



# Epidemiology of mental disorders during pregnancy and link to birth outcome: a large-scale retrospective observational database study including 38,000 pregnancies

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## Abstract

**Purpose** To investigate the real-life epidemiology of mental disorders during pregnancy and their impact on birth outcome in an unselected low-risk population in Germany.

**Methods** Claims data of the Techniker Krankenkasse (TK) were analyzed as part of a retrospective observational study over a one-year period from 01/2008 to 12/2008 including 38,174 pregnant women. ICD-10 codes were clustered into four diagnostic groups: depression, anxiety disorders, somatoform/dissociative disorders and acute stress reactions. The relationship between mental disorders, birth mode and infant weight was tested using chi-squared tests and multivariate logistic regression. Main outcome measures included the prevalence of mental disorders during pregnancy, performed cesarean sections and infants born underweight.

**Results**  $N=16,639$  cases with at least one diagnosis from the four mental disorder diagnostic groups were identified: 9.3% cases of depression, 16.9% cases with an anxiety disorder, 24.2% cases with a somatoform/dissociative disorder, and 11.7% cases of acute stress reactions. Women diagnosed with a mental disorder were more likely to deliver their child by cesarean section ([depression: OR=1.26 (95% CI 1.14–1.39); anxiety: OR 1.11 (95% CI 1.02–1.19); somatoform disorders: OR 1.12 (95% CI 1.05–1.20); acute stress reactions: OR 1.17 (95% CI 1.07–1.28)]. Furthermore, infants of women diagnosed with an ICD-10 code for depression during pregnancy were more likely to be underweight and/or delivered preterm [OR=1.34 (95% CI 1.06–1.69)].

**Conclusions** We observed substantially high prevalence rates of mental disorders during pregnancy which urgently warrant more awareness for validated screening and adequate treatment options.

**Keywords** Pregnancy · Depression · Anxiety · Prevalence · Cesarean section · Birthweight

## Introduction

Pregnancy and puerperium are times of particular vulnerability, as many women exhibit symptoms of emotional distress during this period. Since hormonal changes increase

the lifetime risk for affective disorders, the risk of depression is naturally higher in women during the childbearing years [1]. Furthermore, women can be affected by affective disorders in the perinatal period with no definite causal link to pregnancy and birth. These are referred to as perinatal mood disorders and comprise of depression, anxiety disorders, somatoform/ dissociative disorders or reactions to severe traumatic stresses and adjustment disorders.

Previous studies have focused mostly on maternal depression [2, 3, 4]. According to a systematic literature review, antenatal depression affects approximately 17% of women with the highest prevalence in the second and third trimesters of pregnancy [2]. Postpartum depression is a common but often overlooked diagnosis that affects approximately 10–15% of women in the postpartum period [3]. In comparison to classical depressive symptoms, a

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postpartum depression is characterized by emotional instability and insensitivity, or obsessive thoughts toward the newborn baby. These episodes begin within 4 weeks postpartum and may last up to one year [5]. Risk factors that have been identified include a previous history of depression, anger experience and expression, a lack of social support and a low socioeconomic status, stressful life events or pregnancy complications [6–10].

When a depressive episode is already present during pregnancy, it has been identified as a potential risk factor for subsequent postpartum depressive episodes and adverse perinatal outcomes. The literature suggests that there is an association between untreated depression or anxiety during pregnancy, and increased rates of preterm birth, low birth weight, infant growth impairment and behavioral disorders during childhood [11–14]. In spite of negative long-term effects for mother and offspring, studies showed that up to 86% of pregnant women suffering from mental disorders were not treated adequately due to the fear of possible teratogenic effects [15]. Moreover, the risk of relapse during pregnancy increases when drugs are discontinued [16–20].

Other psychiatric comorbidities have been less well studied. Maternal anxiety disorders have also become the focus of attention during the past few years [21], but other conditions, such as somatoform disorders, were not considered in previous research and consequently, only very little is known on prevalence rates and the potential impact on pregnancy.

