Other disorders of amniotic fluid and membranes	1.8%	1.1%	0.62 (0.15–2.60)	0.68 (0.15–3.07)
Other labour and delivery complications ****	32.2%	34.1%	1.09 (0.79–1.51)	1.13 (0.80–1.60)
Puerperium complications not during or immediately after delivery *****	3.3%	5.0%	1.58 (0.77–3.25)	2.26 (1.00–4.90) *****
Any of the above complications	55.4%	62.6%	1.35 (0.98–1.85)	1.32 (0.94–1.84)

* Adjusted for year of delivery, education, number of pre-conception psychiatric hospitalisations, and variables associated with the most recent pre-conception psychiatric hospitalisation (timing, length of hospitalisation, and psychiatric diagnosis).

** Includes eclampsia and pre-eclampsia.

*** Other pregnancy complications include infectious conditions complicating pregnancy, abnormality of organs or soft tissues of the pelvis, and conditions complicating pregnancy or childbirth (e.g. diabetes mellitus, excessive vomiting, and prenatal haemorrhage).

**** Other labour and delivery complications include umbilical cord complications, anaesthesia complications, abnormality of the forces of labour, labour trauma (except lacerations), retained placenta or membranes, and immediate postpartum haemorrhage.

***** Includes infection, lactation problems, venous complications, and other complications related to the puerperium.

***** *P* 0.05, unadjusted or adjusted multivariable logistic regression.

***** *P* 0.01, unadjusted or adjusted multivariable logistic regression.

Table 5

Fetal and newborn complications and postpartum psychiatric hospitalisation for 1842 primiparous women who had singleton live births and a pre-conception history of psychiatric hospitalisation, taken from the Swedish medical birth register for 1987–2001

Complication	No postpartum hospitalisation for psychosis (<i>n</i> = 1663)	Postpartum hospitalisation for psychosis (<i>n</i> = 179)	Unadjusted OR (95% CI)	Adjusted OR (95% CI) *
Congenital anomalies	4.5%	6.7%	1.54 (0.82–2.90)	1.58 (0.82–3.07)
Low birthweight	6.5%	6.2%	0.94 (0.50–1.79)	0.85 (0.44–1.66)
Preterm delivery	8.8%	7.9%	0.90 (0.51–1.59)	0.80 (0.44–1.45)
Small for gestational age	5.8%	6.3%	1.09 (0.57–2.08)	1.20 (0.61–2.35)
Other fetal or newborn complications **	19.1%	21.8%	1.18 (0.81–1.72)	0.96 (0.64–1.44)
Any of the above complications	22.5%	26.8%	1.26 (0.89–1.79)	1.06 (0.73–1.55)
Infant mortality (within 365 days of birth)	0.7%	2.8%	3.96 (1.38–11.36) ***	4.10 (1.33–12.64) ***

* Adjusted for year of delivery, education, number of pre-conception psychiatric hospitalisations, and variables associated with the most recent pre-conception psychiatric hospitalisation (timing, length of hospitalisation, and psychiatric diagnosis).

** Other fetal complications include fetal problems affecting the management of the mother, abnormal fetal heart rate, and fetal complications originating in the perinatal period.

*** *P* 0.01, unadjusted or adjusted multivariable logistic regression.