Regarding the mode of delivery, cesarean section rates are on the rise worldwide: cesarean sections have become increasingly common in both developed and developing countries over the last decades [22, 23]. The causes of this increase often remain hidden and vary across countries and regions. In Germany, the percentage of cesarean deliveries has doubled in the last 25 years from 15.3% in 1991 to 30.5% in 2016 [24]. Substantial variation in cesarean section rates between the former eastern and western parts of Germany has also been observed [25].

The decision to perform a cesarean section is mainly based on the question of what is best for the mother and child. Therefore, the indications can be categorized into medically indicated or elective cesarean sections [22, 26, 27]. While the former indications are divided into absolute and relative indications, the latter are performed solely at the wish of the mother without a medical indication. In total, absolute indications are responsible for less than 10% of all deliveries by cesarean section in Germany [28, 29]. Thus, they are frequently performed for a relative indication in about 90% of the cases.

Due to improved surgical techniques, regional anesthesia and prevention of infections, the cesarean sections have lost its fright in the meantime [30, 31]. Yet, as with any surgery, cesarean sections are associated with short- and long-term

complications for both mother and child. Apart from acute intraoperative risks, several complications are described for the postpartum period [32, 33] or subsequent pregnancies including placental anomalies, uterine rupture [34, 35] or risk of infertility [36–39]. Regarding neonatal outcomes, there is evidence for increased risks of bronchial asthma, type 1 diabetes mellitus or allergic rhinitis for babies delivered by elective cesarean section [40–44].

A number of factors have been discussed recently to explain the increasing cesarean section rates in Europe and worldwide. Late motherhood and changing risk profiles appear to have a substantial impact on rising rates [45–49]. According to the German Federal Statistical Office, the proportion of women giving birth at the age of 35 years or older ranges at over 20% [24]. Moreover, the prevalence of maternal obesity and gestational diabetes has strongly risen over the last decades leading to further possible sequelae [50–53].

Women with psychiatric comorbidities during pregnancy care more likely to deliver their baby by cesarean section, although in most cases clear medical indications are lacking [54]. It is argued that psychological distress may affect maternal confidence for delivery and hinder the progress of labor. Thus, pregnant women suffering from psychiatric disorders appear to have a lower pain threshold contributing to an increased frequency of cesarean delivery [54]. Regarding the increasing cesarean rates worldwide, a potential relationship between psychological distress and mode of delivery is of particular interest [55].

In fact, the consensus surrounding the indications for cesarean section has changed recently [56]. Psychological factors such as fear of vaginal birth, previous traumatic births, and other psychosomatic or psychiatric reasons are increasingly considered when deciding about the right mode of delivery.

Therefore, the primary aim of this study was to analyze reliable epidemiological data on the prevalence of mental disorders during pregnancy and their association to birth outcomes in Germany in a large unselected low-risk cohort.

## Methods

### Study design and population

This report is part of a retrospective observational study performed by TK which aimed to investigate the medical care situation of women and their children prior to, during and after birth. The larger study focused on an analysis of the most prevalent secondary diagnoses associated with pregnancy and their influence on birth outcome and the offspring. The study was approved by the Federal Insurance Office of Germany (Bundesversicherungsamt) and is based on anonymized claims data of a cohort of female insureds

who gave birth in 2008 and their children. The analyzes in this report were conducted on a subsample of 38,174 mothers, corresponding to the number of women who were insured at least four quarters before and seven quarters after the quarter of giving birth and whose data could be matched with the data of their child/children. As the children do not necessarily have the same insurance as their mothers, some were lost to follow-up. The matching rate was more than 80% of mothers and the matched sample sufficiently corresponded to the whole population in terms of age, cesarean section, and low birth weight (see Table 1).

## Study variables

### Mental disorders

Diagnoses from in-patient and out-patient data of our cohort of pregnant women were used to identify mental disorders one year prior to the quarter of delivery. Billing relevant coding in primary care as well as in specialist settings were taken as the basis for this claims data source. They were encoded by the International Statistical Classification of Diseases and Related Health Problems (ICD-10 German Modification). The Diagnoses according to ICD-10 were summarized in 4 groups: Depression, anxiety, somatoform disorders and acute stress reactions. Cases of depression were identified by ICD-10 codes F32–F33. Anxiety disorders were defined as ICD-10 codes F40–F41 and somatoform/dissociative disorders as ICD-10 Codes F44–F45, F48.1 and F68.0. ICD-10 codes F43 and F62 defined acute stress reactions. Therefore, we focused on the most prevalent mental disorders. There are other mental health disorders, which are important in maternal mental health, such as eating disorders, psychosis, drug/alcohol misuse disorders, and personality disorders. As they were coded in only a very small minority of women, we did not perform further analyzes with these groups.

**Table 1** Comparison of female insured population and matched subsample

	Basic population	Matched sample	Difference
Mothers, <i>n</i>	48,446	38,174	– 10,272
Children, <i>n</i>	52,137	38,857	– 13,280
Age, mean years	32.3	32.1	– 0.2
Cesarean section, %	30	29.8	– 0.2
Birth weight < 2500 g, %	3.8	3.6	– 0.1
Out-patient deliveries, %	2.9	2.7	– 0.2

### Mode of delivery and birth weight

For hospital births, the mode of delivery was identified via G-DRG (German Diagnosis Related Groups System). G-DRGs are used in billing and contain information on patients' diagnoses and procedures performed during their hospital visit. In the G-DRG System of 2008 12 G-DRGs encoded births with a clear distinction between vaginal birth (G-DRGs O02A, O02B, O60A–O60D) and cesarean section (G-DRGs O01A–O01F). As cesarean sections are only performed in hospitals, outpatient and home births were defined as vaginal deliveries.

The G-DRG system does not systematically distinguish between pre-term and term deliveries. Owing to the lack of information, we decided to use the ICD-10 Codes P07 (preterm deliveries or birth weight below 2500 g) and P08.0 (birth weight above 4500 g) in hospital claims data as a proxy for gestational time of delivery. Reported birth weight of 2499 g and lower was defined as underweight, whereas more than 4500 g defined an overweight baby.

### Statistical methods

All analyzes were performed using SAS version 9.3 (SAS Institute, Cary, NC, USA). Diagnostic data were examined regarding prevalence rates of mental disorders in association with mode of delivery and birth weight. First, the differences in the prevalence of mental disorders by birth mode and weight were tested using chi-squared tests. In the second step, adjusted odds ratios for the likelihood of cesarean section as well as low birth weight were calculated using multivariate logistic regression for each of the four mental disorder diagnostic groups. All models were controlled for age of the mother and residence at birth (East Germany vs. West Germany). As preterm delivery and cesarean section were shown to be highly correlated, odds ratios for cesarean section were additionally adjusted for birth weight and vice versa. Due to the explorative character of the study, all *p* values need to be interpreted descriptively.

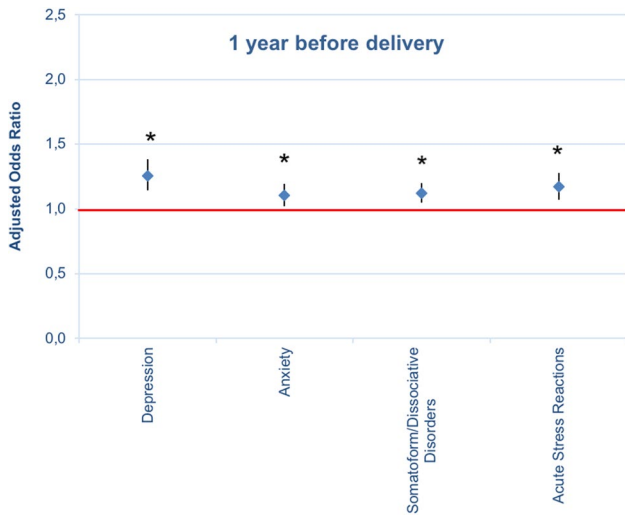
## Results

### Prevalence of mental disorders

Among 38,174 pregnancies in 2008, there were 9.3% cases of depression, 16.9% cases with a diagnosis of an anxiety disorder, 24.2% cases with a somatoform/dissociative disorder, and 11.7% cases of acute stress reactions. The prevalence rates of mental disorders four quarters prior to delivery and sample characteristics are shown in Table 2.

**Table 2** Prevalence of mental disorders four quarters prior to delivery associated with mode of delivery (cesarean section no/yes)

	Total <i>N</i>	Depression		Anxiety		Somatoform/ Dissociative Disorders		Acute Stress Reactions		At least one disease	
		<i>N</i>	%	<i>N</i>	%	<i>N</i>	%	<i>N</i>	%	<i>N</i>	%
All	38.174	3547	9.3	6442	16.9	9245	24.2	4468	11.7	16.639	43.6
C-Section no	26.789	2312	8.6	4431	16.5	6331	23.6	3004	11.2	11.413	42.6
C-Section yes	11.385	1235	10.8	2011	17.7	2914	25.6	1464	12.9	5226	45.9



**Fig. 1** Adjusted odds ratios and 99% confidence intervals for delivery by cesarean section in women with mental disorders. Statistically significant differences are marked with an asterisk

**Mode of delivery and birth weight**

Women diagnosed with a mental disorder from one of the four diagnostic groups were more likely to deliver their child by cesarean section [depression: OR = 1.26 (95% CI 1.14–1.39); anxiety: OR 1.11 (95% CI 1.02–1.19); somatoform disorders: OR 1.12 (95% CI 1.05–1.20); acute stress

reactions: OR 1.17 (95% CI 1.07–1.28)]. Pregnant women suffering from any form of depression had the highest risk to deliver by cesarean section (OR 1.257) (see Fig. 1).

In the next step, the association between having a diagnosis of one of the four mental disorder diagnostic groups and giving birth to an underweight infant was examined. Altogether, there were 36,632 cases of infants with a normal birth weight (95.96%), and 1164 cases (3.05%) of infants coded with the ICD-10 code P07 (preterm deliveries or birth weight below 2500 g). In all, 378 infants were born overweight (0.99%). After performing the regression analysis, women who had a diagnosis of depression or acute stress reaction in at least one of the 4 quarters prior to delivery were significantly more likely to deliver an underweight infant or to deliver preterm with the highest Odds Ratio for the depression group [OR = 1.337 (95% CI 1.06–1.69)] (see Table 3).

**Discussion**

So far, no epidemiological data for mental disorders during pregnancy have been provided by any database or registry. We hereby present claims data from more than 38,000 mother–child pairs and therefore an epidemiological profile of mental disorders during pregnancy in Germany for the first time. In the year 2008, 16,639 women with at least one diagnosis from the four mental disorder diagnostic

**Table 3** Birth weight in association with mental disorders

	Total <i>N</i>	Depression		Anxiety		Somatoform/ Dissociative Disorders		Acute Stress Reactions	
		<i>N</i>	%	<i>N</i>	%	<i>N</i>	%	<i>N</i>	%
All	38.174	3547	9.3	6442	16.9	9245	24.2	4468	11.7
Normal/overweight	37.010	3397	9.2	6218	16.8	8927	24.1	4300	11.6
Underweight	1164	150	12.9	224	19.2	318	27.3	168	14.4
<i>p</i> value		< 0.001		0.028		0.012		0.003	
OR*		1.34		1.12		1.13		1.20	
<i>p</i> value OR*		0.001		0.146		0.081		0.034	
OR* 99% CI		1.06; 1.69		0.92; 1.37		0.95; 1.34		0.96; 1.50	

\*Adjusted for cesarean section

groups during pregnancy were identified. In summary, we found 9.3% cases of depression, 16.9% cases with a diagnosis of anxiety disorder, 24.2% cases of somatoform/dissociative disorders and 11.7% cases of acute stress reactions.

Some of the prevalence rates confirm those reported in previous studies. Bennett et al. extracted prevalence rates for depression during pregnancy of 7.4%, 12.8%, and 12.0% for the first, second, and third trimesters, respectively [4]. Underwood et al. found an average rate of antenatal depression across several studies of 17% for prenatal and 13% for postnatal depression [2]. For perinatal anxiety, prevalence rates of depression were usually higher than the estimated depression rates at around 15% for prenatal and 11.1% for postnatal anxiety disorders, which is perfectly in line with our results [57, 58].

Considering other mental disorders, data on prevalence rates are sparse or simply do not exist. Regarding acute stress reactions in general, the authors found no available source that provide a prevalence rate during pregnancy. As we have found that 11.7% of patients were diagnosed with such a disorder, this result emphasizes the importance of our study as a first source for a general prevalence rate during pregnancy. When concentrating on sub-diagnosis in this group, post-traumatic stress disorder (PTSD) was most prevalent. Previous literature on PTSD has also shown very different prevalence rates of between 3.3% in community samples and 18.95% in high-risk samples [59]. These very different prevalence rates could be interpreted as being in line with our results, as our prevalence rate of 11.7% could symbolize the middle of these two extremes, which would reflect the unselected character of the low-risk population.

Furthermore, somatoform disorders have also been only sparsely studied during pregnancy. As one of the only studies, Sydsjö et al. found a prevalence rate of 5.9% in a sample of women who actively requested a cesarean section [60]. Hence, our data showed a surprisingly high prevalence of cases of somatoform or dissociative disorders (24.2%), which was not expected. This could be partly explained through the fact that this diagnostic group contained hypochondriacal disorders (ICD-10 F45.2), which is the diagnosis that could be coded for high pregnancy- or delivery-related anxiety. Another study, examining primary care settings in Germany in not-pregnant patients found a comparable prevalence of 28.5% of somatoform disorders [61]. The accumulation of SFD was higher in female patients than in males (RR 1.7), in particular when the number of children were  $> 1$  (RR 1.8). The female–male difference was more marked in persistent somatoform pain disorder (RR 2.1) and unspecific somatization disorder (RR 5.0). Therefore, not only depression and anxiety, but also the diagnostic group of somatoform

disorders during pregnancy should be the subject of future studies.

Considering birth outcome, our results showed that women diagnosed with any mental disorder from one of the four diagnostic groups were significantly more likely to deliver their child by cesarean section. Studies on the mode of delivery in association with psychiatric comorbidity are, again, sparse. Our findings are partly comparable to the findings of Sydsjö et al. [60]. Using the Swedish Birth Registry, they observed in a sample of 64,000 women that women who actively requested a cesarean section had a significantly higher psychiatric comorbidity than other women (10 versus 3.5%,  $p < 0.001$ ). The authors concluded that this finding points to the need for psychological support for these women as well as the need to screen and treat psychiatric illness during pregnancy. In another study, the same study group found that psychiatric disorders after childbirth were also more common in women giving birth by cesarean section upon maternal request when compared to other women (11.2% vs 5.5%,  $p < 0.001$ ). Additionally, an elective cesarean section increased the risk of psychiatric disorders after childbirth (OR 1.5, 95% CI 1.2–1.9). Hence, these results support the thesis that women who give birth by an elective cesarean section upon maternal request more often suffer from psychiatric disorders both before and after delivery. This indicates that these women represent a vulnerable group requiring special attention from obstetricians and general health-care providers and that this vulnerability should be taken into account when deciding on the mode of delivery.

As our results cannot show any causal direction, two interpretations are possible at this point. On the one hand, similar to the studies mentioned above, women with psychiatric comorbidity might request cesarean sections more actively than their healthy controls. On the other hand, health-care professionals might not know how to handle this specific patient group, advising more often cesarean sections, and therefore increasing the cesarean section rate. Future research should comprise the patients' and the doctors' motivation in this patient group.

Additionally, as another key result of our study, psychiatric comorbidity can have an impact on the offspring. Infants of women diagnosed with an ICD-10 code for depression during pregnancy were significantly more likely to be underweight and/or delivered preterm, as coded by the ICD-10. The literature concerning this specific association is controversial, however. Many studies examined the association between prenatal depression and preterm birth or low infant birth weight, explained through a pathway of cortisol activation, but they did not show a consistent picture. A systematic review and meta-analysis including 23 studies demonstrated that untreated depression during pregnancy was associated with significantly increased risks of preterm birth (odds ratio [OR], 1.56; 95% CI, 1.25–1.94) and low birth weight (OR,

1.96; 95% CI, 1.24–3.10) with a trend toward higher risks for exposure to more severe depression [62]. Grote et al. presented somewhat different results in their meta-analysis: They also found that women with depression during pregnancy were at increased risk for preterm birth and low birth weight, although the magnitude of the effect varied as a function of depression measurement, country location, and socioeconomic status [63].

The choice of whether to prescribe a psychotropic drug during pregnancy to prevent relapse or fetal exposure to maternal psychiatric illness is a difficult one. As mentioned above, untreated mental disorders during pregnancy may lead to adverse outcomes for mother and child. On the other hand, pregnant women who take psychopharmacological drugs have an increased risk of pregnancy complications such as abnormal bleeding during pregnancy, miscarriage, prematurity, preeclampsia, low birth weight, gestational diabetes and hypertension [15, 64–66]. Beyond that, negative side effects of psychotropic drugs on the offspring may include toxicity, withdrawal symptoms for the fetus, morphologic teratogenicity and breastfeeding risks [67–70].

Concerning this issue, our study showed that the use of psychotropic drugs was above average for all diagnostic groups of mental disorders. In summary, the risks stemming from psychopharmacological drug use during pregnancy must be balanced against the risks and long-term consequences of an untreated maternal mental disorder.

In conclusion, maternal depression and sometimes anxiety during pregnancy have begun to be recognized as factors that may adversely alter pregnancy outcomes [71]. However, so far, regarding the situation in Germany, clinical routine is far from being adapted to this patient group, as there is neither routine screening nor any special obstetric counseling. Representing one of the largest study samples that has ever been analyzed, our results emphasize the urgent need to adapt standard care.

## Strengths and limitations

The key strength of our study is the large population-based database with comprehensive longitudinal data in a low-risk population. As we used claims data, we minimized the problem of selection bias among study participants. To date, there has been a gap in real-life data on mental disorders during pregnancy in Germany, and in studies globally. As such a database also implies several potential limitations, some aspects of our data have to be considered with caution. As billing-relevant coding was taken as the basis for this claims data source, we assumed correct codes for the diagnosis of all four mental disorder groups in primary care as well as in specialist settings. However, incomplete or incorrect coding cannot be ruled out completely. Owing to the large size of

the TK birth cohort, covering nearly 10% of the German population in 2008, we assumed that our findings are sufficiently valid. In particular, diagnoses of mental disorders are not easily made and therefore, doctors frequently hesitate to code such a diagnosis. However, even if we assume that only half of the diagnoses were coded correctly, the numbers would still be impressive. Another limitation of claims data is that the scope of patients is limited to the insured patients only. As the TK is one of the largest German health insurance providers, covering more than 10% of the population, their members are representative for the country with a slight tendency towards more skilled professions requiring a higher education and to male insurants with a gender ratio of 1.04 (male:female) compared with 0.96 in the general population [72].

## Conclusion

These data provide an important epidemiological profile of mental disorders during pregnancy in Germany. Claims data have the ability to complement data from research studies to generate a more complete and accurate view of people's health problems. The tremendously high prevalence rates of mental disorders urgently warrant more awareness and a validated and systematic screening, which does not exist at the moment. The elevated risk of having a cesarean section in this group of patients indicates that these women are a vulnerable group requiring special attention from obstetricians and general health-care providers and that this vulnerability should be taken into account when deciding on the mode of delivery. Furthermore, pregnant women diagnosed with depression have a higher risk of giving birth preterm or having a child weighing less than 2500 g.

Antenatal depression should, thus, be identified through screening and should be treated. Hence, our data show that in the absence of national registries, health insurance data can provide a valuable instrument for epidemiological studies, and thus have the potential to improve the quality of standard care.

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**Author contributions** SW, MG: study concept, interpretation of data, manuscript writing and editing. AL, AG, MS: study concept and design, data analysis, manuscript editing. MF: data analysis, manuscript writing. CS, MW: manuscript writing and editing.

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## Compliance with ethical standards

**Conflict of interest** The authors declare that they have no conflict of interest.

**Ethical approval** The study was approved by the Federal Insurance Office of Germany (Bundesversicherungsamt, Reference Number IT 5 - 8269 - 70/2014, approved on 16 January 2014).

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